V. 97.4

UNITED STATES DISTRICT COURT
EASTERN DISTRICT OF MICHIGAN
SOUTHERN DIVISION

TELEFLEX INCORPORATED,

Plaintiff,

vs.

KSR INTERNATIONAL CO.,

Defendant.

Case No: 02-74586
Hon. Lawrence P. Zatkoff

Magistrate Judge Steven D. Pepe

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BRIEF IN SUPPORT OF DEFENDANT'S MOTION FOR SUMMARY JUDGMENT OF INVALIDITY

STATEMENT OF ISSUES

Non-party Technology Holding Company ("THC") is the assignee and sole owner of U.S. Patent Nos. 6,237,565B1 (the "'565 Patent"), 6,305,239B1 (the "'239 Patent") and 6,374,695B1 (the "'695 Patent"). In this action commenced November 18, 2002, THC's alleged licensee, plaintiff Teleflex Incorporated ("Teleflex"), has accused defendant KSR International Co. ("KSR") of selling position-adjustable, vehicular control pedals that allegedly embody THC-owned "patented invention[s]," within the meaning of 35 U.S.C § 271(a).

On April 2, 2003, KSR moved for an Order dismissing this action for lack of subject matter jurisdiction, on the grounds that (a) Teleflex is not a "patentee" having standing to sue under 35 U.S.C. § 281, and (b) "any defect in standing creates a defect in subject matter jurisdiction, necessitating dismissal under Federal Rule of Civil Procedure 12(b)(1)." Lans v. Gateway 2000, Inc., 84 F. Supp. 2d 112, 114 n.6 (D.D.C. 1999), aff'd sub nom. Lans v. Digital Equip. Corp., 252 F.3d 1320, 1328 (Fed. Cir. 2001) ("if a party lacks title to a patent, that party 'has no standing to bringing an infringement action' under that patent") (citation omitted). KSR's motion to dismiss remains pending.

In KSR International Co. v. Technology Holding Co., No. 03-277-KAJ (D. Del., filed Mar. 12, 2003) (the "Delaware Action"), THC has accused KSR of infringing the same three patents as its alleged licensee, Teleflex, has asserted in this action. On April 16, 2003, KSR moved in the Delaware Action for summary judgment of invalidity of each of the THC-owned patents that Teleflex has attempted to assert in this action.

If despite the foregoing, this Court determines to adjudicate the validity of the THC-owned patents that Teleflex has attempted to assert in this action, the following issues are raised by the present motion for summary judgment:

1. Whether the '239 Patent is invalid under 35 U.S.C. § 102.

2. Whether the '695 Patent is invalid under 35 U.S.C. § 102.

3. Whether Claim 4 of the '565 Patent is invalid under 35 U.S.C. § 103.

4. Whether the '239 and '695 Patents are invalid under 35 U.S.C. § 103.

KSR responds: YES

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FACTS

KSR International Company ("KSR") is a corporation organized and existing under the laws of Nova Scotia, Canada, having its principal place of business in Ridgetown, Ontario, Canada (Declaration of Larry Willemsen, sworn to July 7, 2003 [hereinafter "Willemsen Decl."] ¶ 2). KSR manufactures and supplies pedal systems, throttle controls, latches, handles, and other components installed as original equipment in various makes of vehicles manufactured by General Motors Corporation ("GM"), Ford Motor Company ("Ford"), DaimlerChrysler Corporation ("Daimler"), and other vehicle manufacturers worldwide. A description of KSR's business may be found at the "web site" associated with www.ksrint.com (Willemsen Decl. ¶ 3).

Non-party Technology Holding Company ("THC") is a corporation organized and existing under the laws of Delaware, having its principal place of business in Little Falls Centre II, 2751 Centerville Road, Suite 310, Wilmington, Delaware 19808 (Declaration of James W. Dabney, sworn to July 6, 2003 [hereinafter, "Dabney Decl."] ¶¶ 2-4 & Exs. 1 - 3). At the time this action was commenced on November 18, 2002, THC was the sole owner of the '565 Patent, the '239 Patent, and the '695 Patent (collectively the "THC Patents") by virtue of a series of assignments[1] including a written "Assignment of Patents" dated September 27, 2002, executed by Teleflex Inc. ("Teleflex") and recorded with the United States Patent and Trademark Office (the "September 2002 Assignment"; see Dabney Decl. ¶ 2 & Ex. 1).

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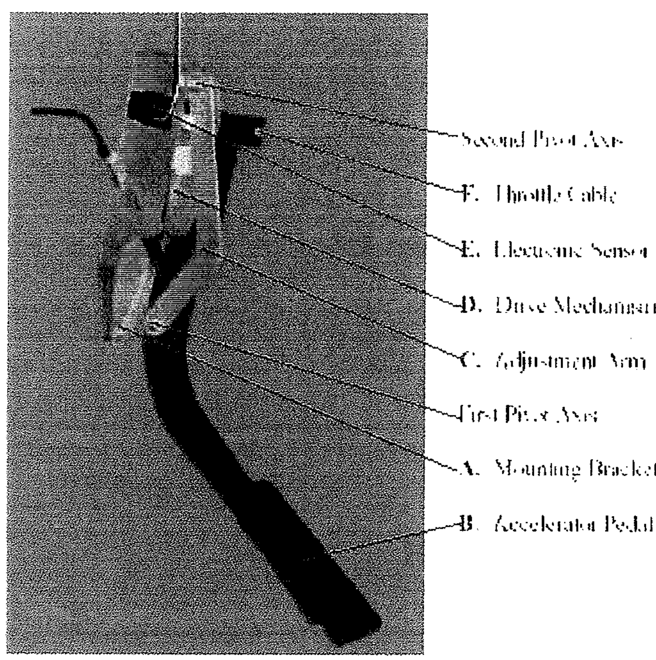
[1] As described more fully infra, the alleged "inventions" disclosed in the '239 Patent and the '695 Patent were originally assigned to Claes Johansson Automotive AB, a Swedish entity (Dabney Decl. ¶¶ 11-12 & Exs. 10-11).

Teleflex is a Delaware corporation headquartered in Plymouth Meeting, Pennsylvania (Dabney Decl. ¶ 2 & Ex. 1). Teleflex is a direct competitor of KSR in the business of supplying pedal systems to Ford, GM, Daimler, and other vehicle manufacturers.

Adjustable Pedal Assemblies

This case concerns position-adjustable vehicle pedals, commonly known as "gas pedals," that are used to actuate a motor vehicle's fuel system. A position-adjustable pedal is one whose resting position can be moved, or "adjusted," relative to a driver's seating position. Set forth below is an image of an "adjustable" pedal assembly that was installed in a 1975 Pontiac Grand Ville convertible (Willemsen Decl ¶ 7 & Ex. 1; Declaration of Daniel H. Kruger, sworn to July 6, 2003 [hereinafter, "Kruger Decl."] ¶ 21 & Ex. 1):



The pedal assembly depicted above includes a mounting bracket ("A") designed for attachment to a vehicle structure. The accelerator pedal ("B") is mounted on an adjustment arm ("C"). A drive mechanism ("D") is operably connected to the adjustment arm ("C"). Actuation of the drive mechanism ("D") causes the adjustment arm ("C") to rotate about its pivot axis, thereby moving the pedal ("B") between a plurality of operable positions (Willemsen Decl. ¶¶ 7, 27-28 & Exs. 1, 3-4)). Computer animations showing the actual movement of structures comprising a 1975 Pontiac Grand Ville adjustable accelerator pedal, and how those structures anticipate the asserted claims of the '239 and '695 Patents, appear in the files named "Pontiac" in the compact disk submitted as Exhibit 1 to this Brief (see Kruger Decl. ¶¶ 16 -24 & Ex. 1).[2]

The 1975 Pontiac Grand Ville, like most cars built prior to 2002, came with an engine whose throttle was actuated by a cable. In vehicles equipped with cable-actuated throttle controls, depression of the accelerator pedal typically causes a cable to pull on a valve housed in a carburetor or fuel injection unit, thereby increasing the amount of fuel and air entering the engine and hence engine speed (Willemsen Decl. ¶ 8). Accelerator pedals designed to actuate throttle cables also often actuate electronic sensors, exemplified by the electronic sensor ("E") incorporated in the 1975 Pontiac Grand Ville pedal for controlling an automatic transmission (id. ¶ 7 & Ex. 1).

Commencing in the mid-1990's, increasing numbers of vehicles sold in the United States came equipped with engines whose throttles were controlled electronically, by computerized systems commonly known as "electronic throttle controls" ("ETC's"). Electronic throttle controls can accommodate improved traction control and vehicle directional stability systems, simplified cruise controls, and on-board computer-

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[2] The mpeg files in Exhibit 1 are best viewed with Windows Media Player or a similar program.

controlled systems for improving fuel economy and reducing tailpipe emissions (Willemsen Decl. ¶ 9). In vehicles whose engines are equipped with electronic throttle controls, accelerator pedals typically are coupled to a type of electronic sensor called a "potentiometer," which works something like a light dimmer (Willemsen Decl. ¶¶ 10 - 19 & Exs. 8-10).

In fact, an adjustable pedal assembly incorporating a potentiometer is disclosed in Figure 4 of published French Patent Application No. 2,739,947 to Urset ("Urset"), reprinted below (Dabney Decl. ¶ 7 & Ex. 6):

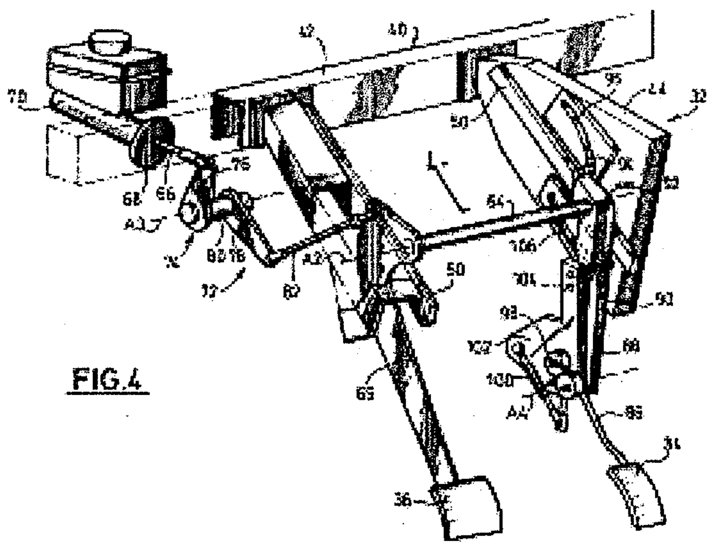

FIG.4

In the above design, the accelerator pedal (34) acts on an electronic potentiometer (98) that modulates an electronic signal as a function of the angular position of the pedal around its pivoting axis A4 (Dabney Decl. ¶¶ 7-8 & Exs. 6-7; Willemsen Decl. ¶ 29 & Ex. 5). The electronic signal is communicated to a computer processor that, in turn, causes a fuel injection unit or other fuel system to vary the amount of fuel and air entering the engine (Willemsen Decl. ¶ 10). Computer animations showing the actual movement of structures disclosed in Urset, and how those structures anticipate the asserted claims of the '239 and '695 Patents, appear in the files named "Urset" in Exhibit 1 to this Brief (Kruger Decl. ¶¶ 32-39 & Ex. 1).

KSR Adjustable Pedals

In mid-1998, KSR was chosen by Ford to supply adjustable pedal systems for the Ford Crown Victoria, Mercury Grand Marquis, and Lincoln Town Car lines commencing with the 2001 model year. The Ford engines installed in these vehicles utilized cable-actuated throttle controls, and the KSR-supplied accelerator pedals accordingly included cable-attachment arms. Neither Teleflex nor THC has ever alleged that any pedal systems supplied to Ford for the 2001, 2002, or 2003 model Crown Victoria, Grand Marquis, or Town Car programs incorporate or use any patented inventions allegedly owned by Teleflex or THC. KSR was awarded U.S. Patent No. 6,151,986 for the design of the adjustable pedal systems supplied to Ford commencing with the 2001 model year (Willemsen Decl. ¶ 24).

In mid-2000, KSR was chosen by GM to supply adjustable pedal systems for the Chevrolet and GMC light pick-up truck lines commencing with the 2003 model year. The GM engines installed in these vehicles utilized electronic throttle controls, and the KSR-supplied accelerator pedals accordingly included off-the-shelf electronic pedal position sensors -- the identical sensors, in fact, as had been utilized in 1994 and later models of Chevrolet and GMC pick-up trucks equipped with optional diesel engines. KSR has patents pending on the design of the adjustable pedal system supplied to GM commencing with the 2003 model year (Willemsen Decl. ¶¶ 14-18, 25).

By letter dated March 28, 2001 -- long prior to when Teleflex could have legitimately or legally seen the design of any KSR adjustable pedals that were then being developed for the 2003 model Chevrolet and GMC light pick-up truck lines -- Teleflex sent a letter to KSR which stated in part (Willemsen Decl ¶ 26 & Ex. 2):

> We understand that you have made several proposals to General Motors Corporation based on an adjustable pedal product in combination with an electronic throttle control. . . . Teleflex believes that any supplier of a product that combines an adjustable pedal with an electronic throttle control necessarily employs technology covered by one or more of the above Teleflex patents and applications.

That is to say, Teleflex took -- and apparently still takes -- the position that it had somehow patented the "combination" of "an adjustable pedal with an electronic throttle control," and so could accuse KSR of patent infringement without even seeing how any KSR-manufactured pedal assemblies were designed or operated.

Course of Proceedings

After attempting and failing to persuade KSR to enter into a "business arrangement" involving "some type of royalty arrangement coupled with the supply by us [Teleflex] to you [KSR] of electronic throttle controls or other components of an adjustable pedal system" (Willemsen Decl. ¶ 26 & Ex. 2), Teleflex on December 17, 2001, commenced an action in this Court entitled Teleflex Inc. v. KSR International Co., Case No. 01-74775 (the "First Teleflex Action"). The Complaint in the First Teleflex Action alleged that Teleflex was "the current assignee of all right, title and interest in the '565 Patent, including the right to bring and maintain this action with respect to the '565 Patent."[3] The Complaint in the First Teleflex Action included no allegations relating to the '239 Patent or the '695 Patent.

[3] Teleflex's Amended Complaint for Patent Infringement filed in the First Teleflex Action dated February 13, 2002, at ¶ 8.

On November 13, 2002, Teleflex voluntarily dismissed, without prejudice, its Complaint in the First Teleflex Action. Five days later, on November 18, 2002, Teleflex filed a new complaint commencing the present action, Case No. 02-74586 (the "Second Teleflex Action"). Teleflex's Complaint in this Second Teleflex Action alleged in part:

> 8. Teleflex is the current assignee as to all right, title and interest in the '565 Patent, including the right to bring and maintain this action with respect to the '565 Patent.
>
> 16. Teleflex is the current assignee as to all right, title and interest in the '239 Patent, including the right to bring and maintain this action with respect to the '239 Patent.
>
> 24. Teleflex is the current assignee as to all right, title and interest in the '695 Patent, including the right to bring and maintain this action with respect to the '695 Patent.

In fact, as KSR subsequently discovered, Teleflex as of November 18, 2002, was not the "assignee" or owner of any of the patents being asserted. Subsequent to the commencement of the First Teleflex Action, and prior to the commencement of the Second Teleflex Action, Teleflex on September 27, 2002, formally assigned to non-party THC "all of its [Teleflex's] right, title and interest in and to the Inventions" covered by any "patent used exclusively or primarily in the conduct of Assignor's [Teleflex's] automotive, marine, aerospace/defense divisions businesses" (Dabney Decl. ¶ 2 & Ex. 1), including specifically "all claims by reason of infringement of the Patents and the right to sue and collect damages for such infringement" (id.). As KSR has previously demonstrated,[4] Teleflex's assignment of patents and patent claims to THC on September 27, 2002, destroyed any basis Teleflex might have had for claiming to be a "patentee" for

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[4] See Reply Brief in Support of Motion to Dismiss for Lack of Subject Matter Jurisdiction filed May 6, 2003.

purposes of 35 U.S.C. § 281, thus "necessitating dismissal under Federal Rule of Civil Procedure 12(b)(1)." Lans v. Gateway 2000, Inc., 84 F. Supp. 2d 112, 114 n.6 (D.D.C. 1999), aff'd sub nom. Lans v. Digital Equip. Corp., 252 F.3d 1320, 1321 (Fed. Cir. 2001) ("if a party lacks title to a patent, that party 'has no standing to bring an infringement action' under that patent") (citation omitted).

Promptly upon learning of Teleflex's non-ownership of the patents being asserted in this action, KSR commenced the Delaware Action against the patents' actual owner, non-party THC, and moved for an Order dismissing the present action for lack of subject matter jurisdiction.[5] On April 2, 2003, non-party THC served an answer in the Delaware Action that accused KSR of infringing the same three patents (the "THC Patents") that Teleflex had attempted to assert in this Michigan action (Dabney Decl. ¶ 4 & Ex. 3). On April 16, 2003, KSR moved in the Delaware Action for summary judgment declaring the THC Patents invalid under 35 U.S.C. § 103 (id. ¶ 5 & Ex. 4). KSR's summary judgment motion in the Delaware Action remains pending and undecided.[6]

In the event that this Court determines to adjudicate the merits of the THC-owned patents and THC-owned claims for infringement that Teleflex has alleged in this action, KSR hereby moves for summary judgment declaring invalid each of the THC Patents under 35 U.S.C. §§ 102 and 103.

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[5] See Brief in Support of Defendant's Motion to Dismiss for Lack of Subject Matter Jurisdiction filed April 2, 2003; Teleflex's Response to KSR's Motion to Dismiss for Lack of Subject Matter Jurisdiction filed April 22, 2003; Reply Brief in Support of Motion to Dismiss for Lack of Subject Matter Jurisdiction filed May 6, 2003.

[6] On April 28, 2003, the Court hearing the Delaware Action stayed proceedings in that action pending determination of KSR's pending motion to dismiss the within action for lack of subject matter jurisdiction.

SUMMARY OF THE ARGUMENT

The claimed "inventions" of the THC Patents are invalid under 35 U.S.C. §§ 102 and 103, because prior art to the THC Patents expressly teaches both (a) the exact adjustable pedal configurations claimed in the THC Patents, and (b) the desirability of electronic pedal position sensors being deployed, mounted, and coupled to a vehicle's fuel system in the exact manner claimed in the THC Patents.

When it issued the THC Patents, the United States Patent and Trademark Office (the "Patent Office") did not have before it various references -- including the 1975 Pontiac, Urset, U.S. Patent No. 5,010,782 to Asano ("Asano"), or U.S. Patent No. 2,860,720 to Huff ("Huff") -- that disclosed each and every mechanical structure recited in the claims of the THC Patents (Willemsen Decl. ¶¶ 27-41 & Exs. 1, 3-14; Kruger Decl. ¶¶ 2-39 & Ex. 1). Without the impediment of this art, Teleflex's and THC's patent counsel procured issuance of the THC Patents by arguing to the Patent Office -- incorrectly -- that the prior art supposedly did not disclose the mechanical configurations that the 1975 Pontiac, Urset, Asano, Huff, and other prior art indisputably do, in fact, disclose (Dabney Decl. ¶ 14 & Ex. 13 at 13, ¶ 15 & Ex. 14 at 21; ¶ 16 & Ex. 15 at 10; ¶ 17 & Ex. 16 at 11).[7]

The prior art submitted with this motion establishes, not just clearly and convincingly, but beyond any doubt whatsoever, that at relevant times the claimed "inventions" of the THC Patents were unpatentable under 35 U.S.C. §§ 102 and 103. Summary judgment is therefore warranted and appropriate. Cf. Ryko Mfg. Co. v. Nu-

[7] For purposes of the present motion, the Court may assume that THC's assignor's misdescriptions of the prior art during prosecution of the THC Patents were innocent.

Star, Inc., 950 F.2d 714 (Fed. Cir. 1990) (affirming summary judgment of invalidity under 35 U.S.C. § 103, where claimed "invention" consisted of mere substitution of electronic for mechanical activation device in automatic car wash).

ARGUMENT

United States patents contain "a grant to the patentee, his heirs or assigns, of the right to exclude others from making, using, offering for sale, or selling the invention throughout the United States . . . . " 35 U.S.C. § 154(a)(1). The scope of a patent "grant" is measured by the separately numbered "claims" appearing at the end of a patent. See Graver Tank & Mfg. Co. v. Linde Air Prods. Co., 336 U.S. 271, 277 (1949) ("We have frequently held that it is the claim which measures the grant to the patentee."). "While the cases more often have dealt with efforts to resort to specifications to expand claims, it is clear that the latter fail equally to perform their function as a measure of the grant when they overclaim the invention." Id.

The validity of a patent grant thus turns on whether its corresponding "claim" recites subject matter that is patentably distinct from the "prior art" that existed at relevant times. Overly broad patent claims cannot be "saved" from invalidity through judicial importation of limitations appearing only in the "specification" portion of a patent. E.I. Du Pont de Nemours & Co. v. Phillips Petroleum Co., 849 F.2d 1430, 1433-34 (Fed. Cir.), cert. denied, 498 U.S. 986 (1988).

As used in the Patent Act, the term "prior art" refers to subject matter falling within the scope of 35 U.S.C. § 102. For purposes of the present motion, KSR relies on "prior art" meeting the standards of 35 U.S.C. §§ 102 (a) and (b) which provide:

A person shall be entitled to a patent unless--

> (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for patent, or
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of the application for patent in the United States, ...

According to interrogatory answers served by Teleflex, the alleged "inventions" of the '239 and '695 Patents were made on May 23, 1997 (Dabney Decl. ¶ 6 & Ex. 5, response to Interrogatory No. 11). Thus, under 35 U.S.C. § 102(a), the "prior art" of the '239 and '695 Patents includes any pertinent patents or printed publications issued prior to May 23, 1997, "in this or a foreign country," such as French Patent Appln. No. 2,739,947 to Urset published April 18, 1997 (Dabney Decl. ¶ 7 & Ex. 6).

The '239 and '695 Patents issued from "continuation" applications that claimed priority to a "parent" application filed November 24, 1997 (Dabney Decl. ¶¶ 14-15 & Exs. 13-14). Thus, under 35 U.S.C. § 102(b), the "prior art" of the '239 and '695 Patents also includes any pertinent products that were in public use or on sale in the United States on or prior to November 24, 1996, such as the adjustable pedals that were offered as an option in the 1975 Pontiac Grand Ville (Willemsen Decl. ¶ 7 & Ex. 1) and the electronic throttle control ("ETC") pedals that came standard in 1994 Chevrolet C/K pick-up trucks equipped with diesel engines (id. ¶¶ 14-19 & Exs. 8-10).

According to interrogatory answers served by Teleflex, the alleged "inventions" of the '565 Patent were made on February 14, 1998 (Dabney Decl. ¶ 6 & Ex. 5, response to Interrogatory No. 11). Thus, under 35 U.S.C. § 102(a), the "prior art" of the '565 Patent includes any pertinent patents or printed publications issued prior to February 14, 1998, such as U.S. Patent No. 5,010,782 to Asano. The '565 Patent issued from a "continuation" application that claimed priority to a "parent" application filed January 26, 1999 (Dabney Decl. ¶ 17 & Ex. 16). Thus, under 35 U.S.C. § 102(b), the "prior art" of the '565 Patent also includes any pertinent products that were in public use or on sale in the United States on or prior to January 26, 1998.

I. THE '239 PATENT IS INVALID UNDER 35 U.S.C. § 102.

"It is well-settled that a claim is anticipated if each and every limitation is found either expressly or inherently in a single prior art reference." Celeritas Technologies, Ltd. v. Rockwell Int'l Corp., 150 F.3d 1354, 1361 (Fed. Cir. 1998). As set forth below, Claim 1 of the '239 Patent is fully anticipated by both Urset and the 1975 Pontiac Grand Ville adjustable accelerator pedal.

The '239 Patent (see Exhibit 2 hereto) discloses a single embodiment of an "adjustable pedal assembly" comprising the structures depicted below:

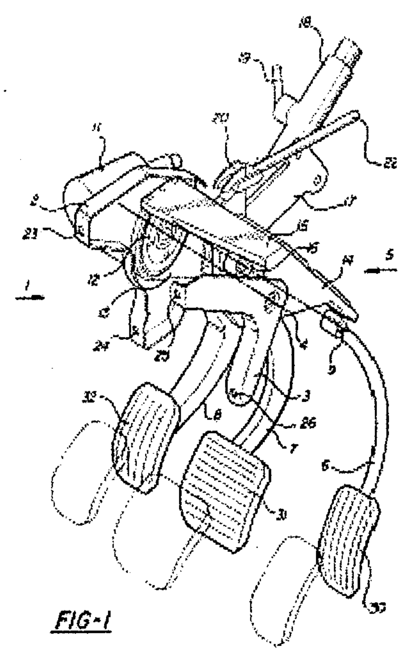

FIG-1

In the above design, an adjustable pedal assembly is disclosed comprising a "mounting arrangement" (2, 3, 23, 24, 25, 26) designed for attachment to a vehicle structure. A pedal (6, 7, or 8) is pivotally supported for rotation about a first pivot axis (9) with respect to the "mounting arrangement." An "adjustment element" (5) is pivotally supported for rotation about a second pivot axis (4) that is parallel to the first. A drive mechanism (11) is operably connected to the "adjustment element" (5) and causes it to rotate about its pivot axis, thereby causing the pedals to move between a plurality of operable positions. With regard to the accelerator pedal (6), the specification recites that it is "preferably connected to an electric control potentiometer," but that "a mechanical connection such as a wire or cable, can be used as an alternative to the electrical transfer" ('239 Patent at col. 5, lines 1, 41-43).[8]

Although the '239 Patent discloses various structures (e.g., the particular configuration of the disclosed, rearward facing "mounting arrangement") that THC's assignor(s) might have pointed out in claim 1 of the '239 Patent in order to distinguish the subject matter of that claim from the prior art,[9] they did not do so. Rather, in an apparent attempt to exclude KSR from selling KSR-designed (and separately patented) pedal

[8] The drawings submitted with the original Swedish "parent" application of the '239 Patent, filed by non-party Claes Johansson Automotive AB, notably did not include the Figure "36" or the associated text referring to "electronic control potentiometer 36" appearing in column 6, lines 1-9 of the '239 Patent (Dabney Decl. ¶ 11 & Ex. 10 at KSR007626). These matters appear to have been hand-written in by Teleflex's and THC's U.S. patent counsel.

[9] The '239 Patent was prosecuted as a "continuation" application filed September 5, 2000, based on the disclosure of a "parent" application that was filed nearly two (2) years previously and issued as U.S. Patent No. 6,151,984 (the "'984 Patent"; see Exhibit 3 hereto). The '984 Patent, whose claims are considerably narrower than those of the '239 and '695 Patents, has never been asserted against KSR.

assemblies that are totally different, in design and mode of operation, from any "invention" even arguably disclosed in the '239 Patent, THC's and Teleflex's patent counsel wrote Claim 1 of the '239 so broadly and so generically that it is fully anticipated by prior art to the '239 Patent. [10]

The '239 Patent is invalid under 35 U.S.C. § 102(a), because its sole claim is fully anticipated by Urset (see Willemsen Decl. ¶ 30 & Ex. 6; Kruger Decl. ¶ 32 & Ex. 1). A computer animation, comparing the words of Claim 1 of the '239 Patent with 3-dimensional images of the Urset disclosure, appears in the file named "Urset_239_claim_1.mpeg" in the disk submitted as Exhibit 1 to this Brief. A conventional claim chart comparing the language of Claim 1 of the '239 Patent with the Urset disclosure appears in Exhibit 6 to the accompanying Declaration of Larry Willemsen.

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[10] It should be noted that, for purposes of determining whether a person is using a "patented invention" for purposes of 35 U.S.C. § 271(a), "the court must consider the substance of the invention along with the form of the claims," and must determine whether an accused product is or "is not the equivalent of the invention disclosed in [a] . . . patent". Mead Digital Sys., Inc. v. A.B. Dick Co., 723 F.2d 455, 463 & n.12 (6th Cir. 1983) (emphasis added). See, e.g., Sanitary Refrigerator Co. v. Winters, 280 U.S. 30, 41-42 (1929) (quoting Burr v. Duryee, 68 U.S. (1 Wall.) 531, 573 (1864)); Autogiro Co. of Am. v. United States, 384 F.2d 391, 399-400 (Ct. Cl. 1967); Nickerson v. Bearfoot Sole Co., 311 F.2d 858, 879-81 (6th Cir. 1962), cert. denied, 375 U.S. 815 (1963). No comparable "equivalents" analysis is pertinent to questions of anticipation under 35 U.S.C. § 102. Lewmar Marine, Inc. v. Barient, Inc., 827 F.2d 744, 747-48 (Fed. Cir. 1987), cert. denied, 484 U.S. 1007 (1988).

Figures 3 and 4 of Urset are reprinted below (Dabney Decl. ¶¶ 7-8 & Exs. 6-7):

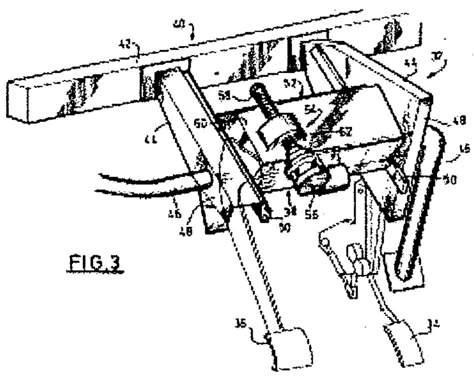

FIG.3

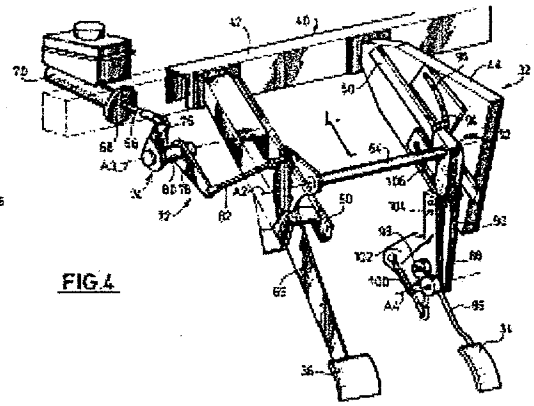

FIG.4

In the above design, an adjustable pedal assembly is disclosed comprising a mounting arrangement (40, 44, 46, 52) designed for attachment to a vehicle structure. A pedal (34) is pivotally supported for rotation about a first pivot axis (A4) with respect to the mounting arrangement. An "adjustment element" (90) is pivotally supported on a shaft (64) for rotation about a second pivot axis (A2) that is parallel to the first. A drive mechanism (56) is operably connected to the "adjustment element" (90) and causes it both to slide and to rotate about its pivot axis (A2), thereby moving the pedal (34) between a plurality of operable positions. Mounted adjacent to the accelerator pedal (34) is an "accelerator potentiometer" (98) whose electronic output varies "as a function of the angular position of the pedal 34 about its pivoting axis". The output of the disclosed "accelerator potentiometer" is independent of the pedal's adjustment movement between operable positions (Kruger Decl. ¶ 33; Willemsen Decl. ¶ 30 & Ex. 6; see Exhibit 1 hereto).

Under 35 U.S.C. § 282, "[t]he burden of establishing invalidity of the patent or any claim thereof shall rest with the party asserting such invalidity." Further, "the facts to support a conclusion of invalidity of an issued patent must be proved by clear and convincing evidence." Ryko, 950 F.2d at 716. These principles flow from the presumed expertise of the Patent Office in discharging its statutory functions, and the deference ordinarily due a Government agency when it considers a matter falling within its jurisdiction. See American Hoist & Derrick Co. v. Sowa & Sons, Inc., 725 F.2d 1350, 1359 (Fed. Cir.), cert. denied, 469 U.S. 821 (1984).

But where, as here, an invalidity defense relies on prior art that was never considered by the Patent Office in issuing a challenged patent, there is no reason for a Court to defer to any non-existent judgment of the Patent Office with respect to the uncited art:

> When an attacker, in sustaining the burden imposed by § 282, produces prior art or other evidence that was not considered in the PTO, there is . . . no reason to defer to the PTO so far as its effect on validity is concerned. Indeed, new prior art not before the PTO may so clearly invalidate a patent that the burden is fully sustained merely by proving its existence and applying the proper law . . . . When new evidence touching validity of the patent not considered by the PTO as relied on, the tribunal considering it is not faced with having to disagree with the PTO or with deferring to its judgment or with taking its expertise into account.

American Hoist, 725 F.2d at 1359-60 (emphasis in original).

"A patent, in the last analysis, simply represents a legal conclusion reached by the Patent Office," typically reached "in an ex parte proceeding, without the aid of the arguments which could be advanced by parties interested in proving patent invalidity." Lear v. Adkins, 395 U.S. 653, 670 (1969). The present case is a paradigm of one in which "new prior art not before the PTO . . . so clearly invalidate[s] a patent that the burden is fully sustained merely by proving its existence and applying the proper law." American Hoist, 725 F.2d at 1359-60.

Here as set forth above, in Willemsen Exhibit 6, and in the compact disk annexed as Exhibit 1 hereto, a single reference -- Urset -- clearly discloses each and every structure recited in Claim 1 of the '239 Patent. That claim is accordingly invalid under 35 U.S.C. § 102(a). Celeritas, 150 F.3d at 1361.

Claim 1 of the '239 Patent is also fully anticipated by the adjustable pedal assembly that was installed as optional equipment in the 1975 Pontiac Grand Ville (Willemsen Decl ¶ 27 & Ex. 3; Kruger Decl. ¶ 18 & Ex. 1; see Exhibit 1 hereto). A computer animation, comparing the words of Claim 1 of the '239 Patent with 3-dimensional images of the 1975 Grand Ville accelerator pedal assembly disclosure, appears in the file named "Pontiac_239_claim_1.mpeg" in Exhibit 1 to this Brief. A conventional claim chart comparing the language of Claim 1 of the '239 Patent with photographs of the 1975 Grand Ville accelerator pedal assembly appears in Exhibit 3 to the accompanying Declaration of Larry Willemsen.

II. THE '695 PATENT IS INVALID UNDER 35 U.S.C. § 102

The disclosure of the '695 Patent (see Exhibit 4 hereto) is identical to that of the '239 Patent. The only difference between the '695 Patent and the '239 Patent is that the two claims of the '695 Patent include some additional descriptions of the alleged "inventions" that are not present in Claim 1 of the '239 Patent.

The '695 Patent is invalid under 35 U.S.C. § 102(a), because both of its claims are fully anticipated by Urset and the 1975 Pontiac Grand Ville accelerator pedal assembly (see Willemsen Decl. ¶ 28 & Ex. 4; Kruger Decl. ¶¶ 19-24 & Ex. 1). Computer animations, comparing the words of Claims 1 and 2 of the '695 Patent with 3-dimensional images of the Urset disclosure and the 1975 Pontiac Grand Ville accelerator pedal assembly, appear in the files whose names include "Urset" and "Pontiac" in the accompanying compact disk (see Exhibit 1 hereto). Conventional claim charts, comparing the language of Claims 1 and 2 of the '695 Patent with the Urset disclosure and the 1975 Pontiac Grand Ville accelerator pedal assembly, appear in Exhibits 4 and 7 to the accompanying Declaration of Larry Willemsen.

For the same reasons that Claim 1 of the '239 Patent is invalid under 35 U.S.C. § 102(a), Claims 1 and 2 of the '695 Patent are also and equally invalid under that statute. Each and every structure recited in Claims 1 and 2 of the '695 Patent is disclosed in Urset (see Exhibit 1 hereto; Willemsen Decl ¶ 31 & Ex. 7). Each and every structure recited in Claims 1 and 2 of the '695 Patent is also disclosed in the 1975 Pontiac Grand Ville pedal assembly (id. ¶ 28 & Ex. 4). These references are, without more, fatal to the validity of the '695 Patent.

When it issued the '695 Patent to THC's assignor, the Patent Office explained its action as follows (Dabney Decl. ¶ 15 & Ex. 14 at 26):

> The following is an examiner's statement of reasons for allowance: The prior art taken as a whole, neither teaches nor renders obvious an adjustable pedal assembly comprising a mounting arrangement, at least one pedal, an adjustment element, a first pivot axis connecting the pedal to the adjustment element, and a second pivot axis connecting the adjustment element to the mounting arrangement, said axises being parallel, and wherein the pedal is pivotal about the first axis which is movable with the adjustable element about the second axis (connected at the mounting arrangement).

When it made the above-quoted statement, the Patent Office did not have the benefit of Urset, the 1975 Pontiac Grand Ville Pedal, or U.S. Patent No. 2,860,720 to Huff ("Huff"; see Exhibit 13 hereto; Willemsen Decl. ¶ 40 & Ex. 14), each of which references disclosed the very combination of structure whose purported non-existence was the expressly stated basis for the Patent Office's issuance of the '695 Patent to

Teleflex.[11] The record of this case shows, clearly and convincingly, that both claims of the '695 Patent are fully anticipated by prior art, and are therefore invalid under 35 U.S.C. § 102.

III. CLAIM 4 OF THE '565 PATENT IS INVALID UNDER 35 U.S.C. § 103.

35 U.S.C. § 103(a) provides:

> A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.

"Obviousness is a question of law based upon underlying factual determinations." Sandt Technology, Ltd. v. Resco Metal & Plastics Corp., 264 F.3d 1344, 1354 (Fed. Cir. 2001) (quoting Heidelberger Druckmaschinen AG v. Hantscho Commercial Prods., Inc., 21 F.3d 1068, 1071 (Fed. Cir. 1994)). "Therefore, a district court can properly grant, as a matter of law, a motion for summary judgment on patent invalidity when the factual inquiries into obviousness present no genuine issue of material facts." Ryko Mfg Co. v. Nu-Star, Inc., 950 F.2d 714, 716 (Fed. Cir. 1990).

In Graham v. John Deere Co., 383 U.S. 1, 17-18 (1966), the Supreme Court set forth the analytical framework for determining questions of patent invalidity under 35 U.S.C. § 103:

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[11] The Huff reference (see Exhibit 13 hereto) discloses all of the structure recited in the '239 Patent and '695 Patent claims except for the recited "electric generator", an off-the-shelf part used in vehicles whose engines utilize electronic, rather than cable-actuated, throttle controls. The Patent Office statement quoted in the text demonstrates clearly that there was and is no patentable novelty in attaching an off-the-shelf pedal position sensor to an otherwise old adjustable pedal configuration. The Huff reference is discussed more fully in Part IV, infra.

Under § 103, the scope and content of the prior art are to be determined; differences between the prior art and the claims at issue are to be ascertained; and the level of ordinary skill in the pertinent art resolved. Against this background, the obviousness or nonobviousness of the subject matter is determined. Such secondary considerations as commercial success, long felt but unsolved needs, failure of others, etc., might be utilized to give light to the circumstances surrounding the origin of the subject matter sought to be patented.

As set forth below, Claim 4 of the '565 Patent is written so broadly as to leave no patentable "differences" between the claimed subject matter and the prior art of those patents. The absence of patentable "differences between the prior art and the claims at issue," 383 U.S. at 17, is demonstrated in the file named "Asano_565_claim_4.mpeg" of Exhibit 1 to the accompanying Declaration of Daniel H. Kruger and attached to this Brief as Exhibit 1. A conventional claim chart demonstrating the invalidity of the '565 Patent are submitted as Exhibit 12 to the accompanying Declaration of Larry Willemsen.

The '565 Patent (see Exhibit 5 hereto) discloses a "vehicle control pedal apparatus 12", the two preferred embodiments of which appear in the figures below:

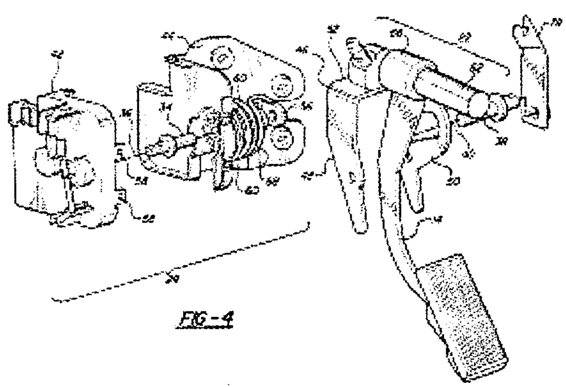


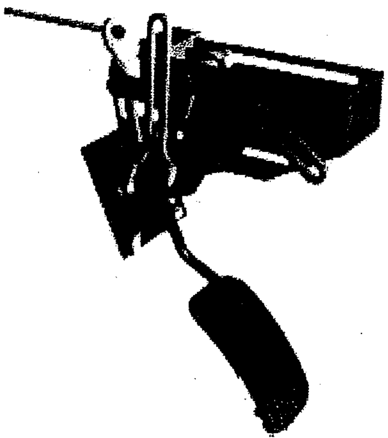
FIG-4

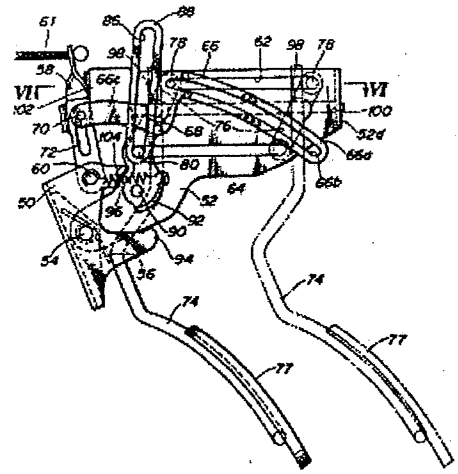
In the above design, an "adjustable pedal assembly 22" is pivotally mounted on a support (18, 44). A screw drive mechanism housed in a guide member (62) causes the pedal (14) to slide back and forth along the guide member. The position of the pivot (24) remains constant while the pedal arm (14) slides back and forth along a tubular guide member (62). In one embodiment, the assembly includes a "cable attachment member 78" for actuating an engine throttle cable. In a second embodiment, in lieu of or in addition to the "cable attachment member 78", the disclosed pedal assembly can optionally include an electronic pedal position sensor (42), characterized in the '565 Patent as an "electronic throttle control 28" (see Exhibit 5 hereto at col. 3, line 29). The disclosed "electronic throttle control" is a modular unit (42) attached to a portion of the pedal's support (18, 44) and engaged with the pivot member (34) of the pedal arm (14).

A. Scope and Content of Prior Art.

"The relevant art is defined by the nature of the problem confronting the would-be inventor." Ryko, 950 F.2d at 716. Here, the "problem" ostensibly confronting the '565 inventor was to provide an adjustable pedal assembly that could be installed in a vehicle whose engine utilized an electronic, rather than a cable-actuated, throttle control system. Thus, as the references cited on the face of the '565 Patent make clear, the "relevant art" to that patent includes (a) adjustable vehicle pedal assemblies and (b) electronic pedal position sensors.

The prior art to the '565 Patent includes U.S. Patent No. 5,010,782 filed July 28, 1989 ("Asano"; see Exhibit 6 hereto). Figure 5 of Asano is reproduced at right, below; a computer animation of Asano appears at left, below (see Kruger Decl. ¶ 5):





In the above design, an adjustable pedal assembly is pivotally mounted on a support (50). The assembly includes a cable attachment structure (58) for actuating an engine throttle cable (61). A screw drive (100) housed in a guide member (52) causes the pedal (74) to slide back and forth along the guide member. The position of the support pivot (54) remains constant while the pedal arm (74) slides back and forth along a guide member (52). The operation of Asano is depicted in the computer animation file named "Asano_565_claim_4.mpeg" on the disk submitted as part of Exhibit 1 to the accompanying Declaration of Daniel H. Kruger. Asano was not cited to the Patent Office during prosecution of the '565 Patent or its parent, even though Teleflex's and THC's patent counsel had cited Asano to the Patent Office during prosecution of the "parent" of the'239 Patent (see Exhibit 3 hereto).[12]

[12] The design disclosed in the '565 Patent is virtually identical to that disclosed in U.S. Patent No. 5,722,302 filed October 2, 1996, and originally assigned to Comfort Pedals, Inc. (see Exhibit 1 at Rixon_Engelgau_565_4_compare.mpeg; Kruger Decl. ¶ 29 & Ex. 1; Willemsen Decl. ¶ 32 & Ex. 11; Dabney Decl. ¶ 9 & Ex. 8. KSR believes that pedal assemblies embodying the design disclosed in the '302 Patent were on sale or in public use long prior to January 26, 1998; however, THC and Teleflex have thus far interposed

The prior art to the '565 Patent further includes specific teachings with respect to the desirability of electronic, as distinguished from mechanical, throttle controls in automotive vehicles, from the point of view of engine management and pedal operability:

> Control of throttle in passenger cars and trucks is usually dependent upon the position of an accelerator pedal, which represents vehicle operator demand. The accelerator pedal position, or demand, is then linked to the engine throttle. Accelerator pedal movement was transmitted for many years through mechanical linkages consisting of solid rods and ball joints. In some applications, the solid rod linkage was replaced by a cable within a sleeve, referred to in the trade as a Bowden cable. These mechanical linkages are prone to problems which tend to affect all mechanical systems, such as sticking, freezing, breakage, and other mishaps. In addition, adaptation of the mechanical linkages to allow for special features such as more efficient energy utilization, reduced emissions, idle speed control, and "limp-home" modes of operation are generally not practical, or even possible in some cases.
>
> By using a sensor to sense accelerator demand, a servo-motor to control the throttle position, and a computer system to control operation of the throttle relative to the input from the accelerator pedal sensor and other various sensed inputs, a variety of special features may be incorporated in the accelerator-throttle linkage. In these computer-assisted systems, the throttle linkage is commonly referred to as a "drive-by-wire" system, since the linkage is electrical.

U.S. Patent No. 5,998,892 filed as of September 4, 1996; see Exhibit 7 at col. 1, lines 40-64.

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groundless objections to making discovery on this point. KSR has deferred challenging these objections in view of the pending motion to dismiss for lack of subject matter jurisdiction and KSR's co-pending motion filed April 25, 2003, for a stay of discovery-related proceedings pending determination of the subject matter jurisdiction issue.

The prior art status of the Ford Expedition pedal disclosed in Rixon '302 is a matter that KSR would pursue in discovery if this action were dismissed and proceedings in the Delaware Action resumed, or if the discovery period in this action were extended. In order to avoid a factual dispute concerning cumulative evidence of invalidity, KSR does not, in this motion, rely on Rixon '302, except to note that (a) Asano was cited during prosecution of Rixon '302, and thus not surprisingly, (b) the claims of Rixon '302 are much narrower than the claims of the '565 Patent.

The prior art to the '565 Patent further includes express teaching with regard to the desirability of electronic, as distinguished from mechanical, linkages between vehicle accelerator pedals and engine throttles:

> In the automotive art, accelerator type foot pedals are employed for controlling the flow of fluids to the engines. These usually include a pedal mounting affixed to the vehicle body and a series of links and levers, or Bowden wires, connecting the pedal to the carburetor, fuel injector, controller or the link. These link connections usually must be designed to withstand and accommodate engine movements relative to the vehicle frame, as well as to provide accurate control despite such movements. In addition, space must be provided for the linkages to function properly. The choices for routing of the mechanical control rods or wires are limited by their nature. With electrical sensing means directly associated with the pedal, the connection to a carburetor or the like can be accomplished with electrical wiring which relatively speaking, can free the connection problems from the special physical relationships of the older mechanical systems.

U.S. Patent No. 5,408,899 filed June 13, 1993, at col. 1 lines14-32; see Exhibit 8.

The prior art to the '565 Patent further includes express teachings with respect to the desirability of locating an electronic pedal position sensor adjacent to a vehicle's accelerator pedal, inside the vehicle's passenger compartment, rather than in a vehicle's engine compartment:

> An early design of an electronic control system located the movement detecting sensor in the engine compartment near the fuel pump; however, this arrangement proved undesirable due to the complex mechanical linkage required to connect the foot pedal to the sensor. Moreover, the harsh operating environment of the engine compartment exposed the sensor to heat, oil and dirt, which can contribute to premature failure of sensitive components. Subsequent designs thus located the sensor in the cab or operator compartment, the sensor being incorporated in a foot pedal arrangement that included a means for providing rotative motion of a potentiometer in response to depression of the foot pedal.

U.S. Patent No. 5,241,936 filed September 9, 1991; see Exhibit 9, at col. 1 lines 52-65.

The prior art to the '565 Patent further includes a number of modular, self-contained pedal position sensors that (a) were specifically designed to be mounted on the pivot of an accelerator pedal, and (b) were specifically intended and marketed for use to actuate electronic throttle controls in vehicles. One example of a modular prior art pedal position sensor is disclosed in U.S. Patent No. 5,385,068 filed December 18, 1992 (the "'068 Patent"; see Exhibit 10; Willemsen Decl. ¶ 12). Figure 1 of the '068 Patent, depicting a "position sensor 17", is reproduced below:

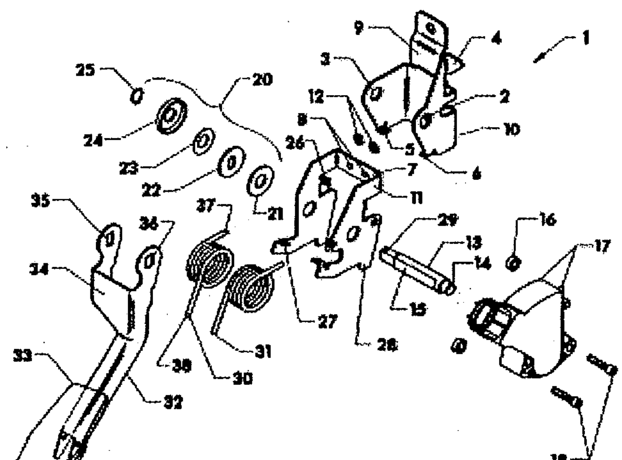
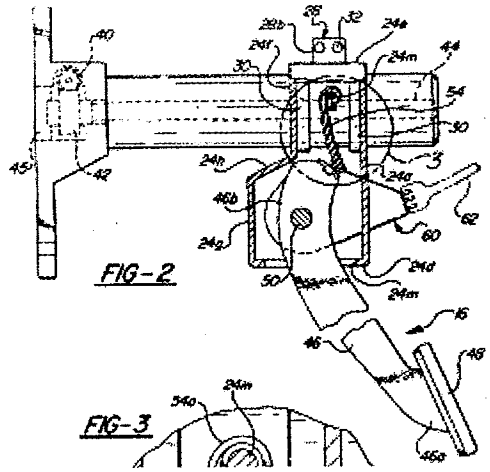


FIGURE 1

A second example of a modular prior art pedal position sensor is the "503 Series" pedal position sensor manufactured by CTS Corporation of Elkhart, Indiana ("CTS") and offered for sale in the United States continuously since at least 1993 (Willemsen Decl. ¶¶ 14-19 & Exs. 8-10). A physical sample of a CTS 503 Series pedal position sensor is being submitted with this Brief (id. ¶ 18). The modular design of the CTS 503 Series sensor enabled it to be installed on different makes and models of vehicle accelerator pedal assemblies at relevant times (id. ¶ 19). At relevant times CTS provided specifications identifying minimum requirements (e.g., minimum surface requirements for attachment points) that any person of ordinary skill in the pedal design art could follow and use to design a pedal assembly that could accommodate a CTS 503 Series sensor (id. ¶ 21)

The prior art to the '565 Patent further includes the accelerator pedal assembly installed in certain 1994 Chevrolet C/K pick-up trucks depicted in Exhibit 11 to this Brief (the "1994 GM ETC Pedal"). The 1994 GM ETC Pedal included a CTS 503 Series position sensor mounted on the pedal's support bracket, adjacent to the pedal and engaged with the pivot shaft about which the pedal rotated in operation (Willemsen Decl. ¶ 16). Depression of the 1994 GM ETC Pedal caused a pivot shaft to rotate inside the position sensor engaged with the pedal's pivot shaft, producing electronic signal outputs that vary with the pedal's operating position (id.). At all relevant times, CTS 503 Series pedal position sensors were specifically designed to be engaged with the rotating pivot shaft of an accelerator pedal assembly, and were preferably mounted adjacent to an accelerator's pivot shaft as exemplified by the 1994 GM ETC Pedal shown in Exhibit 6 to this brief (id. ¶¶ 19, 21).

The prior art to the '565 Patent further includes at least two adjustable pedal assemblies incorporating an electronic pedal position sensor, namely, Urset (described above) and U.S. Patent No. 5,819,593 filed August 17, 1995 ("Rixon '593"; see Exhibit 12). Figure 2 of Rixon '593 is reproduced below:



In the above design, an accelerator pedal (46) is pivotally mounted on the housing (24) of a sliding carrier assembly (12). A pedal position sensor, identified as "potentiometer 60", is engaged with the disclosed pedal's pivot shaft and emits varying electric signal outputs corresponding to the pedal's arm position as it pivots about the axis of the pivot shaft (50) between resting and applied positions. The pedal position sensor disclosed in Rixon is mounted in exactly the same way -- engaged with the accelerator pedal's pivot shaft -- as every other electronic pedal position sensor in the prior art of record, and also functions in exactly the same way as every other electronic pedal position sensor in the prior art of record.

B. Differences Between the Prior Art and Claim 4 of the '565 Patent

As is set forth in the computer animation file named "Asano_565_claim_4.mpeg" (see Exhibit 1 hereto; Kruger Decl. ¶¶ 5-6), and as is also set forth in the claim chart submitted as Exhibit 12 to the accompanying Declaration of Larry Willemsen, Asano discloses each and every structure recited in claim 4 of the '565 Patent, with the exception of the optional "an electronic control (28) attached to said support" and "responsive to said pivot (24) for providing a signal (32) that corresponds to pedal arm position as said pedal arm pivots about said axis (26) between rest and applied positions." According to the '565 Patent, the recited "electronic control" can be "any of various electronic throttle control mechanisms known in the art, as the one described in" Rixon '593 (see Exhibit 12 hereto, at col. 3, lines 22-25).

C. The Level of Ordinary Skill in the Art at Relevant Times.

At relevant times, a person of average or "ordinary" skill in the art of the THC Patents would have had a minimum of two (2) years of college level training in mechanical engineering and two-three years' work experience spanning at least one complete pedal design "cycle" (Willemsen Decl. ¶ 20).[13] As set forth below, however, one need not have had any training in the mechanical arts in order to see that the subject matter of claim 4 of the '565 Patent was neither novel nor patentable as of January 26, 1998.

D. Claim 4 of the '565 Patent Recites a Trivial and Obvious Variant of Asano.

With regard to the '565 Patent, the legal question raised by this motion is whether, to a person of ordinary skill in the pedal design art as of January 26, 1998, it would have been obvious to combine (a) the adjustable pedal assembly of Asano, with (b) an off-the-shelf electronic pedal position sensor, such as the CTS 503 Series pedal position sensor. Under well-settled law, "when determining the patentability of a claimed invention which

[13] Teleflex contends that a person of "ordinary" skill in the art of the THC Patents would have had "an undergraduate degree in mechanical engineering (or an equivalent amount of industry experience) who has familiarity with pedal control systems for vehicles" (Dabney Decl. ¶ 6 & Ex. 5, answer to Interrogatory No. 6). For purposes of this motion, the Court may assume, for purposes of argument, the skill level contended for by Teleflex, to the extent it differs from KSR's description.

combines two known elements, 'the question is whether there is something in the prior art as a whole to suggest the desirability, and thus the obviousness, of making the combination.'" Ecolochem, Inc. v. Southern Cal. Edison Co., 227 F.3d 1361, 1372 (Fed. Cir. 2000) (quoting In re Beattie, 974 F.2d 1309, 1311-12 (Fed. Cir. 1992) (quoting Lindemann Maschinenfabrik GmbH v. American Hoist & Derrick Co., 730 F.2d 1452, 1462 (Fed. Cir. 1984))).

The record here abounds with evidence suggesting the "desirability" of adding an electronic pedal position sensor to Asano at relevant times:

-- As of January 26, 1998, a vehicle manufacturer's choice of fuel system dictated whether a vehicle's accelerator pedal needed to be coupled to an electronic pedal position sensor, or not (Willemsen Decl. ¶ 22). Vehicles equipped with electronic throttle controls require, by their very nature, the use of electronic sensors capable of sensing an accelerator pedal's position (id. ¶ 11). To be installable in a vehicle whose engines utilized an electronic throttle control, such as certain 1994 Chevrolet C/K pick-up trucks, the Asano pedal would have had to be coupled to an electronic pedal position sensor (id.). The fundamental requirements of electronic throttle control systems, without more, provided compelling suggestion and motivation to add an electronic pedal position sensor to Asano: without such an addition, the Asano pedal could not be installed in a vehicle with an electronic throttle control system,

-- As of January 26, 1998, prior art of record expressly taught that electronic pedal position sensors coupled to electronic throttle controls had various operational advantages over mechanical cable linkages coupled to mechanical throttle controls (see Exhibits 7-9 hereto; Willemsen Decl. ¶ 9). These advantages (e.g., reduced emissions, better mileage, suit claimed an automatic car wash activated by an electronic keypad entry system. Id. at 717. The plaintiff alleged that he was the first to think of using a keypad entry system to activate a car wash (as distinct from some other type of powered system). In affirming a grant of summary judgment of invalidity under 35 U.S.C. § 103, the Federal Circuit in Ryko held that known advantages of using electronic keypad systems to control powered systems in general (e.g., garage doors) provided ample motivation for using such a system to control a car wash. The present case is considerably more compelling than Ryko; for here, the record shows not only that pedal position sensors offer exactly the same functional advantages when coupled to adjustable and non-adjustable pedal systems, but that the choice of a vehicle engine's fuel management system, when electronic, actually dictates use of electronic pedal position sensors coupled to a vehicle's accelerator pedal as described above.

In Novo Nordisk A/S v. Becton Dickinson & Co., 304 F.3d 1216 (Fed. Cir. 2002), the patent-in-suit claimed a 30 gauge needle in a pen-style insulin injection system. Id. at 1218-19. The prior art disclosed 30-gauge needles and pen-style insulin injection systems, but the plaintiff alleged that it was the first to think of offering the two features in combination. Id. In affirming a judgment holding the patent invalid under 35 U.S.C. § 103, the Federal Circuit cited evidence that the thinner needles "reduced the pain associated with self-administered insulin injections," and that "the known pain reduction provided the requisite motivation to narrow the needle" in the accused devices. Id. at 1219. Here, the known desirability, if not necessity, of utilizing electronic pedal position sensors to cooperate with an electronic throttle control in a vehicle provided "motivation" at least a compelling as that found invalidating in Novo Nordisk.

In Richardson-Vicks Inc. v. Upjohn Co., 122 F.3d 1476 (Fed. Cir. 1997), the patent-in-suit claimed an over-the-counter ("OTC") medicine that combined the analgesic, ibuprofen, and the decongestant pseudo ephedrine. Id. at 1477. Although both medicaments were in the prior art, and the prior art also included tablets combining pseudo ephedrine with aspirin and with acetaminophen, the plaintiff claimed that it was the first to think of offering pseudo ephedrine in a tablet with ibuprofen. In upholding a judgment of invalidity under 35 U.S.C. § 103, the Federal Circuit found that there was "strong motivation to combine the two ingredients into a single unit dosage" in view of publications announcing FDA intent to permit OTC sales of ibuprofen, and OTC industry anticipation that 'ibuprofen would quickly begin displacing acetaminophen and aspirin as the preferred analgesic." Id. at 1484. So too here, as of January 26, 1998, an increasing number of vehicles sold in the United States were being equipped with electronic throttle control systems because such systems offer various operational advantages over cable-actuated throttle control systems (Willemsen Decl. ¶ 9). This increased demand for pedals compatible with electronically controlled throttle systems provided clear commercial motivation for combining Asano and a CTS 503 Series sensor that was identical, in principle, to the motivation identified in Richardson-Vicks as warranting a conclusion of obviousness.

During the prosecution of the '565 Patent, the Patent Office took the position that "the use of an electronic throttle control means (28) attached to a support member (40, 26) in a pedal assembly is old and well-known in the art" (Dabney Decl. ¶ 17 & Ex. 16 at

4).[14] THC's assignor did not, and could not, dispute this contention. Instead, counsel for THC and Teleflex argued that claim 4 of the '565 Patent was patentable because a mechanical limitation recited in the claim, namely, "wherein the position of said pivot (24) remains constant while said pedal arm (14) moves in fore and aft directions with respect to said pivot" (see Exhibit 5 hereto at col. 6, lines 34-36), purportedly did not exist in the prior art.[15] In fact, as illustrated in accompanying compact disk (Kruger Decl. Ex. 1; Willemsen Decl. ¶ 36), Asano discloses an adjustable pedal assembly whose support pivots remains in a constant position during pedal arm adjustment -- the very feature that defendant's assignor argued distinguished claim 4 of the '565 Patent from the prior art.

Under a long and unbroken line of Supreme Court decisions, "[a] patent for a combination which only unites old elements with no change in their respective functions . . . obviously withdraws what already is known into the field of its monopoly and diminishes the resources available to skillful men." Sakraida v. Ag Pro, Inc., 425 U.S. 273, 281 (1976) (quoting Great Atl. & Pac. Tea Co. v. Supermarket Equip. Corp., 340 U.S. 147, 152 (1950)). The Supreme Court has thus repeatedly articulated and applied a special "test of validity of combination patents," Sakraida, 425 U.S. at 482, which test

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[14] The Patent Office notably took the same position during prosecution of both the '239 Patent (Dabney Decl. ¶ 14 & Ex. 13 at 3-5) and the '695 Patent (id. ¶ 15 & Ex. 14 at 13).

[15] With reference to what became claim 4 of the '565 Patent, defendant's assignor argued: "Independent claim 24 is a duplicate of claim 15 in the parent application except the word 'throttle' has been eliminated. . . . Accordingly, claim 24 is allowable for the same reasons claim 15 was allowed in U.S. Patent No. 6,129,241" (Dabney Decl. ¶ 17 & Ex. 16, at p. 11). THC's assignor argued that "claim 15 in the parent application" was allowable because the claim "require[d] the position of the pivot to remain constant while the pedal arm moves in fore and aft directions with respect to the pivot" (id. ¶ 16 & Ex. 15 at p. 10). That is exactly the design of Asano.

asks whether an alleged invention "simply arranges old elements with each performing the same function that it had been known to perform," or whether a claimed combination produces "a 'new or different function'". Id. (quoting Anderson's-Black Rock, Inc. v. Pavement Salvage Co., 396 U.S. 57, 60 (1969) (quoting Lincoln Engineering Co. v. Stewart-Warner Corp., 303 U.S. 545, 549 (1938))).

In the present case, Claim 4 of the '565 Patent plainly flunks "the test of validity of combination patents." Sakraida, 425 U.S. at 282 (quoting Anderson's-Black Rock, 396 U.S. at 60). The claim purports to combine a pre-existing pedal assembly, such as Asano, with a pre-existing electronic position sensor, such as the CTS 503 series sensor, with both components doing nothing more than each component was designed, individually, to do. Claim 4 of the '565 Patent is thus indistinguishable in principle from the patent claim held invalid in Anderson's-Black Rock, where the claimed invention consisted of combining an old radiant heat burner with an old black top spreader, with neither component performing any new or different function from what they had been designed to do originally. As a matter of law, such a combination is "not an invention by the obvious-nonobvious standard." 396 U.S. at 63. "The mere aggregation of a number of old parts or elements which, in the aggregation, perform or produce no new or different function or operation than that theretofore performed or produced by them, is not patentable invention." Great Atl., 340 U.S. at 151 (quoting Lincoln Engineering, 303 U.S. at 549).

In view of the uncited Asano reference, the subject matter of claim 4 of the '565 Patent consists of nothing more than following the instructions associated with a CTS 503 Series position sensor and using such a sensor for its intended and designed purpose on a pre-existing adjustable pedal assembly design (Willemsen Decl. ¶¶ 17-21 & Exs. 8-10). The claim is clearly invalid under 35 U.S.C. § 103.

E. Secondary Considerations.

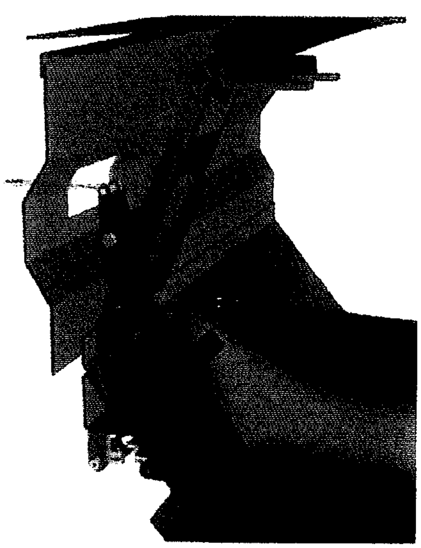
KSR is unaware of any secondary considerations as could support a legal conclusion of non-obviousness with respect to the subject matter of claim 4 of the '565 Patent (Willemsen Decl. ¶¶ 42-44). In response to interrogatories directed to this topic, Teleflex identified no secondary considerations tending to show non-obviousness (Dabney Decl. ¶ 6 & Ex. 5, answers to Interrogatory Nos. 8, 13).

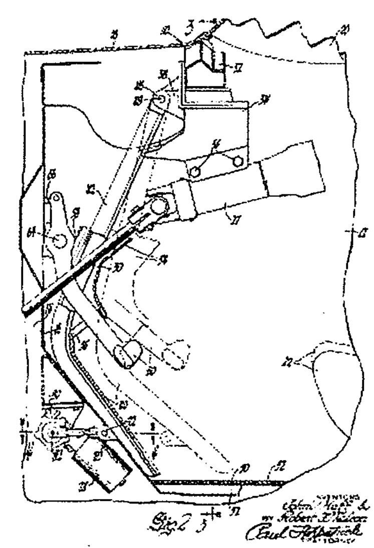
Notably, however, as the Federal Circuit held in Ryko, summary judgment may be granted under 35 U.S.C. § 103 even where a patentee (which Teleflex is not) puts forward evidence of "secondary considerations" favoring patentability. The plaintiff in Ryko submitted affidavits that the claimed invention in that case -- use of an electronic keypad to control a car wash -- had enjoyed commercial success, had met a long felt need, and that others had tried and failed to solve the problem solved by the claimed invention. 950 F.2d at 719. The Federal Circuit nevertheless upheld the District Court's award of summary judgment invalidating the plaintiff's patent under 35 U.S.C. § 103, holding that "secondary considerations did not carry sufficient weight to override a determination of obviousness based on primary considerations," and that "a court is entitled to weight all the considerations, primary and secondary, and then render its decision" on the question of obviousness. Id.

IV. THE '239 AND '695 PATENTS ARE INVALID UNDER 35 U.S.C. § 103.

For substantially the same reasons that claim 4 of the '565 Patent is invalid under 35 U.S.C. § 103, claim 1 of the '239 Patent and claims 1 and 2 of the '695 Patent are equally invalid under that statute. The desirability, and thus the obviousness, of using pedal position sensors on vehicle pedal assemblies intended for use in vehicles having electronic throttle controls, described at pp. 23-27, supra, was no less documented as of November 20, 1996 (the critical date for the '239 and '695 Patents under 35 U.S.C. § 102(b)) than it was on January 26, 1998. The level of ordinary skill in the pedal design art was also the same as of both dates (Willemsen Decl. ¶ 20).

It remains only to be demonstrated that, as with the '565 Patent, the prior art considered by the Patent Office during the prosecution of the '239 and '695 Patents did not include a key reference, Huff (see Exhibit 13 hereto; Willemsen Decl. ¶¶ 38-40 & Exs. 13-14), which disclosed the exact mechanical configuration claimed in the '239 and '695 Patents. Figure 2 of Huff is reproduced at right, below; a computer animation of the Huff adjustable pedal assembly is reproduced at left, below (Kruger Decl. ¶ 7 & Ex. 1):





In the above design, an accelerator pedal (62) is pivotally supported for rotation about a first pivot axis (64). An "adjustment element" (42) is pivotally supported on a mounting arrangement (38) for rotation about a second pivot axis (48) that is parallel to the first. A drive motor (78) is operably connected to the "adjustment element" (42) and causes it to rotate about its pivot axis, thereby causing the pedals also to rotate about that axis. The accelerator pedal (62) is connected to a rod for actuation of a throttle control. Huff was not cited to the Patent Office during prosecution of the '239 Patent or the '695 Patent.

As set forth above, in the animations named "Huff" on Exhibit 1 hereto, and in the claim charts submitted as Exhibits 13 and 14 to the accompanying Declaration of Larry Willemsen, the sole difference between Huff, on the one hand, and the claimed "inventions" of the '239 and '695 Patents, on the other, is the presence of an optional, off-the shelf pedal position sensor, mounted on an accelerator pedal pivot in exactly the same way as the pedal position sensor in the 1994 GM ETC Pedal, Urset, Rixon '593 and every other prior art pedal position sensor of record.

For all of the reasons set forth on pp. 28-35, above, claim 1 of the '239 Patent and claims 1 and 2 of the '695 Patent are invalid under 35 U.S.C. § 103. As of November 20, 1996, as the Patent Office repeatedly ruled during the prosecution of those patents,[16] there was no patentable novelty in adding on off-the-shelf pedal position sensor to a pre-existing adjustable pedal assembly, such as Huff. A position sensor could have been added to Huff without materially altering the design of Huff (Willemsen Decl. ¶ 41) and an artisan would have been naturally motivated to do this in order to render the Huff design usable in a modern vehicle whose fuel system was managed by an electronic throttle control (id. at ¶ 11). As of November 20, 1996, abundant motivations, incentives, and teachings existed to combine a modular position sensor, such as the CTS 503 Series sensor, with the Huff adjustable pedal assembly.

CONCLUSION

For all the reasons set forth above, defendant's motion for summary judgment should granted.

Dated: July 7, 2003

Respectfully submitted,

DICKINSON WRIGHT PLLC

By ______________________

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[16] See Dabney Decl. ¶ 15 & Ex. 14 at 13; ¶ 14 & Ex. 13 at 3-5.

Exhibit 1

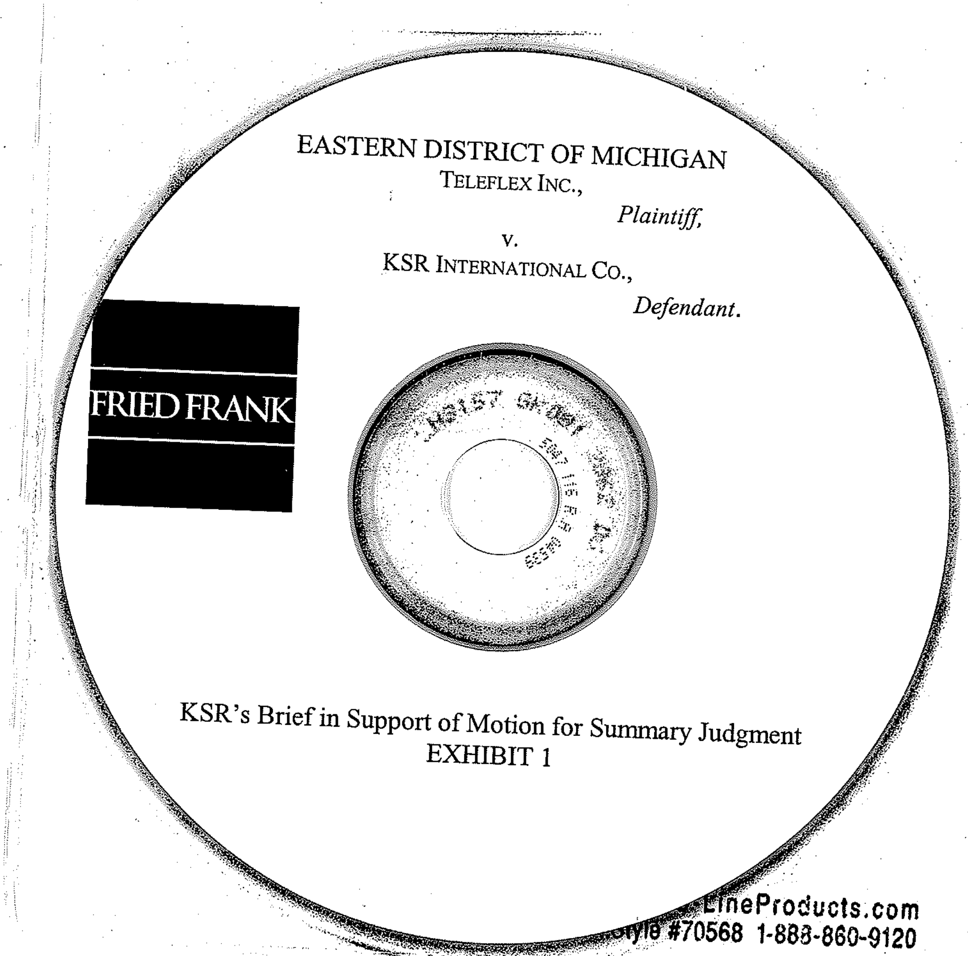

EASTERN DISTRICT OF MICHIGAN
TELEFLEX INC.,
Plaintiff,
v.
KSR INTERNATIONAL CO.,
Defendant.
FRIED FRANK
KSR's Brief in Support of Motion for Summary Judgment
EXHIBIT 1
LineProducts.com
#70568 1-888-860-9120

Exhibit 2

US006305239B1

(12) United States Patent
Johansson et al.

(10) Patent No.: US 6,305,239 B1
(45) Date of Patent: Oct. 23, 2001

(54) ADJUSTABLE PEDAL ASSEMBLY

(75) Inventors: Mattias Johansson, Nittorp; Gunnar Fornell, Dalstorp, both of (SE)

(73) Assignee: Teleflex Incorporated, Plymouth Meeting, PA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: 09/655,159

(22) Filed: Sep. 5, 2000

Related U.S. Application Data

(63) Continuation of application No. 09/174,748, filed on Oct. 19, 1998.

(30) Foreign Application Priority Data

Nov. 24, 1997 (SE) 9704288

(51) Int. Cl.[7] G05G 1/14
(52) U.S. Cl. 74/512; 180/334
(58) Field of Search 74/512, 513, 514, 74/560; 180/334

(56) References Cited

U.S. PATENT DOCUMENTS

3,319,487 5/1967 Lystad et al. 74/560
3,563,111 2/1971 Zeigler 74/512
4,470,570 9/1984 Sakurai et al. 244/235
5,056,742 10/1991 Sakurai 244/235
5,172,606 12/1992 Dzioba et al. 74/512
5,241,936 * 9/1993 Byler et al. .... 74/513 X
5,351,573 * 10/1994 Cicotte 74/512
5,385,068 * 1/1995 White et al. 74/512
5,408,899 * 4/1995 Stewart 74/513
5,416,295 * 5/1995 White et al. .... 74/560 X
5,460,061 10/1995 Redding et al. 74/512
5,768,946 * 6/1998 Fromer et al. 74/514
5,771,752 * 6/1998 Cicotte 74/512
5,996,439 * 12/1999 Elton et al. 74/512
6,019,015 * 2/2000 Elton 74/513
6,151,984 * 11/2000 Johansson et al. 74/512

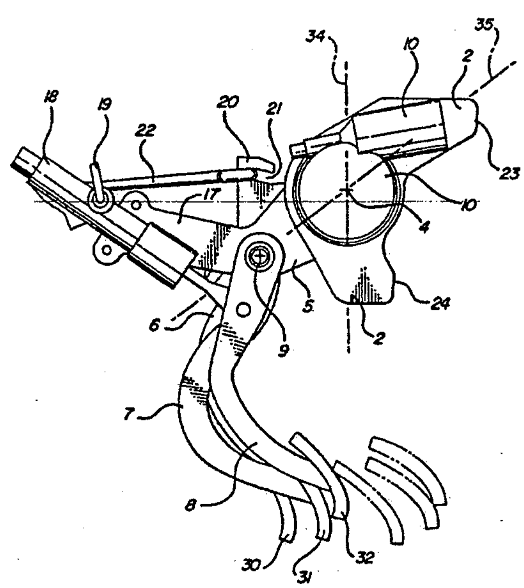
* cited by examiner

Primary Examiner—David A. Bucci
Assistant Examiner—Colby Hansen
(74) *Attorney, Agent, or Firm*—Howard & Howard

(57) ABSTRACT

An adjustable pedal assembly includes a mounting arrangement (1) for attachment to a vehicle structure (37), an accelerator pedal (6), a brake pedal (7), and a clutch pedal (8). The pedals (6, 7, 8) are pivotally supported with respect to the mounting arrangement (1) and define a first pivot axis (9). An adjustment element (5) is pivotally supported with respect to the mounting structure (1) and defines a second pivot axis (4). The adjustment element (5) selectively moves the pedals (6, 7, 8) between a plurality of operable positions. The adjustable pedal assembly is characterized by the pedals (6, 7, 8) being pivotally supported with respect to the adjustment element (5) wherein the second pivot axis (4) is generally parallel to the first pivot axis (9). A driving mechanism with an electric motor (11) and gear assembly (12) is used to rotate the adjustment element (5) about the second pivot axis (4). The pedals (6, 7, 8) are pivotally mounted within the adjustment element (5) to pivot about the first pivot axis (9), thus the first pivot axis (9) moves with respect to the second pivot axis (4) when the adjustment element (5) is rotated.

1 Claim, 3 Drawing Sheets



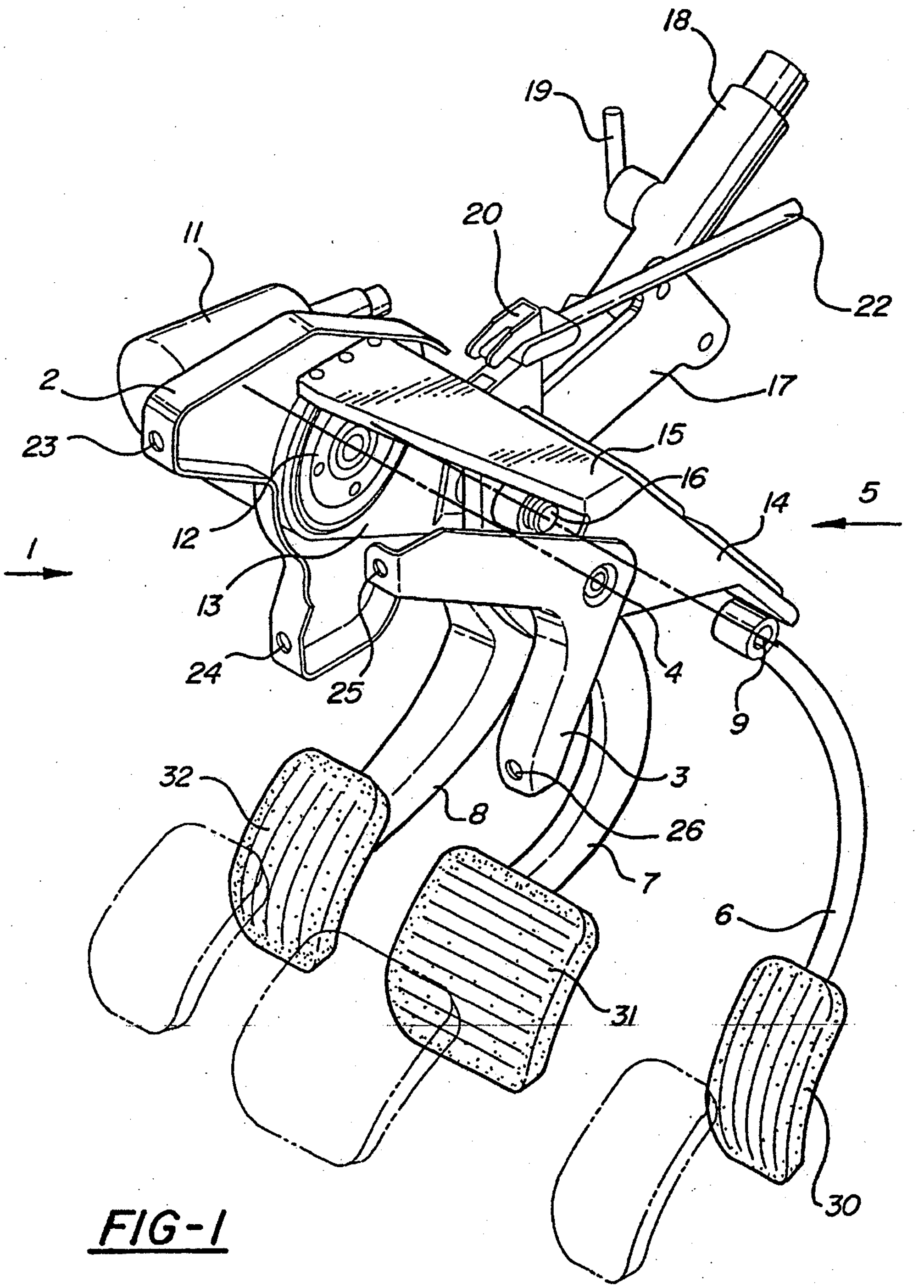


FIG-1

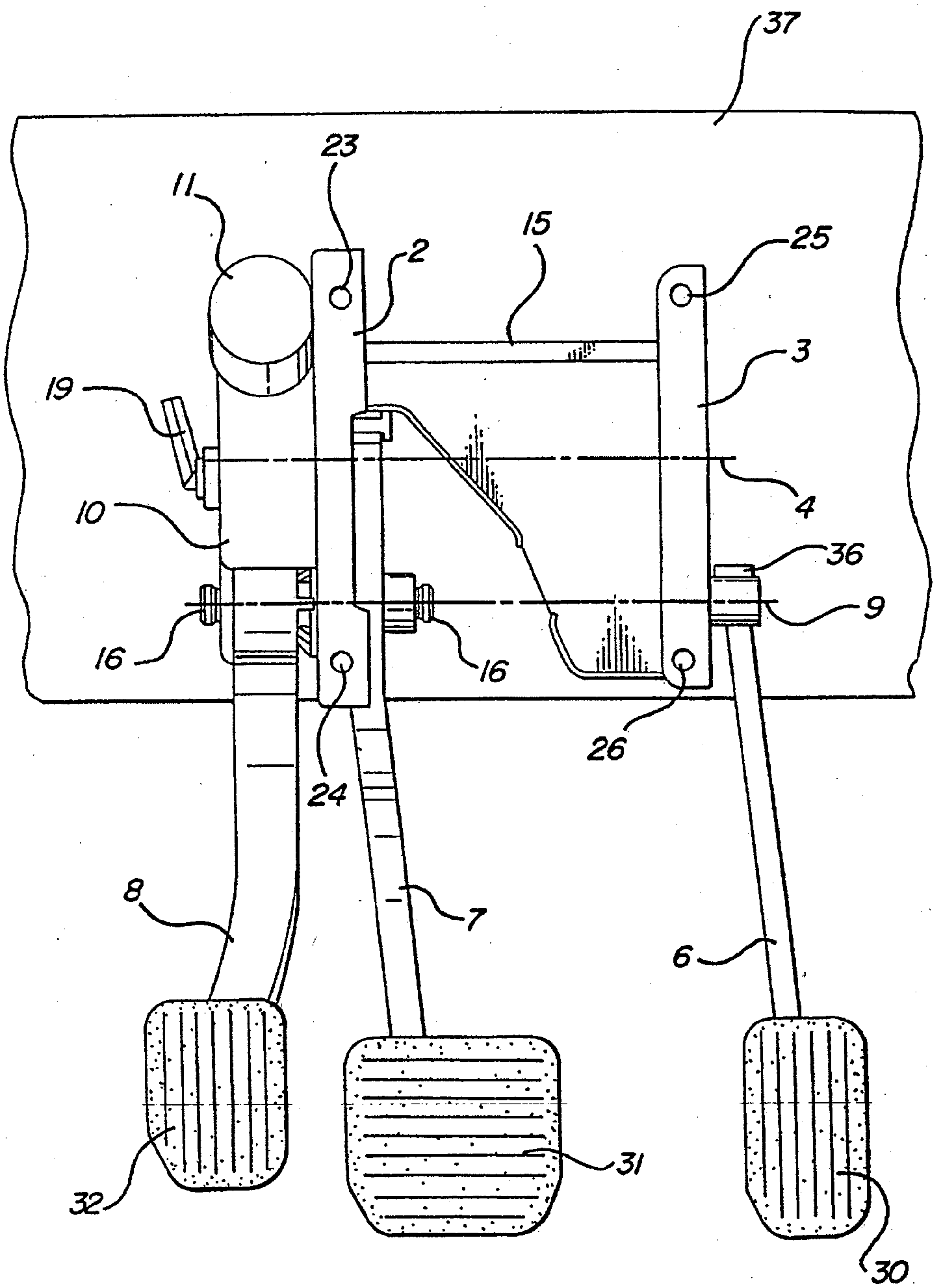


FIG-2

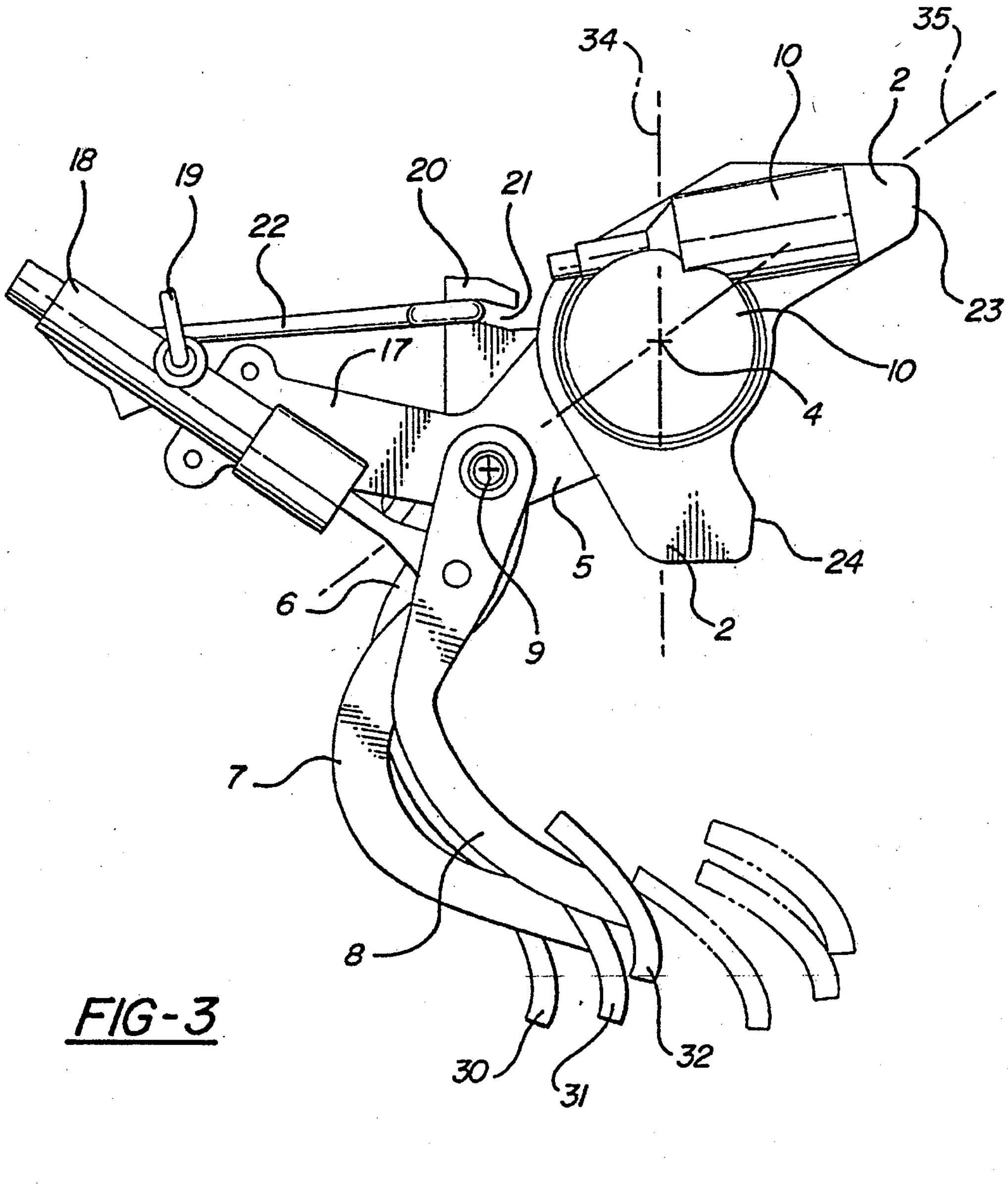


FIG-3

ADJUSTABLE PEDAL ASSEMBLY

RELATED APPLICATION

This application is a continuation of copending application Serial No. 09/174,748, filed Oct. 19, 1998.

TECHNICAL FIELD

The present invention concerns an adjustable pedal assembly for a vehicle including a mounting arrangement for attaching the pedal assembly to a vehicle structure where a plurality of pedals are arranged pivotally relative to the mounting arrangement and are arranged pivotally relative to an adjustment element, with the pedals pivoting about one axis and the adjustment element pivoting about another axis.

BACKGROUND OF THE INVENTION

Conventional automotive technology has provided an adjustable driver's seat to accommodate drivers of various heights. Typically, seat adjusters can move the seat in various directions including up and down, fore and aft, and/or tilting the seat relative to the vehicle. This allows the driver to move closer to or farther away from vehicle control pedals. Another option used in the automotive industry to accommodate drivers having different heights, is to provide the vehicle with an adjustable steering wheel. The steering wheel is typically adjustable in a longitudinal direction in relation to the vehicle and can usually be adjusted vertically.

Despite the great adjustment possibilities that exist with these two different options, it is not always possible to find an optimal driving position if the mounting of the vehicle control pedals is fixed within the vehicle. A third option is to have vehicle control pedals that are selectively adjustable to accommodate drivers having different heights. One such adjustable pedal assembly is described in U.S. Pat. No. 4,870,871. The adjustable pedal assembly in this patent involves fastening the pedals along threaded shafts, whereby the pedals can be shifted horizontally toward or away from the vehicle driver through rotation of the shafts. This construction is complicated and expensive. Additionally, if the vehicle collides with another object, some of the pedal components in this design may come into contact with the driver, which is undesirable.

For an adjustable pedal assembly to operate well in practice, it is not sufficient that the pedals merely be shiftable toward and away from the driver. In positions where the pedals are far away, i.e., at a long distance from the driver, it is necessary that pedal pads be orientated in a more vertical position than is the case when the pedals are closer to the driver. A shorter driver, who moves the driver's seat closer to the steering wheel and higher up, will maneuver the pedals more from above than is the case with a tall driver who lowers the driver's seat and moves it away from the steering wheel.

Thus, it would be desirable to provide an adjustable pedal assembly that includes horizontal adjustment, i.e., adjustment in fore and aft directions with respect to the vehicle, and which includes angular adjustment of the pedal pads so that the pads can be angled upwardly when the pedals are closer to the driver. It is important that this pedal assembly include a drive arrangement for selectively adjusting pedal position that can be easily integrated in the vehicle. It is also desirable for the adjustable pedal assembly to to be designed such that if the vehicle is in a collision, the pedal components will not come into contact with the driver. Finally, the adjustable pedal assembly should be simpler in design and less expensive than prior art pedal assemblies.

SUMMARY OF THE INVENTION AND ADVANTAGES

An adjustable pedal assembly includes a mounting arrangement for attachment to a vehicle structure and at least one pedal pivotally supported with respect to the mounting structure. The pedal pivots about a first pivot axis. An adjustment element is pivotally supported with respect to the mounting structure and defines a second pivot axis. The adjustment element selectively moves the pedal between a plurality of operable positions. The assembly is characterized by the pedal being pivotally supported with respect to the adjustment element wherein the second pivot axis is generally parallel to the first pivot axis.

BRIEF DESCRIPTION OF THE DRAWINGS

Other advantages of the present invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

FIG. 1 is a perspective view of the subject adjustable pedal assembly;

FIG. 2 is a front view of the adjustable pedal assembly shown in FIG. 1; and

FIG. 3 is a side view of the adjustable pedal assembly shown in FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the Figures, wherein like numerals indicate like or corresponding parts throughout the several views, an adjustable pedal assembly is shown in FIG. 1. The invention will be described below using directional and positional indications. These indications concern the conditions that prevail when the object of the invention is mounted in a vehicle. Thus, indications such as "left," "right," "forward (fore direction)," "rearward (aft direction)," etc. in the application concern corresponding indications as normally used in connection with a vehicle and should not be considered limiting.

In FIG. 1, reference number **1** generally concerns a mounting arrangement by which the adjustable pedal assembly is mounted to a vehicle structure **37**. The mounting arrangement **1** is designed and situated to provide a securing of the pedal assembly in a special supporting bar that is separate from a vehicle cowl so that the pedal assembly is not affected by such movements that the cowl might make during a collision. The mounting arrangement **1** which thus will be designated as stationary relative to the vehicle, is comprised of a first fastening element **2** and a second fastening element **3** with fastening points **23** and **24** as well as **25** and **26**, respectively. The two (2) fastening elements **2** and **3** have supports that define a pivot axis **4**. Any type of fasteners known in the art can be used to fasten the fastening elements **2**, **3** to the vehicle structure **37** at fastening points **23**, **24**, **25**, **26**.

The object of the invention also includes an adjustment element that is generally designated by **5**. The adjustment element **5** is connected to the mounting arrangement **1** and is pivotal relative to the mounting arrangement about the pivot axis **4**.

The adjustment element **5** serves to fasten and support a plurality of pedals **6**, **7**, **8** which are supported by the mounting arrangement **1**. Each of the pedals **6**, **7**, **8** is connected to an actuator that is used to control a vehicle system. This will be discussed in greater detail below.

Preferably, pedal 8 is a clutch pedal used to activate a clutch mechanism for shifting gears within a vehicle. Pedal 7 is preferably a brake pedal used to activate a vehicle braking system and pedal 6 is preferably an accelerator pedal used to activate an engine throttle. While three (3) pedals 6, 7, 8 are shown, it should be understood that the adjustable pedal assembly could include more or less pedals. Each of the pedals 6, 7, 8 extends downwardly from the adjustment element 5 and terminates at a pedal pad 30, 31, 32, respectively. The pedal pads 30, 31, 32 are attached to free ends of the pedals 6, 7, 8 and are adapted to receive the driver's foot.

The pedals 6, 7, 8 are pivotally supported in the adjustment element 5 and are pivotal around a common pivot axis 9, which is shown in FIG. 1. The two (2) pivot axes 4 and 9 are essentially parallel to each other, and are approximately horizontal and crosswise relative to the longitudinal direction of the vehicle.

As an alternative to the common pivot axis 9 for the three (3) pedals 6, 7, 8, it is possible that each of the pedals 6, 7, 8 could be suspended around two or possibly three pivot axes separated from each other. In this embodiment also, the pivot axes are approximately parallel to each other, and are generally horizontal and orientated crosswise relative to the longitudinal direction of the vehicle.

It is evident from the view in FIG. 3, which shows the adjustable pedal assembly from the side, that the pivot axis 9 for the pedals 6, 7, 8 is located beneath and in front of the pivot axis 4 for the adjustment element 5. Because the pedals 6, 7, 8 in the unactuated state are spring-tensioned to stop positions in the clockwise direction around the pivot axis 9, it is evident that with the pivoting of the adjustment element 5 around the pivot axis 4, the adjustment element 5 and the pedals 6, 7, 8 suspended on the adjustment element 5 will move as a rigid unit.

FIG. 3 shows the pedals 6, 7, 8 with solid lines in the unactuated state and in an initial position before such a pivoting and with dashed lines in the unactuated stated after such a pivoting. In other words, the solid lines show the position of the pedals 6, 7, 8 at their furthest position from the driver before they are pivoted as a unit about pivot axis 4 and the dashed lines show the position of the pedals 6, 7, 8 after they have been pivoted as a unit about pivot axis 4 and where the pedals 6, 7, 8 are in their closest position to the driver. It is evident from FIG. 3 that as the pedals 6, 7, 8 were pivoted about pivot axis 4, the pedal pads 30, 31, 32 were shifted rearwardly in the longitudinal direction of the vehicle to a considerable extent. Additionally, as the pedals 6, 7, 8 were pivoted about pivot axis 4, the pedal pads 30, 31, 32 were angled upwardly at an angle that is as great as the angle of rotation for the adjustment element 5 around the pivot axis 4. The pedal pads 30, 31, 32 are also lifted to a higher level.

In the example shown, the longitudinal shift of the pedal pads can be up to 100 mm with a pivot angle of about 18° around the pivot axis 4 at the same time as the pedal pads 30, 31, 32 are lifted about 20 mm. A corresponding angling up of the pedal pads 30, 31, 32 is also effected. The position of the pivot axis 9 of the pedals 6, 7, 8 in the example illustrated means that in the initial position according to the drawing, an angle is formed between a vertical line 34 through the pivot axis 4 and a connecting line 35 between the pivot axis 4 and the pivot axis 9 of approximately 35°. It should be understood that the numerical quantities for the horizontal, vertical, and angular adjustments discussed above, are exemplary in nature and are not limiting.

A driving mechanism is used to selectively move the adjustment element 5 about the pivot axis 4. In the fastening element 2 of the mounting arrangement 1, shown in FIG. 2, a stator element 10 is attached to an angular gear assembly that can be selectively driven under the effect of an electric drive motor 11. The angular gear assembly has a rotor element 12, seen in FIG. 1, which rotates with respect to the stator 10, and which is supported on the fastening element 2 to drive the adjustment element 5. Thus, with the rotation of the rotor element 12, the adjustment element 5 will follow the movement and hence pivot about the pivot axis 4.

The angular gear assembly is designed as a planetary gear that is self-braking and designed to handle very large rotational torques on the order of 1000 Nm (Newton-meters) or more. Thus, no locking element is required for locking the adjustment element 5 in the selected adjustment position. The gear assembly is also extremely compact in its outer dimensions which improves packaging.

As an alternative to the angular gear, a linear adjusting device can be coupled to a connecting element 15 that extends between fastening element 2 and fastening element 3, and which is located at a distance from the pivot axis 4. Optionally the linear adjusting device can be connected to an element that is non-rotationally connected to the connecting element 15.

To summarize, the the pedals 6, 7, 8 in the adjustable pedal assembly are pivotally supported with respect to the adjustment element 5 wherein the second pivot axis 4 is generally parallel to the first pivot axis 9. The driving mechanism with the electric motor 11 and gear assembly 12 is used to selectively rotate the adjustment element 5 about the second pivot axis 4. The pedals 6, 7, 8 are pivotally mounted within the adjustment element 5 to pivot about the first pivot axis 9, thus the position of the first pivot axis 9 moves with respect to the second pivot axis 4 when the adjustment element 5 is rotated.

The adjustment element 5 has two (2) opposite fastening ears 13 and 14, one on each side of the connecting element 15. One fastening ear 13 is connected to the rotor element 12 of the angular gear assembly. The other fastening ear 14 has an articulated connection with fastening element 3 so that the adjustment element 5 becomes pivotal around the above pivot axis 4. The connecting element 15 extends horizontally between the two (2) fastening ears 13, 14.

Fastening ear 13 on the adjustment element 5 extends forwardly from the rotor element 12 and serves to support a pivot pin 16, shown in FIG. 2. The pivot pin 16 rotatably supports the clutch 8 and brake 7 pedals and extends longitudinally along pivot axis 9 such that the pedals 7, 8 rotate about pivot axis 9.

The clutch pedal 8 is connected to an actuator that controls the vehicle clutch. The actuator includes a forward-directed arm 17 that is attached to the adjustment element 5, and which serves to fasten a maneuvering device 18 in the form of a piston/cylinder unit that is to be actuated by the clutch pedal 8. The maneuvering device 18 is connected to a freewheel clutch of the vehicle via a tube that is designated by 19. The tube 19 is readily bendable and deformable such that it cannot transfer any movements to the pedal assembly or components of the pedal assembly in the case of a vehicle collision. Thus, when the tube 19 experiences a load level that exceeds a predetermined limit, such as when the vehicle collides with another object, the tube 19 will bend and will prevent the clutch pedal 8 from contacting the driver.

The accelerator pedal 6 is connected to an actuator that controls the vehicle engine throttle. The accelerator pedal 6 is preferably connected to an electric control potentiometer 36, shown schematically in FIG. 2. The potentiometer 36 is fastened in the adjustment element 5 and which emits an electric signal that is dependent on the position of the accelerator pedal 6 around the pivot axis 9. The potentiometer 36 is connected to the engine of the vehicle via electric lines. While an electronic throttle control configuration is preferred, the subject adjustable pedal assembly could be used in standard push-pull cable operated configurations.

The brake pedal 7 is connected to an actuator that controls the vehicle braking system. The brake pedal 7 has an arm 20 directed upwardly, which can be seen as an extension of the pedal arm 7 past the pivot axis 9. The upwardly directed arm 20 has a recess 21 in which a drag link 22 is fastened. The opposite (front) end of the drag link 22 is connected to a brake servo located in the vehicle. By application of the upwardly directed arm 20 the brake pedal 7 will be swung forward (away from the driver) if the drag link 22 should be shifted rearwardly (toward the driver) during a vehicle collision. This will prevent the brake pedal 7 from coming into contact with the driver during a vehicle collision.

To make the brake function independent of the pivoting of the adjustment element 5 around the pivot axis 4, the drag link 22 is located in the forward end position of the pedals 6, 7, 8 over a connection line between the pivot axis 4 and the forward fastening of the drag link 22 in the brake servo. With a counter-clockwise pivoting of the adjustment element, as seen in FIG. 3, such that the pedals 6, 7, 8 are shifted rearwardly in the vehicle, the drag link will pass down on the underside of the connection line. Suitably, the drag link 22 is located symmetrically around the connection line in the two extreme positions of the pedals 6, 7, 8.

The maneuvering device designed as a piston/cylinder unit 18 for the clutch pedal 8 can be omitted and replaced with an arrangement of the type described above in connection with the brake pedal 7. It is also conceivable to use a hydraulic transfer with the brake pedal 7 of the type describe in connection with the clutch pedal 8. With regard to the accelerator pedal 6, a mechanical connection such as a wire or cable, can be used as an alternative to the electrical transfer described above.

The invention has been described in an illustrative manner, and it is to be understood that the terminology which has been used is intended to be in the nature of words of description rather than of limitation.

Obviously, many modifications and variations of the present invention are possible in light of the above teachings. It is, therefore, to be understood that within the scope of the appended claims, wherein reference numerals are merely for convenience and are not to be in any way limiting, the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. An adjustable pedal assembly comprising:

a mounting arrangement (1) for attachment to a vehicle structure (37);

a pedal (6, 7, or 8) pivotally supported for rotation about a first pivot axis with respect to said mounting arrangement (1);

an adjustment element (5) pivotally supported for rotation about a second pivot axis with respect to said mounting arrangement (1) for selectively moving said pedal (6, 7, or 8) between a plurality of operable positions, said second pivot axis (4) being generally parallel to said first pivot axis (9); and

an electrical generator (36) mounted adjacent to said pedal (6) for emitting an electric signal that varies with the position of said pedal (6) around said first pivot axis (9) and independently of movement of said pedal (6) between said plurality of operable positions about said second pivot axis.

* * * * *

Exhibit 3

US006151984A

United States Patent [19]

Johansson et al.

[11] **Patent Number: 6,151,984**

[45] **Date of Patent: Nov. 28, 2000**

[54] **ADJUSTABLE PEDAL ASSEMBLY**

[75] Inventors: **Mattias Johansson**, Nittorp; **Gunnar Fornell**, Dalstorp, both of Sweden

[73] Assignee: **Teleflex Incorporated**, Plymouth Meeting, Pa.

[21] Appl. No.: **09/174,748**

[22] Filed: **Oct. 19, 1998**

[30] **Foreign Application Priority Data**

Nov. 21, 1997 [SE] Sweden 9704288

[51] **Int. Cl.**[7] **G05G 1/14**

[52] **U.S. Cl.** **74/512; 180/334**

[58] **Field of Search** 74/512; 180/334

[56] **References Cited**

U.S. PATENT DOCUMENTS

3,151,499	10/1964	Roe .	
3,319,487	5/1967	Lystad et al. .	
3,563,111	2/1971	Zeigler .	
3,691,868	9/1972	Smith .	
4,875,385	10/1989	Sitrin .	
4,989,474	2/1991	Cicotte et al. .	
5,010,782	4/1991	Asano et al. .	
5,086,663	2/1992	Asano et al. .	
5,172,606	12/1992	Dzioba et al.	74/512
5,460,061	10/1995	Redding et al. .	
5,632,184	5/1997	Callicutt et al. .	
5,685,200	11/1997	Baumann .	
5,855,143	1/1999	Ewing .	

FOREIGN PATENT DOCUMENTS

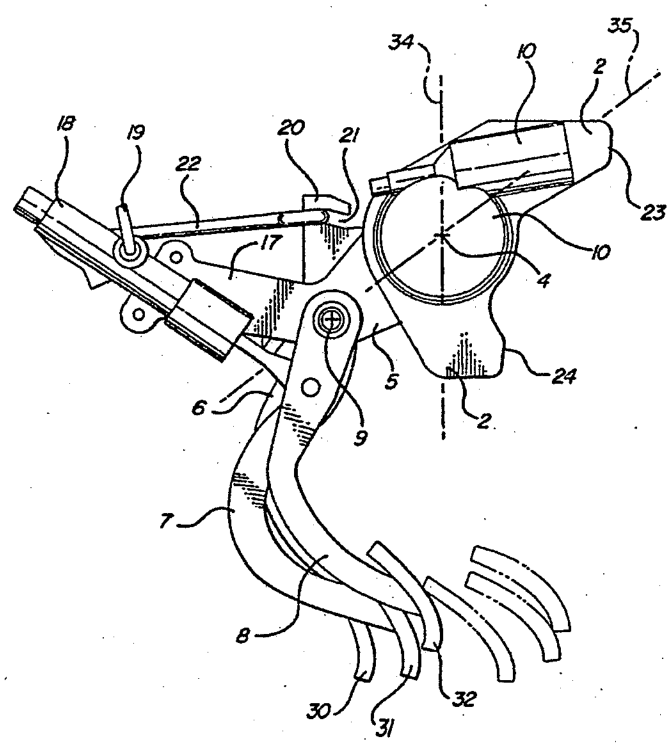
1188954	3/1965	Germany .

Primary Examiner—David A. Bucci
Assistant Examiner—Colby Hansen
Attorney, Agent, or Firm—Howard & Howard

[57] **ABSTRACT**

An adjustable pedal assembly includes a mounting arrangement (1) for attachment to a vehicle structure (37), an accelerator pedal (6), a brake pedal (7), and a clutch pedal (8). The pedals (6, 7, 8) are pivotally supported with respect to the mounting arrangement (1) and define a first pivot axis (9). An adjustment element (5) is pivotally supported with respect to the mounting structure (1) and defines a second pivot axis (4). The adjustment element (5) selectively moves the pedals (6, 7, 8) between a plurality of operable positions. The adjustable pedal assembly is characterized by the pedals (6, 7, 8) being pivotally supported with respect to the adjustment element (5) wherein the second pivot axis (4) is generally parallel to the first pivot axis (9). A driving mechanism with an electric motor (11) and gear assembly (12) is used to rotate the adjustment element (5) about the second pivot axis (4). The pedals (6, 7, 8) are pivotally mounted within the adjustment element (5) to pivot about the first pivot axis (9), thus the first pivot axis (9) moves with respect to the second pivot axis (4) when the adjustment element (5) is rotated.

5 Claims, 3 Drawing Sheets



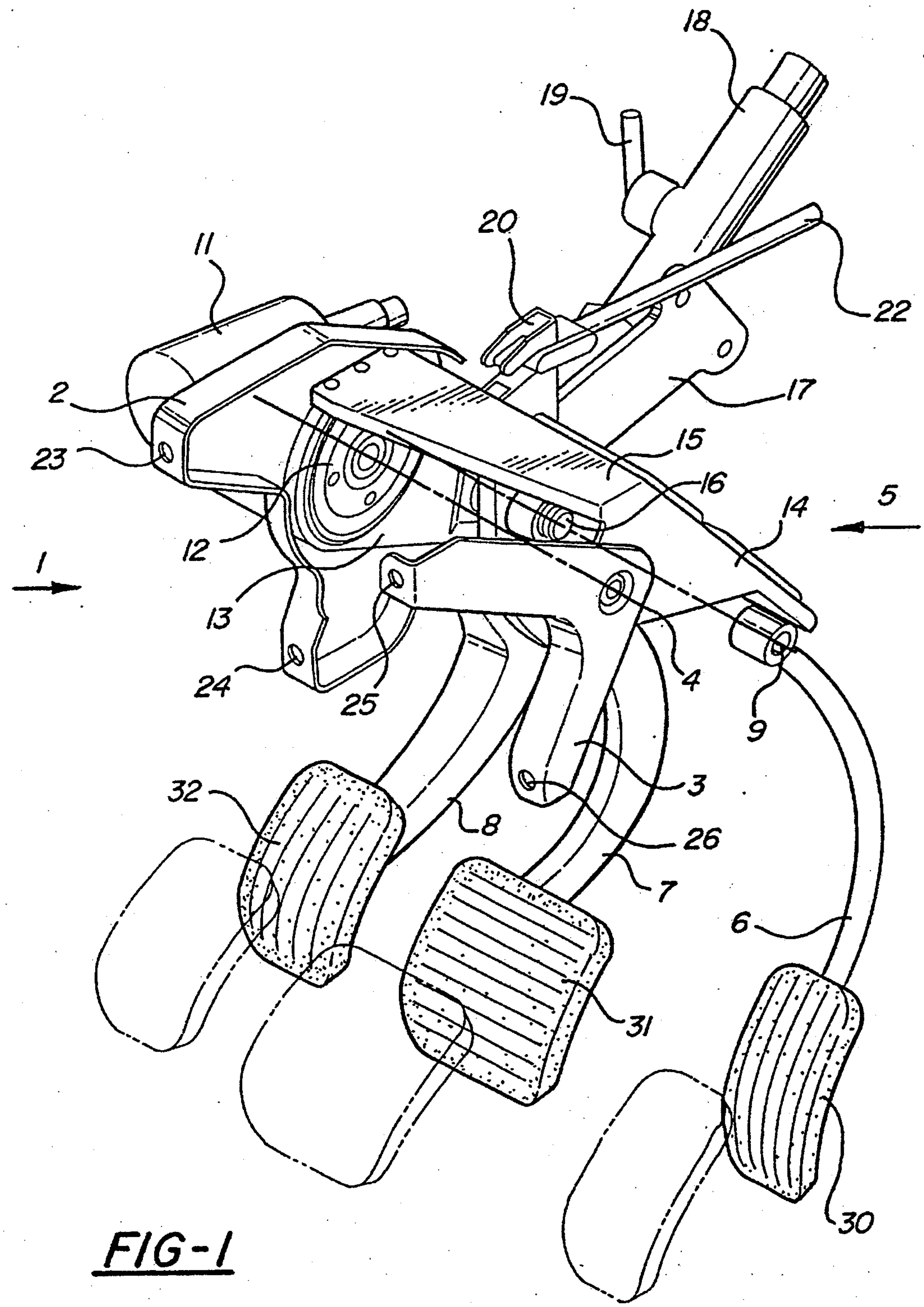


FIG-1

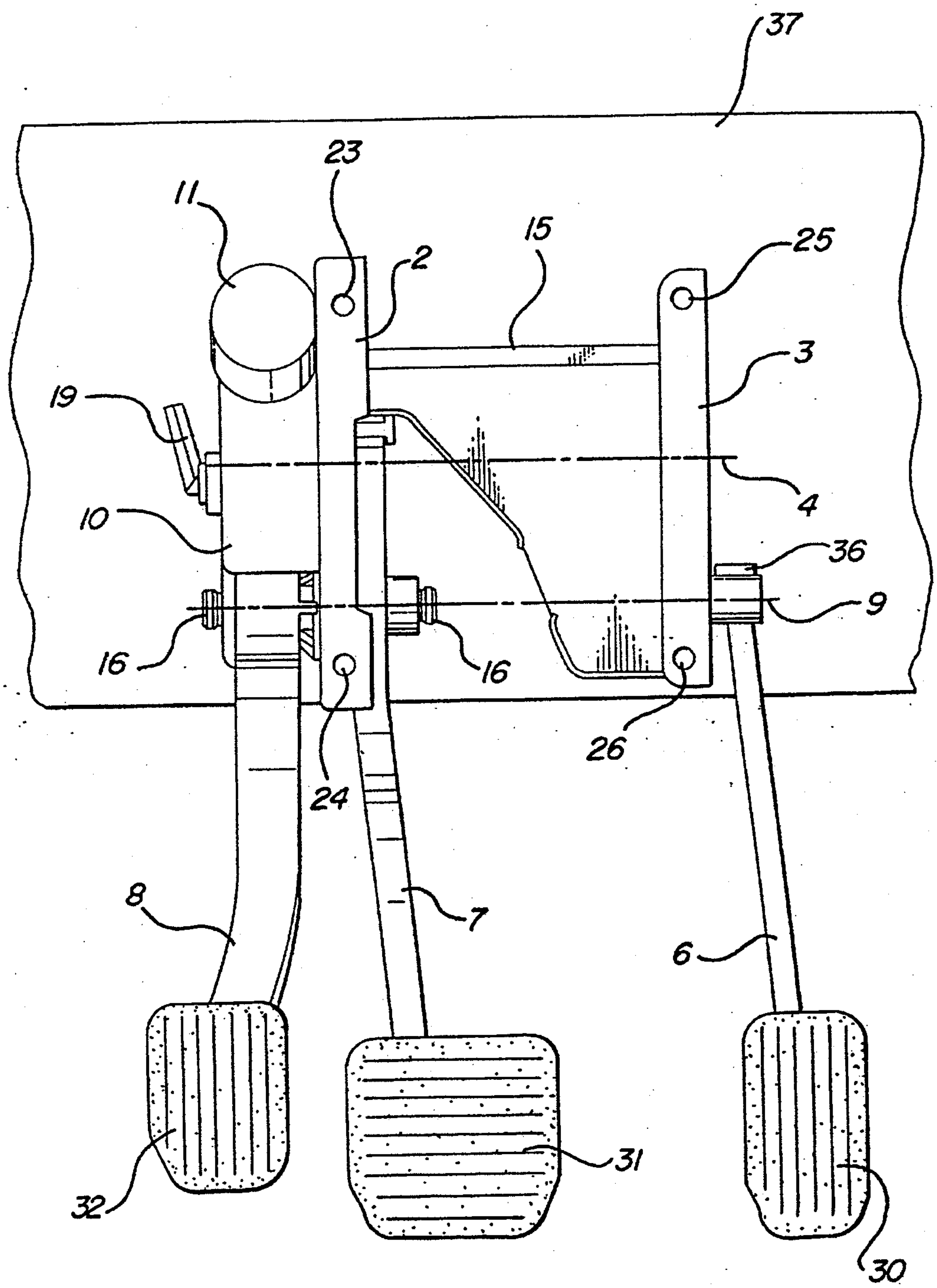


FIG-2

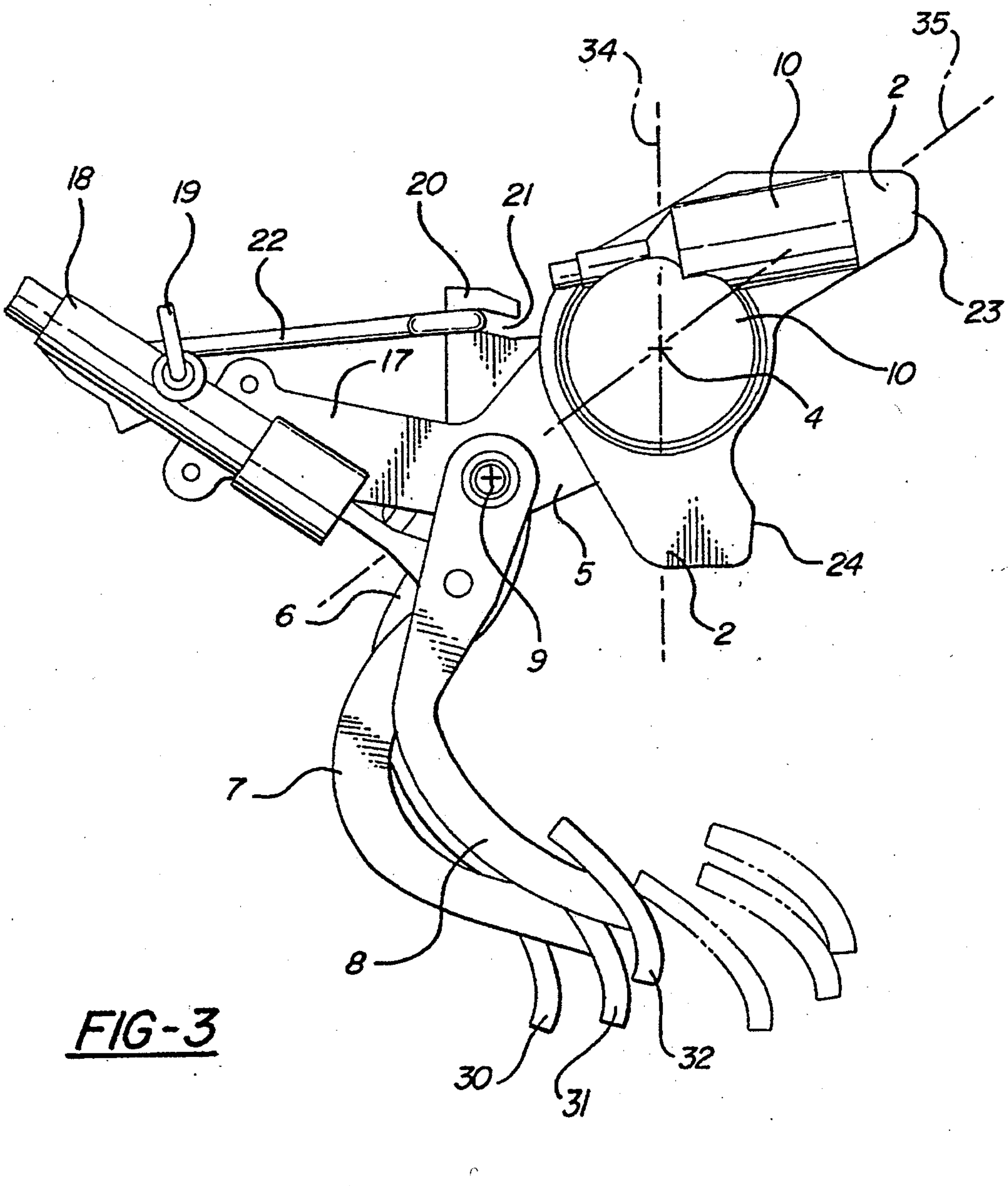


FIG-3

ADJUSTABLE PEDAL ASSEMBLY

TECHNICAL FIELD

The present invention concerns an adjustable pedal assembly for a vehicle including a mounting arrangement for attaching the pedal assembly to a vehicle structure where a plurality of pedals are arranged pivotally relative to the mounting arrangement and are arranged pivotally relative to an adjustment element, with the pedals pivoting about one axis and the adjustment element pivoting about another axis.

BACKGROUND OF THE INVENTION

Conventional automotive technology has provided an adjustable driver's seat to accommodate drivers of various heights. Typically, seat adjusters can move the seat in various directions including up and down, fore and aft, and/or tilting the seat relative to the vehicle. This allows the driver to move closer to or farther away from vehicle control pedals. Another option used in the automotive industry to accommodate drivers having different heights, is to provide the vehicle with an adjustable steering wheel. The steering wheel is typically adjustable in a longitudinal direction in relation to the vehicle and can usually be adjusted vertically.

Despite the great adjustment possibilities that exist with these two different options, it is not always possible to find an optimal driving position if the mounting of the vehicle control pedals is fixed within the vehicle. A third option is to have vehicle control pedals that are selectively adjustable to accommodate drivers having different heights. One such adjustable pedal assembly is described in U.S. Pat. No. 4,870,871. The adjustable pedal assembly in this patent involves fastening the pedals along threaded shafts, whereby the pedals can be shifted horizontally toward or away from the vehicle driver through rotation of the shafts. This construction is complicated and expensive. Additionally, if the vehicle collides with another object, some of the pedal components in this design may come into contact with the driver, which is undesirable.

For an adjustable pedal assembly to operate well in practice, it is not sufficient that the pedals merely be shiftable toward and away from the driver. In positions where the pedals are far away, i.e., at a long distance from the driver, it is necessary that pedal pads be orientated in a more vertical position than is the case when the pedals are closer to the driver. A shorter driver, who moves the driver's seat closer to the steering wheel and higher up, will maneuver the pedals more from above than is the case with a tall driver who lowers the driver's seat and moves it away from the steering wheel.

Thus, it would be desirable to provide an adjustable pedal assembly that includes horizontal adjustment, i.e., adjustment in fore and aft directions with respect to the vehicle, and which includes angular adjustment of the pedal pads so that the pads can be angled upwardly when the pedals are closer to the driver. It is important that this pedal assembly include a drive arrangement for selectively adjusting pedal position that can be easily integrated in the vehicle. It is also desirable for the adjustable pedal assembly to to be designed such that if the vehicle is in a collision, the pedal components will not come into contact with the driver. Finally, the adjustable pedal assembly should be simpler in design and less expensive than prior art pedal assemblies.

SUMMARY OF THE INVENTION AND ADVANTAGES

An adjustable pedal assembly includes a mounting arrangement for attachment to a vehicle structure and at least

one pedal pivotally supported with respect to the mounting structure. The pedal pivots about a first pivot axis. An adjustment element is pivotally supported with respect to the mounting structure and defines a second pivot axis. The adjustment element selectively moves the pedal between a plurality of operable positions. The assembly is characterized by the pedal being pivotally supported with respect to the adjustment element wherein the second pivot axis is generally parallel to the first pivot axis.

BRIEF DESCRIPTION OF THE DRAWINGS

Other advantages of the present invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

FIG. 1 is a perspective view of the subject adjustable pedal assembly;

FIG. 2 is a front view of the adjustable pedal assembly shown in FIG. 1; and

FIG. 3 is a side view of the adjustable pedal assembly shown in FIG. 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the Figures, wherein like numerals indicate like or corresponding parts throughout the several views, an adjustable pedal assembly is shown in FIG. 1. The invention will be described below using directional and positional indications. These indications concern the conditions that prevail when the object of the invention is mounted in a vehicle. Thus, indications such as "left," "right," "forward (fore direction)," "rearward (aft direction)," etc. in the application concern corresponding indications as normally used in connection with a vehicle and should not be considered limiting.

In FIG. 1, reference number **1** generally concerns, a mounting arrangement by which the adjustable pedal assembly is mounted to a vehicle structure **37**. The mounting arrangement **1** is designed and situated to provide a securing of the pedal assembly in a special supporting bar that is separate from a vehicle cowl so that the pedal assembly is not affected by such movements that the, cowl might make during a collision. The mounting arrangement **1** which thus will be designated as stationary relative to the vehicle, is comprised of a first fastening element **2** and a second fastening element **3** with fastening points **23** and **24** as well as **25** and **26**, respectively. The two (2) fastening elements **2** and **3** have supports that define a pivot axis **4**. Any type of fasteners known in the art can be used to fasten the fastening elements **2**, **3** to the vehicle structure **37** at fastening points **23**, **24**, **25**, **26**.

The object of the invention also includes an adjustment element that is generally designated by **5**. The adjustment element **5** is connected to the mounting arrangement **1** and is pivotal relative to the mounting arrangement about the pivot axis **4**.

The adjustment element **5** serves to fasten and support a plurality of pedals **6**, **7**, **8** which are supported by the mounting arrangement **1**. Each of the pedals **6**, **7**, **8** is connected to an actuator that is used to control a vehicle system. This will be discussed in greater detail below.

Preferably, pedal **8** is a clutch pedal used to activate a clutch mechanism for shifting gears within a vehicle. Pedal **7** is preferably a brake pedal used to activate a vehicle braking system and pedal 6 is preferably an accelerator pedal used to activate an engine throttle. While three (3) pedals 6, 7, 8 are shown, it should be understood that the adjustable pedal assembly could include more or less pedals. Each of the pedals 6, 7, 8 extends downwardly from the adjustment element 5 and terminates at a pedal pad 30, 31, 32, respectively. The pedal pads 30, 31, 32 are attached to free ends of the pedals 6, 7, 8 and are adapted to receive the driver's foot.

The pedals 6, 7, 8 are pivotally supported in the adjustment element 5 and are pivotal around a common pivot axis 9, which is shown in FIG. 1. The two (2) pivot axes 4 and 9 are essentially parallel to each other, and are approximately horizontal and crosswise relative to the longitudinal direction of the vehicle.

As an alternative to the common pivot axis 9 for the three (3) pedals 6, 7, 8, it is possible that each of the pedals 6, 7, 8 could be suspended around two or possibly three pivot axes separated from each other. In this embodiment also, the pivot axes are approximately parallel to each other, and are generally horizontal and orientated crosswise relative to the longitudinal direction of the vehicle.

It is evident from the view in FIG. 3, which shows the adjustable pedal assembly from the side, that the pivot axis 9 for the pedals 6, 7, 8 is located beneath and in front of the pivot axis 4 for the adjustment element 5. Because the pedals 6, 7, 8 in the unactuated state are spring-tensioned to stop positions in the clockwise direction around the pivot axis 9, it is evident that with the pivoting of the adjustment element 5 around the pivot axis 4, the adjustment element 5 and the pedals 6, 7, 8 suspended on the adjustment element 5 will move as a rigid unit.

FIG. 3 shows the pedals 6, 7, 8 with solid lines in the unactuated state and in an initial position before such a pivoting and with dashed lines in the unactuated stated after such a pivoting. In other words, the solid lines show the position of the pedals 6, 7, 8 at their furthest position from the driver before they are pivoted as a unit about pivot axis 4 and the dashed lines show the position of the pedals 6, 7, 8 after they have been pivoted as a unit about pivot axis 4 and where the pedals 6, 7, 8 are in their closest position to the driver. It is evident from FIG. 3 that as the pedals 6, 7, 8 were pivoted about pivot axis 4, the pedal pads 30, 31, 32 were shifted rearwardly in the longitudinal direction of the vehicle to a considerable extent. Additionally, as the pedals 6, 7, 8 were pivoted about pivot axis 4, the pedal pads 30, 31, 32 were angled upwardly at an angle that is as great as the angle of rotation for the adjustment element 5 around the pivot axis 4. The pedal pads 30, 31, 32 are also lifted to a higher level.

In the example shown, the longitudinal shift of the pedal pads can be up to 100 mm with a pivot angle of about 18° around the pivot axis 4 at the same time as the pedal pads 30, 31, 32 are lifted about 20 mm. A corresponding angling up of the pedals pads 30, 31, 32 is also effected. The position of the pivot axis 9 of the pedals 6, 7, 8 in the example illustrated means that in the initial position according to the drawing, an angle is formed between a vertical line 34 through the pivot axis 4 and a connecting line 35 between the pivot axis 4 and the pivot axis 9 of approximately 35°. It should be understood that the numerical quantities for the horizontal, vertical, and angular adjustments discussed above, are exemplary in nature and are not limiting.

A driving mechanism is used to selectively move the adjustment element 5 about the pivot axis 4. In the fastening element 2 of the mounting arrangement 1, shown in FIG. 2, a stator element 10 is attached to an angular gear assembly that can be selectively driven under the effect of an electric drive motor 11. The angular gear assembly has a rotor element 12, seen in FIG. 1, which rotates with respect to the stator 10, and which is supported on the fastening element 2 to drive the adjustment element 5. Thus, with the rotation of the rotor element 12, the adjustment element 5 will follow the movement and hence pivot about the pivot axis 4.

The angular gear assembly is designed as a planetary gear that is self-braking and designed to handle very large rotational torques on the order of 1000 Nm (Newton-meters) or more. Thus, no locking element is required for locking the adjustment element 5 in the selected adjustment position. The gear assembly is also extremely compact in its outer dimensions which improves packaging.

As an alternative to the angular gear, a linear adjusting device can be coupled to a connecting element 15 that extends between fastening element 2 and fastening element 3, and which is located at a distance from the pivot axis 4. Optionally the linear adjusting device can be connected to an element that is non-rotationally connected to the connecting element 15.

To summarize, the the pedals 6, 7, 8 in the adjustable pedal assembly are pivotally supported with respect to the adjustment element 5 wherein the second pivot axis 4 is generally parallel to the first pivot axis 9. The driving mechanism with the electric motor 11 and gear assembly 12 is used to selectively rotate the adjustment element 5 about the second pivot axis 4. The pedals 6, 7, 8 are pivotally mounted within the adjustment element 5 to pivot about the first pivot axis 9, thus the position of the first pivot axis 9 moves with respect to the second pivot axis 4 when the adjustment element 5 is rotated.

The adjustment element 5 has two (2) opposite fastening ears 13 and 14, one on each side of the connecting element 15. One fastening ear 13 is connected to the rotor element 12 of the angular gear assembly. The other fastening ear 14 has an articulated connection with fastening element 3 so that the adjustment element 5 becomes pivotal around the above pivot axis 4. The connecting element 15 extends horizontally between the two (2) fastening ears 13, 14.

Fastening ear 13 on the adjustment element 5 extends forwardly from the rotor element 12 and serves to support a pivot pin 16, shown in FIG. 2. The pivot pin 16 rotatably supports the clutch 8 and brake 7 pedals and extends longitudinally along pivot axis 9 such that the pedals 7, 8 rotate about pivot axis 9.

The clutch pedal 8 is connected to an actuator that controls the vehicle clutch. The actuator includes a forward-directed arm 17 that is attached to the adjustment element 5, and which serves to fasten a maneuvering device 18 in the form of a piston/cylinder unit that is to be actuated by the clutch pedal 8. The maneuvering device 18 is connected to a freewheel clutch of the vehicle via a tube that is designated by 19. The tube 19 is readily bendable and deformable such that it cannot transfer any movements to the pedal assembly or components of the pedal assembly in the case of a vehicle collision. Thus, when the tube 19 experiences a load level that exceeds a predetermined limit, such as when the vehicle collides with another object, the tube 19 will bend and will prevent the clutch pedal 8 from contacting the driver.

The accelerator pedal 6 is connected to an actuator that controls the vehicle engine throttle. The accelerator pedal 6 is preferably connected to an electric control potentiometer 36, shown schematically in FIG. 2. The potentiometer 36 is fastened in the adjustment element 5 and which emits an electric signal that is dependent on the position of the accelerator pedal 6 around the pivot axis 9. The potentiometer 36 is connected to the engine of the vehicle via electric lines. While an electronic throttle control configuration is preferred, the subject adjustable pedal assembly could be used in standard push-pull cable operated configurations.

The brake pedal 7 is connected to an actuator that controls the vehicle braking system. The brake pedal 7 has an arm 20 directed upwardly, which can be seen as an extension of the pedal arm 7 past the pivot axis 9. The upwardly directed arm 20 has a recess 21 in which a drag link 22 is fastened. The opposite (front) end of the drag link 22 is connected to a brake servo located in the vehicle. By application of the upwardly directed arm 20 the brake pedal 7 will be swung forward (away from the driver) if the drag link 22 should be shifted rearwardly (toward the driver) during a vehicle collision. This will prevent the brake pedal 7 from coming into contact with the driver during a vehicle collision.

To make the brake function independent of the pivoting of the adjustment element 5 around the pivot axis 4, the drag link 22 is located in the forward end position of the pedals 6, 7, 8 over a connection line between the pivot axis 4 and the forward fastening of the drag link 22 in the brake servo. With a counter-clockwise pivoting of the adjustment element, as seen in FIG. 3, such that the pedals 6, 7, 8 are shifted rearwardly in the vehicle, the drag link will pass down on the underside of the connection line. Suitably, the drag link 22 is located symmetrically around the connection line in the two extreme positions of the pedals 6, 7, 8.

The maneuvering device designed as a piston/cylinder unit 18 for the clutch pedal 8 can be omitted and replaced with an arrangement of the type described above in connection with the brake pedal 7. It is also conceivable to use a hydraulic transfer with the brake pedal 7 of the type describe in connection with the clutch pedal 8. With regard to the accelerator pedal 6, a mechanical connection such as a wire or cable, can be used as an alternative to the electrical transfer described above.

The invention has been described in an illustrative manner, and it is to be understood that the terminology which has been used is intended to be in the nature of words of description rather than of limitation.

Obviously, many modifications and variations of the present invention are possible in light of the above teachings. It is, therefore, to be understood that within the scope of the appended claims, wherein reference numerals are merely for convenience and are not to be in any way limiting, the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. An adjustable pedal assembly comprising:

a mounting arrangement (1) attachable to a vehicle structure (37);

at least one pedal (6, 7, or 8) pivotally supported with respect to said mounting arrangement (1) and defining a first pivot axis (9); and

an adjustment element (5) pivotally supported with respect to said mounting arrangement (1) and defining a second pivot axis (4), said adjustment element (5) for selectively moving said pedal (6, 7, or 8) between a plurality of operable positions, said pedal (6, 7, or 8) being pivotally supported with respect to said adjustment element (5) wherein said second pivot axis (4) is generally parallel to said first pivot axis (9); and

said assembly characterized by said adjustment element (5) including a connector (15) extending between a first ear (13) and a second ear (14), said first (13) and second (14) ears having pivotal connections with respect to said mounting arrangement (1) such that said connector (15) can pivot about said second pivot axis (4).

2. An assembly as set forth in claim 1 wherein said pivotal connection for said first ear (13) is a connection to a drive mechanism and said pivotal connection for said second ear (14) is an articulated connection to a fixed mounting element (3).

3. An adjustable pedal assembly comprising;

a mount (1) attachable to a vehicle structure (37);

an adjustment element (5) pivotally supported by said mount (1) for pivotal movement about an adjustment pivot axis (4) between a plurality of adjustment positions;

a pedal (7) pivotally supported by said adjustment element (5) for pivotal movement about an operational pivot axis (9) between a plurality of operable positions; and

a drag link (22) pivotally connected to said pedal (7) at a first end (20, 21) and extending to a second end for maintaining the movement of the second end independent of the pivotal movement of said adjustment element (5) between said plurality of adjustment positions.

4. An assembly as set forth in claim 3 including a drive mechanism for pivoting said adjustment element (5) between said adjustment positions.

5. An assembly as set forth in claim 4 wherein said drive mechanism comprises a motor (11) and gear assembly (12).

* * * * *

Exhibit 4

US006374695B1

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Johansson et al.

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(45) **Date of Patent:** *Apr. 23, 2002

(54) ADJUSTABLE PEDAL ASSEMBLY

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

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(30) **Foreign Application Priority Data**

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(52) U.S. Cl. 74/512; 180/334

(58) Field of Search 74/512, 513, 514, 74/560; 180/334; 188/158; 364/426

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,319,487 A		5/1967	Lystad et al.	74/560
3,563,111 A		2/1971	Zeigler	74/512
4,327,414 A	*	4/1982	Klein	364/426
4,470,570 A		9/1984	Sakurai et al.	244/235
5,056,742 A		10/1991	Sakurai	244/235
5,125,483 A	*	6/1992	Kitagawa	188/158
5,172,606 A		12/1992	Dzioba et al.	74/512
5,241,936 A	*	9/1993	Byler et al.	74/513 X
5,351,573 A	*	10/1994	Cicotte	74/512
5,385,068 A	*	1/1995	White et al.	74/512
5,408,899 A	*	4/1995	Stewart	74/513
5,416,295 A	*	5/1995	White et al.	74/560 X
5,460,061 A		10/1995	Redding et al.	74/512
5,768,946 A	*	6/1998	Fromer et al.	74/514
5,771,752 A	*	6/1998	Cicotte	74/514
5,996,438 A	*	12/1999	Elton	74/512
5,996,439 A	*	12/1999	Elton et al.	74/512
6,019,015 A	*	2/2000	Elton	74/512

* cited by examiner

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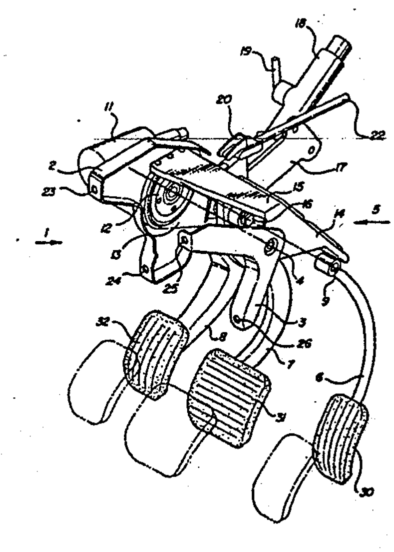
(57) **ABSTRACT**

An adjustable pedal assembly includes a mounting arrangement (1) for attachment to a vehicle structure (37), an accelerator pedal (6), a brake pedal (7), and a clutch pedal (8). The pedals (6, 7, 8) are pivotally supported with respect to the mounting arrangement (1) and define a first pivot axis (9). An adjustment element (5) is pivotally supported with respect to the mounting structure (1) and defines a second pivot axis (4). The adjustment element (5) selectively moves the pedals (6, 7, 8) between a plurality of operable positions. The adjustable pedal assembly is characterized by the pedals (6, 7, 8) being pivotally supported with respect to the adjustment element (5) wherein the second pivot axis (4) is generally parallel to the first pivot axis (9). A driving mechanism with an electric motor (11) and gear assembly (12) is used to rotate the adjustment element (5) about the second pivot axis (4). The pedals (6, 7, 8) are pivotally mounted within the adjustment element (5) to pivot about the first pivot axis (9), thus the first pivot axis (9) moves with respect to the second pivot axis (4) when the adjustment element (5) is rotated.

2 Claims, 3 Drawing Sheets



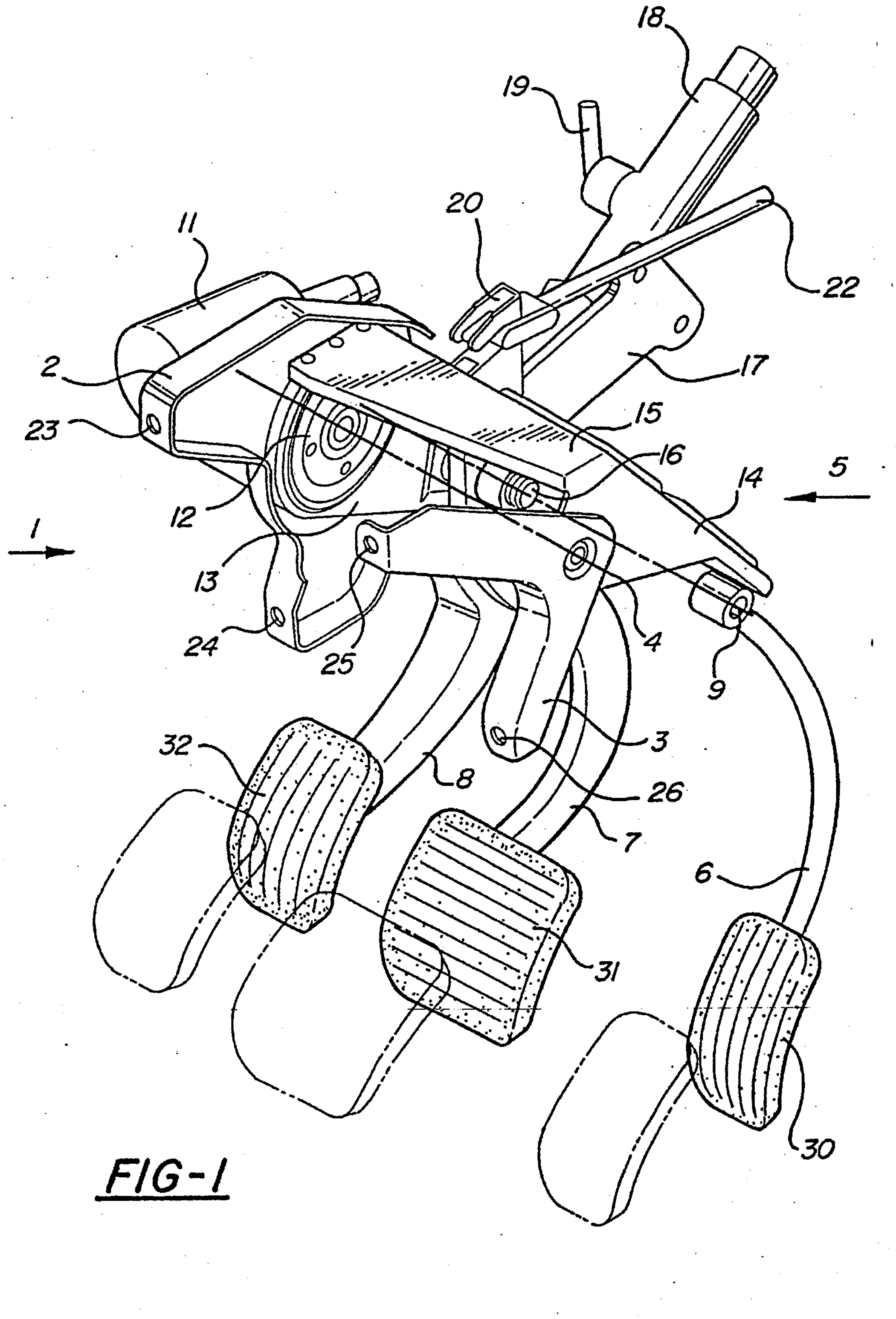


FIG-1

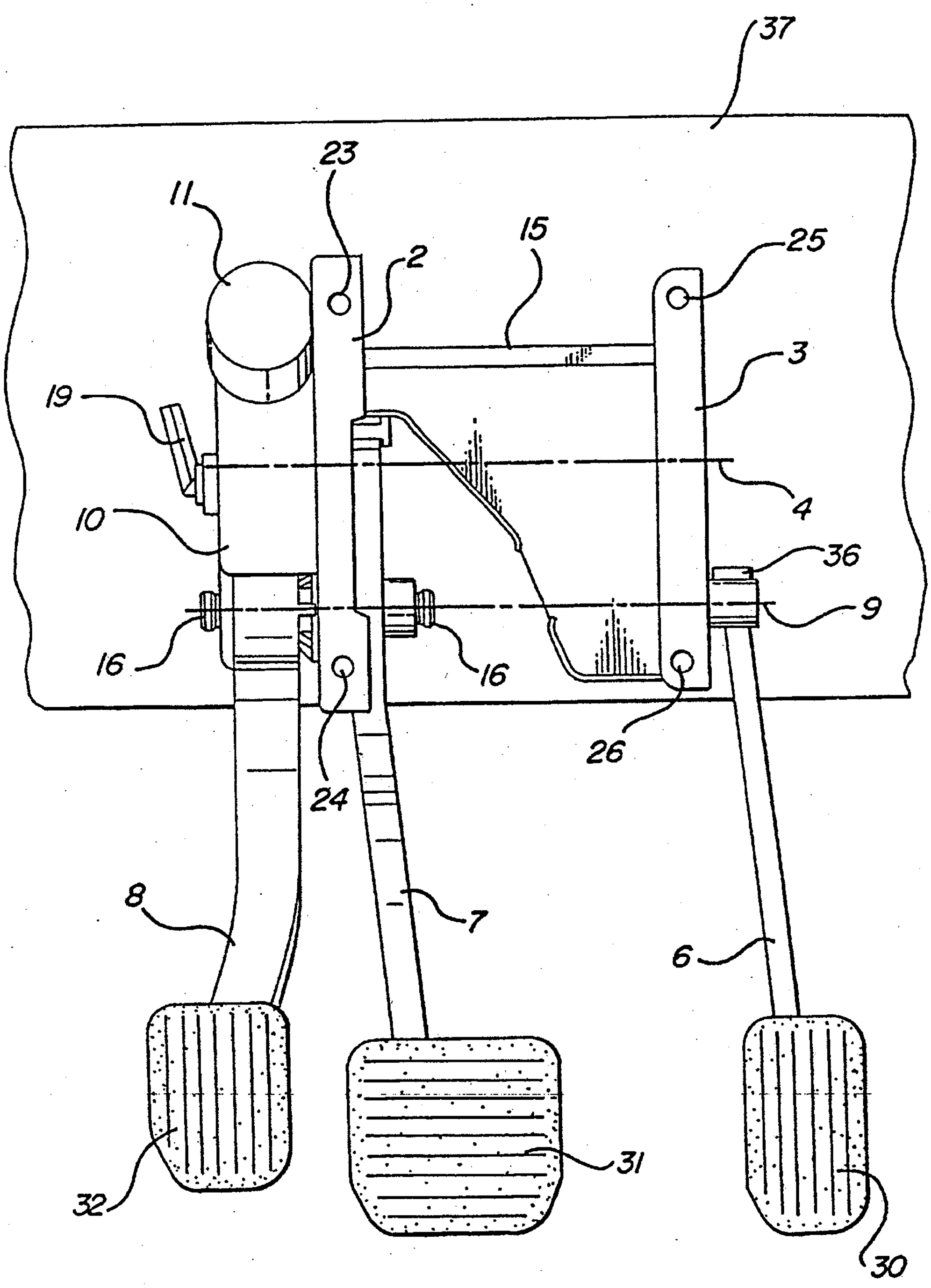


FIG-2

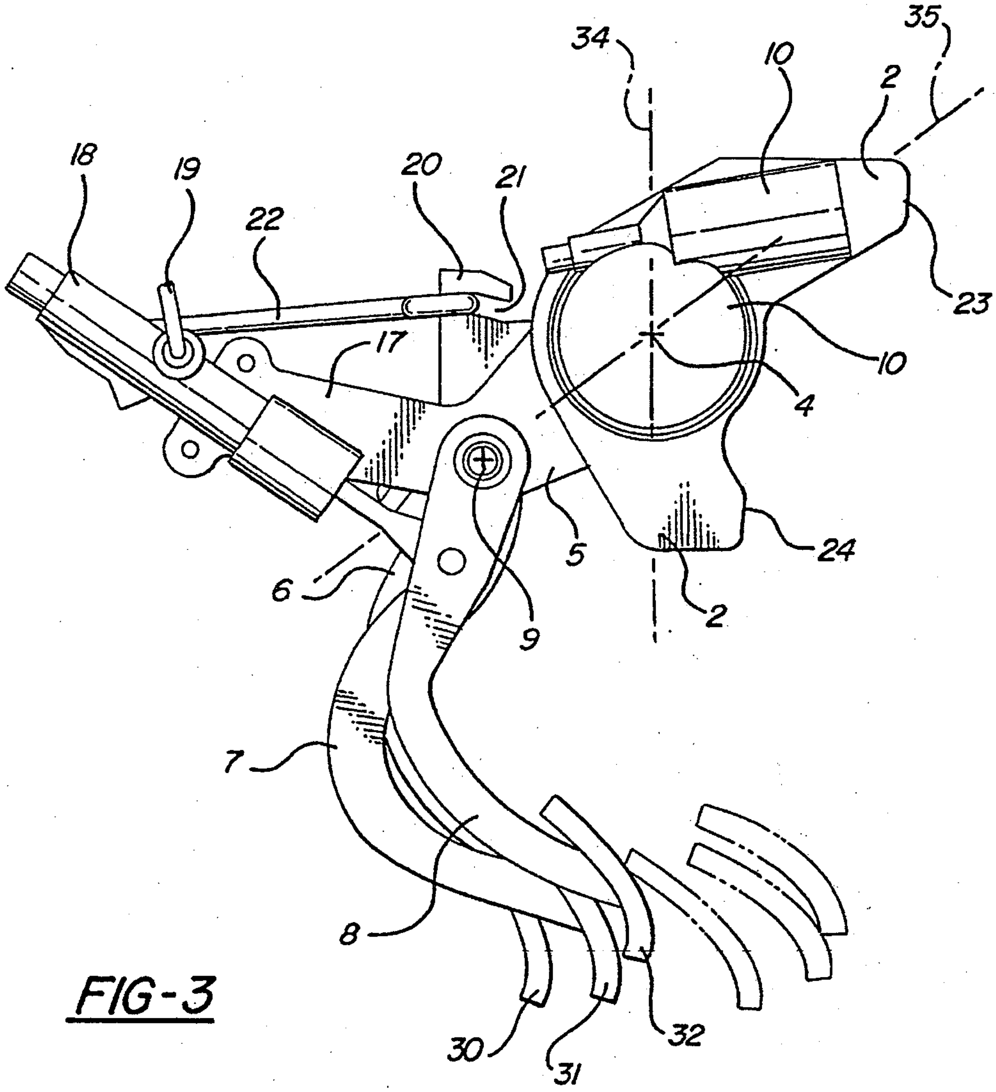


FIG-3

ADJUSTABLE PEDAL ASSEMBLY

RELATED APPLICATION

This application is a continuation of copending application Serial No. 09/174,748, filed Oct. 19, 1998.

TECHNICAL FIELD

The present invention concerns an adjustable pedal assembly for a vehicle including a mounting arrangement for attaching the pedal assembly to a vehicle structure where a plurality of pedals are arranged pivotally relative to the mounting arrangement and are arranged pivotally relative to an adjustment element, with the pedals pivoting about one axis and the adjustment element pivoting about another axis.

BACKGROUND OF THE INVENTION

Conventional automotive technology has provided an adjustable driver's seat to accommodate drivers of various heights. Typically, seat adjusters can move the seat in various directions including up and down, fore and aft, and/or tilting the seat relative to the vehicle. This allows the driver to move closer to or farther away from vehicle control pedals. Another option used in the automotive industry to accommodate drivers having different heights, is to provide the vehicle with an adjustable steering wheel. The steering wheel is typically adjustable in a longitudinal direction in relation to the vehicle and can usually be adjusted vertically.

Despite the great adjustment possibilities that exist with these two different options, it is not always possible to find an optimal driving position if the mounting of the vehicle control pedals is fixed within the vehicle. A third option is to have vehicle control pedals that are selectively adjustable to accommodate drivers having different heights. One such adjustable pedal assembly is described in U.S. Pat. No. 4,870,871. The adjustable pedal assembly in this patent involves fastening the pedals along threaded shafts, whereby the pedals can be shifted horizontally toward or away from the vehicle driver through rotation of the shafts. This construction is complicated and expensive. Additionally, if the vehicle collides with another object, some of the pedal components in this design may come into contact with the driver, which is undesirable.

For an adjustable pedal assembly to operate well in practice, it is not sufficient that the pedals merely be shiftable toward and away from the driver. In positions where the pedals are far away, i.e., at a long distance from the driver, it is necessary that pedal pads be orientated in a more vertical position than is the case when the pedals are closer to the driver. A shorter driver, who moves the driver's seat closer to the steering wheel and higher up, will maneuver the pedals more from above than is the case with a tall driver who lowers the driver's seat and moves it away from the steering wheel.

Thus, it would be desirable to provide an adjustable pedal assembly that includes horizontal adjustment, i.e., adjustment in fore and aft directions with respect to the vehicle, and which includes angular adjustment of the pedal pads so that the pads can be angled upwardly when the pedals are closer to the driver. It is important that this pedal assembly include a drive arrangement for selectively adjusting pedal position that can be easily integrated in the vehicle. It is also desirable for the adjustable pedal assembly to to be designed such that if the vehicle is in a collision, the pedal components will not come into contact with the driver. Finally, the adjustable pedal assembly should be simpler in design and less expensive than prior art pedal assemblies.

SUMMARY OF THE INVENTION AND ADVANTAGES

An adjustable pedal assembly includes a mounting arrangement for attachment to a vehicle structure and at least one pedal pivotally supported with respect to the mounting structure. The pedal pivots about a first pivot axis. An adjustment element is pivotally supported with respect to the mounting structure and defines a second pivot axis. The adjustment element selectively moves the pedal between a plurality of operable positions. The assembly is characterized by the pedal being pivotally supported with respect to the adjustment element wherein the second pivot axis is generally parallel to the first pivot axis.

BRIEF DESCRIPTION OF THE DRAWINGS

Other advantages of the present invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

FIG. 1 is a perspective view of the subject adjustable pedal assembly;

FIG. 2 is a front view of the adjustable pedal assembly shown in FIG. 1; and

FIG. 3 is a side view of the adjustable pedal assembly shown in FIG. 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the Figures, wherein like numerals indicate like or corresponding parts throughout the several views, an adjustable pedal assembly is shown in FIG. 1. The invention will be described below using directional and positional indications. These indications concern the conditions that prevail when the object of the invention is mounted in a vehicle. Thus, indications such as "left," "right," "forward (fore direction)," "rearward (aft direction)," etc. in the application concern corresponding indications as normally used in connection with a vehicle and should not be considered limiting.

In FIG. 1, reference number 1 generally concerns a mounting arrangement by which the adjustable pedal assembly is mounted to a vehicle structure 37. The mounting arrangement 1 is designed and situated to provide a securing of the pedal assembly in a special supporting bar that is separate from a vehicle cowl so that the pedal assembly is not affected by such movements that the cowl might make during a collision. The mounting arrangement 1 which thus will be designated as stationary relative to the vehicle, is comprised of a first fastening element 2 and a second fastening element 3 with fastening points 23 and 24 as well as 25 and 26, respectively. The two (2) fastening elements 2 and 3 have supports that define a pivot axis 4. Any type of fasteners known in the art can be used to fasten the fastening elements 2, 3 to the vehicle structure 37 at fastening points 23, 24, 25, 26.

The object of the invention also includes an adjustment element that is generally designated by 5. The adjustment element 5 is connected to the mounting arrangement 1 and is pivotal relative to the mounting arrangement about the pivot axis 4.

The adjustment element 5 serves to fasten and support a plurality of pedals 6, 7, 8 which are supported by the mounting arrangement 1. Each of the pedals 6, 7, 8 is connected to an actuator that is used to control a vehicle system. This will be discussed in greater detail below.

Preferably, pedal 8 is a clutch pedal used to activate a clutch mechanism for shifting gears within a vehicle. Pedal 7 is preferably a brake pedal used to activate a vehicle braking system and pedal 6 is preferably an accelerator pedal used to activate an engine throttle. While three (3) pedals 6, 7, 8 are shown, it should be understood that the adjustable pedal assembly could include more or less pedals. Each of the pedals 6, 7, 8 extends downwardly from the adjustment element 5 and terminates at a pedal pad 30, 31, 32, respectively. The pedal pads 30, 31, 32 are attached to free ends of the pedals 6, 7, 8 and are adapted to receive the driver's foot.

The pedals 6, 7, 8 are pivotally supported in the adjustment element 5 and are pivotal around a common pivot axis 9, which is shown in FIG. 1. The two (2) pivot axes 4 and 9 are essentially parallel to each other, and are approximately horizontal and crosswise relative to the longitudinal direction of the vehicle.

As an alternative to the common pivot axis 9 for the three (3) pedals 6, 7, 8, it is possible that each of the pedals 6, 7, 8 could be suspended around two or possibly three pivot axes separated from each other. In this embodiment also, the pivot axes are approximately parallel to each other, and are generally horizontal and orientated crosswise relative to the longitudinal direction of the vehicle.

It is evident from the view in FIG. 3, which shows the adjustable pedal assembly from the side, that the pivot axis 9 for the pedals 6, 7, 8 is located beneath and in front of the pivot axis 4 for the adjustment element 5. Because the pedals 6, 7, 8 in the unactuated state are spring-tensioned to stop positions in the clockwise direction around the pivot axis 9, it is evident that with the pivoting of the adjustment element 5 around the pivot axis 4, the adjustment element 5 and the pedals 6, 7, 8 suspended on the adjustment element 5 will move as a rigid unit.

FIG. 3 shows the pedals 6, 7, 8 with solid lines in the unactuated state and in an initial position before such a pivoting and with dashed lines in the unactuated stated after such a pivoting. In other words, the solid lines show the position of the pedals 6, 7, 8 at their furthest position from the driver before they are pivoted as a unit about pivot axis 4 and the dashed lines show the position of the pedals 6, 7, 8 after they have been pivoted as a unit about pivot axis 4 and where the pedals 6, 7, 8 are in their closest position to the driver. It is evident from FIG. 3 that as the pedals 6, 7, 8 were pivoted about pivot axis 4, the pedal pads 30, 31, 32 were shifted rearwardly in the longitudinal direction of the vehicle to a considerable extent. Additionally, as the pedals 6, 7, 8 were pivoted about pivot axis 4, the pedal pads 30, 31, 32 were angled upwardly at an angle that is as great as the angle of rotation for the adjustment element 5 around the pivot axis 4. The pedal pads 30, 31, 32 are also lifted to a higher level.

In the example shown, the longitudinal shift of the pedal pads can be up to 100 mm with a pivot angle of about 18° around the pivot axis 4 at the same time as the pedal pads 30, 31, 32 are lifted about 20 mm. A corresponding angling up of the pedal pads 30, 31, 32 is also effected. The position of the pivot axis 9 of the pedals 6, 7, 8 in the example illustrated means that in the initial position according to the drawing, an angle is formed between a vertical line 34 through the pivot axis 4 and a connecting line 35 between the pivot axis 4 and the pivot axis 9 of approximately 35°. It should be understood that the numerical quantities for the horizontal, vertical, and angular adjustments discussed above, are exemplary in nature and are not limiting.

A driving mechanism is used to selectively move the adjustment element 5 about the pivot axis 4. In the fastening element 2 of the mounting arrangement 1, shown in FIG. 2, a stator element 10 is attached to an angular gear assembly that can be selectively driven under the effect of an electric drive motor 11. The angular gear assembly has a rotor element 12 rotates with respect to the stator 10 and which is supported on the fastening element 2 to drive the adjustment element 5, seen in FIG. 1. Thus, with the rotation of the rotor element 12, the adjustment element 5 will follow the movement and hence pivot about the pivot axis 4.

The angular gear assembly is designed as a planetary gear that is self-braking and designed to handle very large rotational torques on the order of 1000 Nm (Newton-meters) or more. Thus, no locking element is required for locking the adjustment element 5 in the selected adjustment position. The gear assembly is also extremely compact in its outer dimensions which improves packaging.

As an alternative to the angular gear, a linear adjusting device can be coupled to a connecting element 15 that extends between fastening element 2 and fastening element 3, and which is located at a distance from the pivot axis 4. Optionally the linear adjusting device can be connected to an element that is non-rotationally connected to the connecting element 15.

To summarize, the the pedals 6, 7, 8 in the adjustable pedal assembly are pivotally supported with respect to the adjustment element 5 wherein the second pivot axis 4 is generally parallel to the first pivot axis 9. The driving mechanism with the electric motor 11 and gear assembly 12 is used to selectively rotate the adjustment element 5 about the second pivot axis 4. The pedals 6, 7, 8 are pivotally mounted within the adjustment element 5 to pivot about the first pivot axis 9, thus the position of the first pivot axis 9 moves with respect to the second pivot axis 4 when the adjustment element 5 is rotated.

The adjustment element 5 has two (2) opposite fastening ears 13 and 14, one on each side of the connecting element 15. One fastening ear 13 is connected to the rotor element 12 of the angular gear assembly. The other fastening ear 14 has an articulated connection with fastening element 3 so that the adjustment element 5 becomes pivotal around the above pivot axis 4. The connecting element 15 extends horizontally between the two (2) fastening ears 13, 14.

Fastening ear 13 on the adjustment element 5 extends forwardly from the rotor element 12 and serves to support a pivot pin 16, shown in FIG. 2. The pivot pin 16 rotatably supports the clutch 8 and brake 7 pedals and extends longitudinally along pivot axis 9 such that the pedals 7, 8 rotate about pivot axis 9.

The clutch pedal 8 is connected to an actuator that controls the vehicle clutch. The actuator includes a forward-directed arm 17 that is attached to the adjustment element 5, and which serves to fasten a maneuvering device 18 in the form of a piston/cylinder unit that is to be actuated by the clutch pedal 8. The maneuvering device 18 is connected to a freewheel clutch of the vehicle via a tube that is designated by 19. The tube 19 is readily bendable and deformable such that it cannot transfer any movements to the pedal assembly or components of the pedal assembly in the case of a vehicle collision. Thus, when the tube 19 experiences a load level that exceeds a predetermined limit, such as when the vehicle collides with another object, the tube 19 will bend and will prevent the clutch pedal 8 from contacting the driver.

The accelerator pedal 6 is connected to an actuator that controls the vehicle engine throttle. The accelerator pedal 6 is preferably connected to an electric control potentiometer 36, shown schematically in FIG. 2. The potentiometer 36 is fastened in the adjustment element 5 and which emits an electric signal that is dependent on the position of the accelerator pedal 6 around the pivot axis 9. The potentiometer 36 is connected to the engine of the vehicle via electric lines. While an electronic throttle control configuration is preferred, the subject adjustable pedal assembly could be used in standard push-pull cable operated configurations.

The brake pedal 7 is connected to an actuator that controls the vehicle braking system. The brake pedal 7 has an arm 20 directed upwardly, which can be seen as an extension of the pedal arm 7 past the pivot axis 9. The upwardly directed arm 20 has a recess 21 in which a drag link 22 is fastened. The opposite (front) end of the drag link 22 is connected to a brake servo located in the vehicle. By application of upwardly directed arm 20 the brake pedal 7 will be swung forward (away from the driver) if the drag link 22 should be shifted rearwardly (toward the driver) during a vehicle collision. This will prevent the brake pedal 7 from coming into contact with the driver during a vehicle collision.

To make the brake function independent of the pivoting of the adjustment element 5 around the pivot axis 4, the drag link 22 is located in the forward end position of the pedals 6, 7, 8 over a connection line between the pivot axis 4 and the forward fastening of the drag link 22 in the brake servo. With a counter-clockwise pivoting of the adjustment element, as seen in FIG. 3, such that the pedals 6, 7, 8 are shifted rearwardly in the vehicle, the drag link will pass down on the underside of the connection line. Suitably, the drag link 22 is located symmetrically around the connection line in the two extreme positions of the pedals 6, 7, 8.

The maneuvering device designed as a piston/cylinder unit 18 for the clutch pedal 8 can be omitted and replaced with an arrangement of the type described above in connection with the brake pedal 7. It is also conceivable to use a hydraulic transfer with the brake pedal 7 of the type describe in connection with the clutch pedal 8. With regard to the accelerator pedal 6, a mechanical connection such as a wire or cable, can be used as an alternative to the electrical transfer described above.

The invention has been described in an illustrative manner, and it is to be understood that the terminology which has been used is intended to be in the nature of words of description rather than of limitation.

Obviously, many modifications and variations of the present invention are possible in light of the above teachings. It is, therefore, to be understood that within the scope of the appended claims, wherein reference numerals are merely for convenience and are not to be in any way limiting, the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. An adjustable pedal assembly comprising:

a mounting arrangement (1, 2, 3) for attachment to a vehicle structure (37);

at least one pedal (6, 7, or 8) having first and second ends and supported for pivotally moving about a first pivot axis (9);

an adjustment element (5) pivotally supported on said mounting arrangement (1, 2, 3) for pivotal movement about a second pivot axis (4) with respect to said mounting arrangement (1, 2, 3);

said first pivot axis (9) interconnecting said pedal (6,7,8) and said adjustment element (5);

said second pivot axis (4) being generally parallel to said first pivot axis (9),

a drive mechanism operably connected to said adjustment element (5) for selectively rotating said adjustment element (5) about said second pivot axis (4) between various adjusted positions for selectively moving said pedal (6, 7, or 8) between a plurality of operable positions; an electric output control operatively connected to said pedal and directly responsive to movement of said pedal about said first axis for electrically controlling a vehicle system in response to pivotal movement of said pedal about said first axis in any one of said adjusted positions of said adjustment element (5) about said second axis.

2. An adjustable pedal assembly comprising:

a mounting arrangement (1, 2, 3) for attachment to a vehicle structure (37);

at least one pedal (6, 7, or 8) having first and second ends and supported for pivotally moving about a first pivot axis (9);

an adjustment element (5) pivotally supported on said mounting arrangement (1,2,3) for pivotal movement about a second pivot axis (4) with respect to said mounting arrangement (1, 2, 3);

said first pivot axis (9) interconnecting said pedal (6,7, or 8) and said adjustment element (5);

said second pivot axis (4) being generally parallel to said first pivot axis (9), a drive mechanism operably connected to said adjustment element (5) for selectively rotating said adjustment element (5) and said first pivot axis (9) about said second pivot axis (4) between various adjusted positions for selectively moving said pedal (6, 7, or 8) between a plurality of operable positions; an electric signal generator reacting between said pedal and said adjustment element for electrically controlling a vehicle system in response to pivotal movement of said pedal about said first axis in any one of said adjusted positions of said adjustment element (5) about said second axis.

* * * * *

Exhibit 5

US006237565B1

(12) United States Patent
Engelgau

(10) Patent No.: US 6,237,565 B1
(45) Date of Patent: *May 29, 2001

(54) ADJUSTABLE PEDAL ASSEMBLY WITH ELECTRONIC THROTTLE CONTROL

(75) Inventor: Steven J. Engelgau, Royal Oak, MI (US)

(73) Assignee: Teleflex Incorporated, Plymouth Meeting, PA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: 09/643,422

(22) Filed: Aug. 22, 2000

Related U.S. Application Data

(63) Continuation of application No. 09/236,975, filed on Jan. 26, 1999, now Pat. No. 6,109,241.

(51) Int. Cl.[7] F02D 1/00
(52) U.S. Cl. 123/399; 74/560
(58) Field of Search 123/399; 74/560

(56) References Cited

U.S. PATENT DOCUMENTS

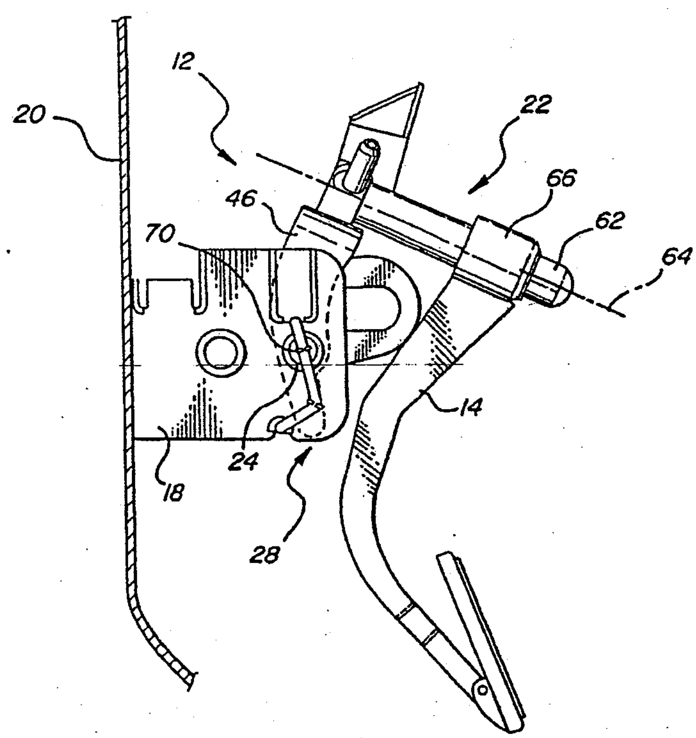
4,470,570 9/1984 Sakurai et al. 244/235
5,056,742 10/1991 Sakurai 244/235

Primary Examiner—John Kwon
(74) Attorney, Agent, or Firm—Howard & Howard

(57) ABSTRACT

A vehicle control pedal apparatus (12) includes a support (18) adapted to be mounted to a vehicle structure (20) and an adjustable pedal assembly (22) having a pedal arm (14) that is moveable in fore and aft directions with respect to the support (18). A pivot (24) pivotally supports the adjustable pedal assembly (22) with respect to the support (18) and defines a pivot axis (26). The control pedal apparatus (12) further includes an electronic throttle control (28) attached to the support (18) for controlling an engine throttle (30). The apparatus (12) is characterized by the electronic throttle control (28) being responsive to the pivot (24) for providing a signal (32) that corresponds to pedal arm position as the pedal arm (14) pivots about the pivot axis (26) between rest and applied positions, Thus, the control pedal apparatus (12) can adjust pedal arm position in fore and aft directions without having to move the electronic throttle control unit (28) along with the pedal arm (14). Additionally, the electronic throttle control (28) is responsive to the pivot (24) about which the adjustable pedal assembly (22) rotates.

4 Claims, 4 Drawing Sheets



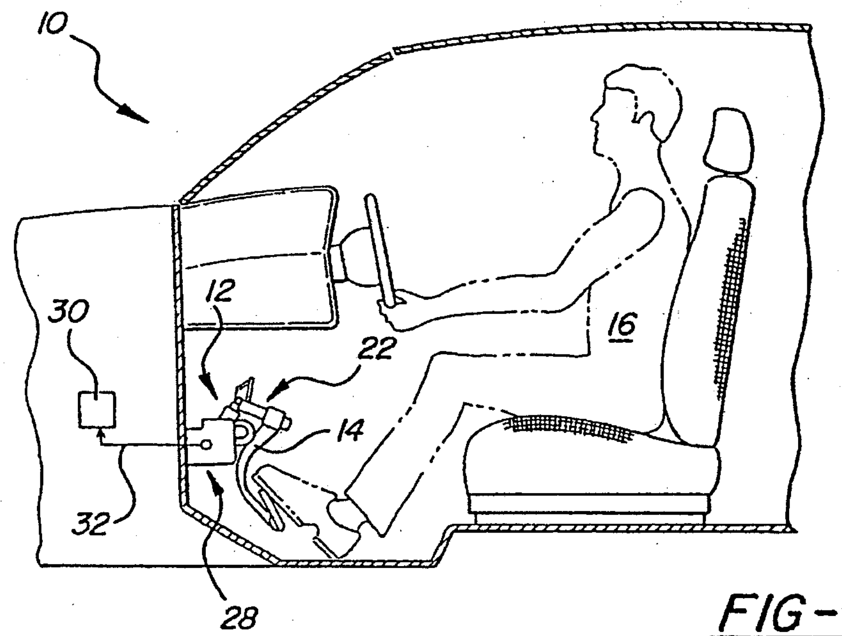


FIG-1

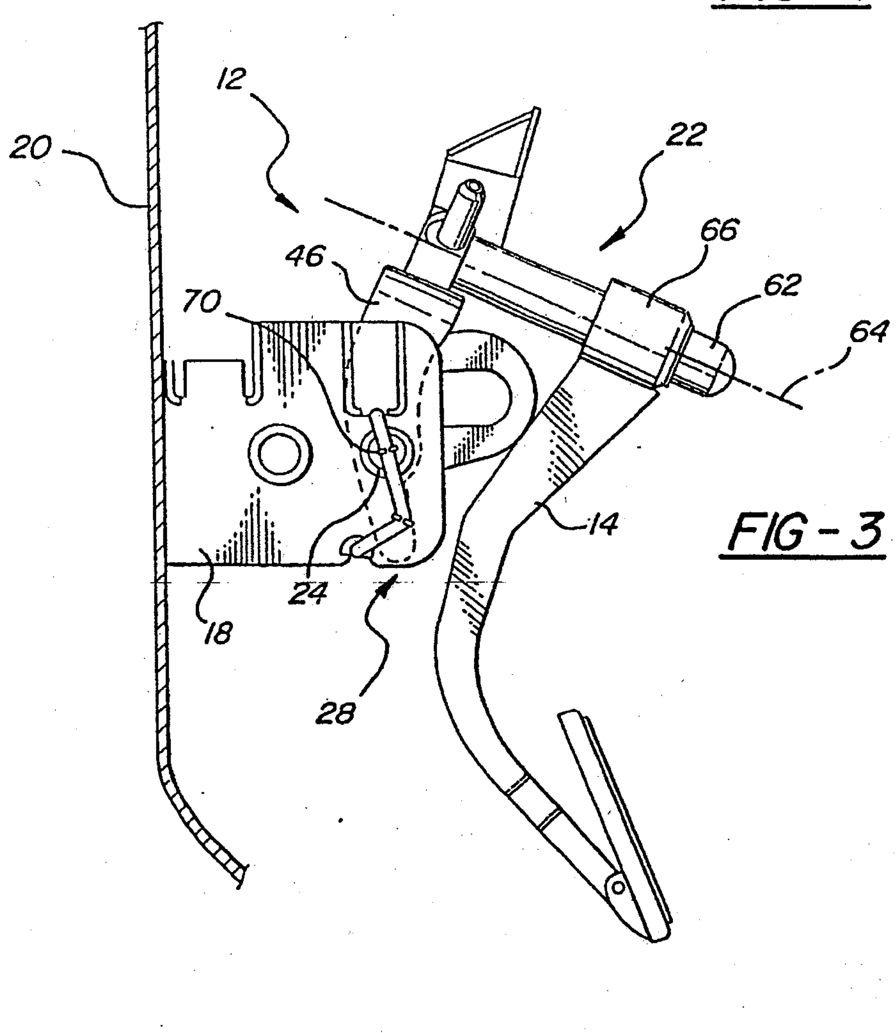
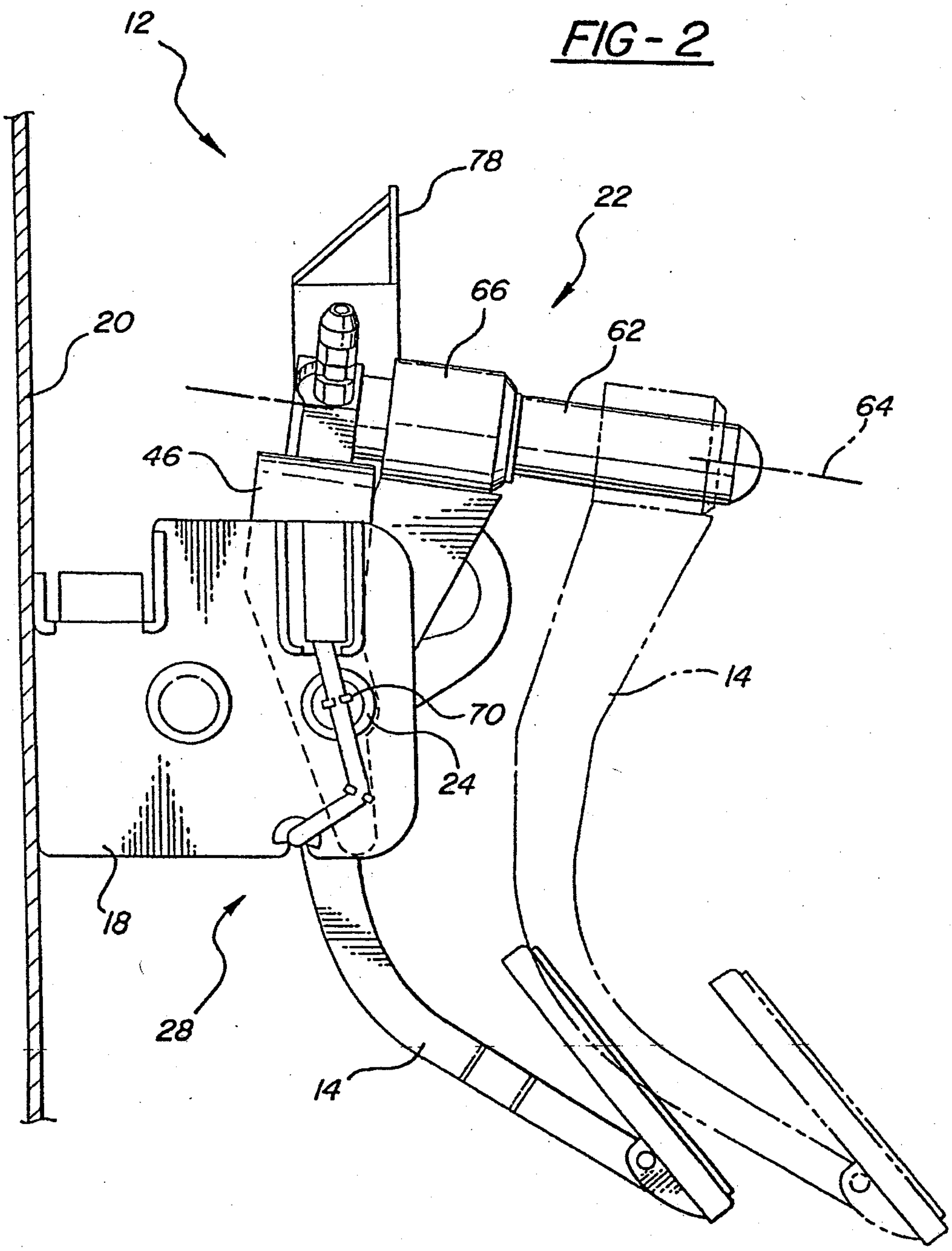


FIG-3

FIG-2



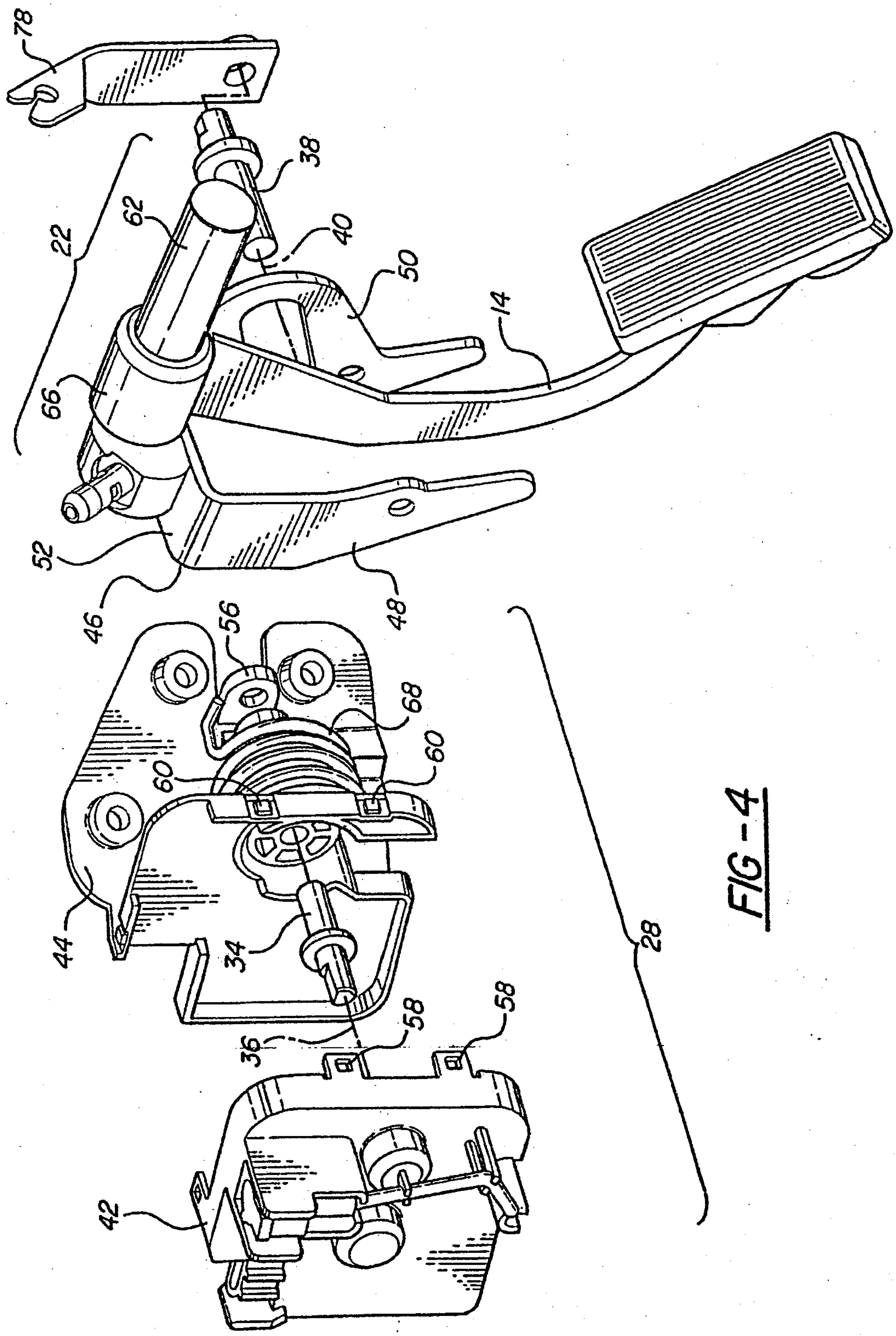


FIG-4

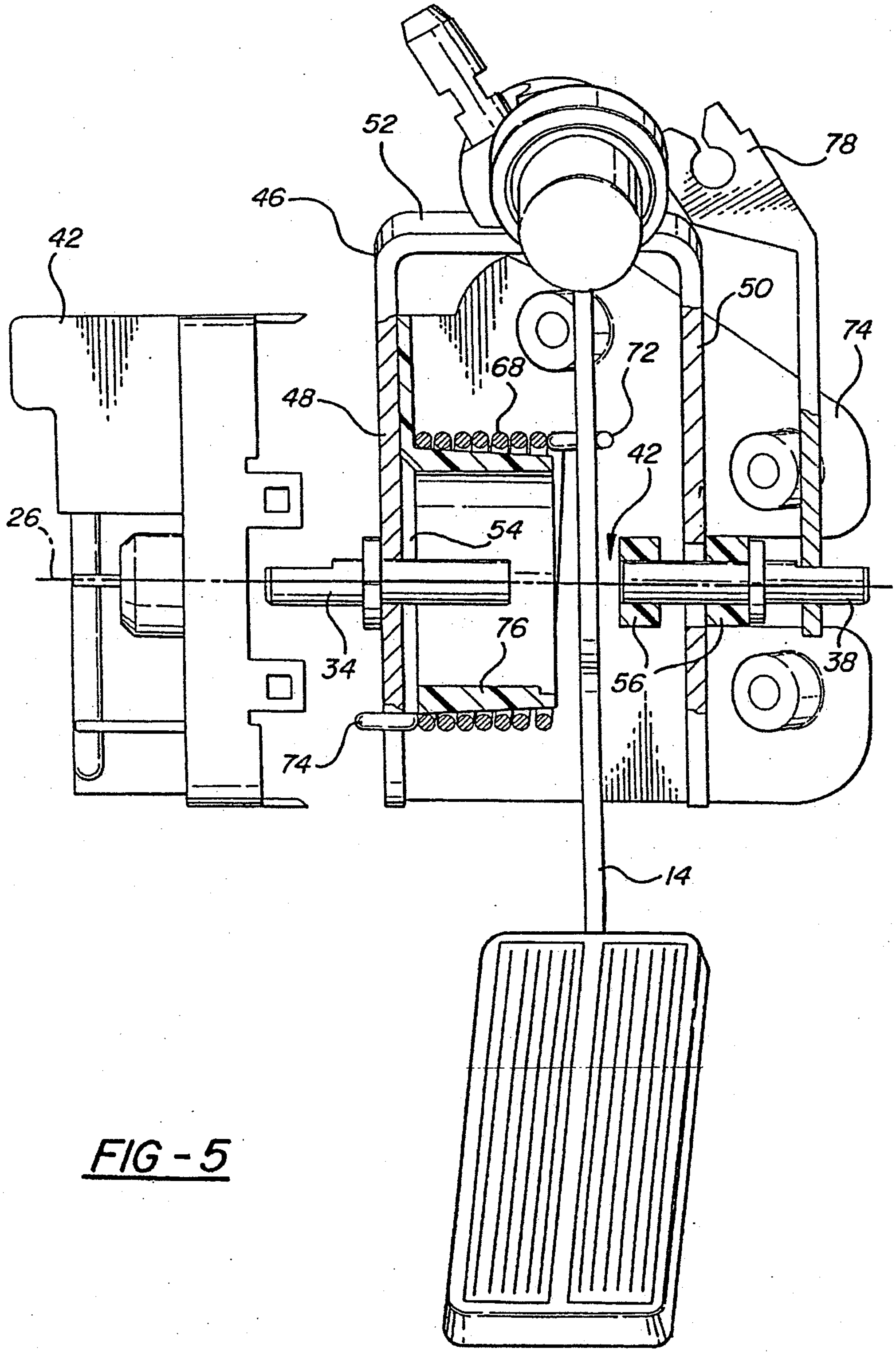


FIG - 5

ADJUSTABLE PEDAL ASSEMBLY WITH ELECTRONIC THROTTLE CONTROL

RELATED APPLICATION

This application is a continuation of application Ser. No. 09/236,975, filed Jan. 26, 1999, U.S. Pat. No. 6,109,241.

TECHNICALLY FIELD

The subject invention relates to vehicle control pedal assembly having an adjustment mechanism for moving a pedal arm in fore and aft directions and an electronic throttle control for controlling an engine throttle. Specifically, the pedal assembly includes a pivot about which the adjustment mechanism rotates when the pedal arm is actuated and which provides input to the electronic throttle control for providing a signal that corresponds to pedal arm position.

BACKGROUND OF THE INVENTION

Pedal assemblies are used in vehicles to control the movement of the vehicle. For example, a vehicle driver applies a force to an accelerator pedal to move the pedal from a rest position to an applied position. In the applied position, the accelerator pedal typically actuates an engine throttle, which controls the acceleration and speed of the vehicle. Often these pedal assemblies include an adjustment apparatus that allows the position of a pedal arm and/or a pedal pad to be moved with respect to the driver. This allows the pedal assembly to accommodate drivers of various heights. Thus, the adjustment apparatus allows the pedal assembly to be moved closer to the driver when the driver is short and allows the pedal assembly to be moved further away from the driver when the driver is tall. Examples, of adjustable pedal assemblies are shown in U.S. Pat. Nos. 5,460,061 and 5,632,183 all assigned to the assignee of the subject invention.

Additionally, adjustable pedal assemblies can include an electronic throttle control assembly for a drive-by-wire system. The electronic throttle control assembly is used to generate an electrical signal that corresponds to the position of the accelerator pedal. The electronic throttle control assembly replaces traditional mechanical linkages between the pedal arm and the engine throttle. One such adjustment apparatus used with an electronic throttle control is shown in U.S. Pat. No. 5,819,593 assigned to the assignee of the present invention.

When a vehicle control pedal assembly includes both an adjustment apparatus and an electronic throttle control, the pedal assembly can be complex with a great number of parts. These control pedal assemblies can be expensive, time consuming to assemble, and require a significant amount of packaging space.

SUMMARY OF THE INVENTION AND ADVANTAGES

A vehicle control pedal apparatus includes a support adapted to be mounted to a vehicle structure and an adjustable pedal assembly with a pedal arm that is moveable in fore and aft directions with respect to the support. A pivot pivotally supports the adjustable pedal assembly with respect to the support and defines a pivot axis. The control pedal apparatus further includes an electronic throttle control attached to the support for controlling an engine throttle. The apparatus is characterized by the electronic throttle control being responsive to the pivot for providing a signal corresponding to pedal arm position as the pedal arm pivots about the pivot axis between rest and applied positions. Accordingly, the subject invention provides a simplified vehicle control pedal assembly that is less expensive, and which uses fewer parts and is easier to package within the vehicle.

BRIEF DESCRIPTION OF THE DRAWINGS

Other advantages of the present invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

FIG. 1 is a side view of a vehicle, partially in cross-section, including the subject pedal assembly,

FIG. 2 is a side view of the subject pedal assembly showing a pedal arm in fore and aft positions;

FIG. 3 is a side view of the subject pedal assembly in a pivoted position;

FIG. 4 is an exploded view of the pedal assembly shown in FIG. 3; and

FIG. 5 is a front view, partially in cross-section , of the pedal assembly shown in FIG. 3.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the Figures, wherein like numerals indicate like or corresponding parts throughout the several views, a vehicle **10** with a control pedal apparatus **12** is shown in FIG. 1. The control pedal apparatus **12** includes a pedal arm **14** that can be adjusted in fore and aft directions with respect to the vehicle **10** by a driver **16**. This adjustment capability allows the pedal arm **14** to be positioned to accommodate drivers **16** of various heights.

The vehicle control pedal apparatus **12** includes a support **18** adapted to be mounted to a vehicle structure **20** such as a firewall or dash member, for example. The support **18** can be a bracket, housing, or other structural support member known in the art. The support **18** can be a unitary member that is attached directly to the vehicle structure **20** or the support **18** can be comprised of a plurality of support members, one of which is attached to the vehicle structure **20**.

As shown in FIGS. 2 and 3, the control pedal apparatus **12** further includes an adjustable pedal assembly **22** with a pedal arm **14** that is moveable in fore and aft directions with respect to the support **18**. In FIG. 2, the pedal arm **14** is shown in the furthest adjustment position in the fore direction in solid lines and in the furthest adjustment position in the aft direction in dashed lines. The adjustable pedal assembly **22** preferably includes an electric motor (not shown) for controlling the movement of the pedal arm **14** in the fore and aft directions, as is well known in the art. The adjustable pedal assembly **22** can be any of various adjustable pedal assemblies known in the art. For example, the adjustable pedal assembly **22** could be similar to the adjustable pedal assembly in U.S. Pat. No. 5,632,183 assigned to the assignee of the present invention and incorporated herein by reference.

A pivot **24** pivotally supports the adjustable pedal assembly **22** with respect to the vehicle structure **20** and defines a pivot axis **26** (shown in FIG. 5). The pivot **24** is preferably comprised of a first pivot member **34** defining a first pivot member axis **36** and a second pivot member **38** defining a second pivot member axis **40**. The first **36** and second **40** pivot member axes are collinear to define the pivot axis **26**.

While two pivot members 34, 38 are preferred a single pivot could be used or additional pivot members could be used to provide additional pivotal support.

The first 34 and second 38 pivot members are longitudinally spaced apart from one another to define a clearance space 42 for the pedal arm 14 as the pedal arm 14 pivots about the pivot axis 26. Thus, when the pedal arm 14 is moved from a rest position to an applied position, as shown in FIG. 3, the pedal arm 14 can move between the first 34 and second 38 pivot members without coming into contact with the pivot members 34, 38. If only a single pivot member is used, the clearance space 42 between pivot members is not needed.

The control pedal apparatus 12 also includes an electronic throttle control mechanism 28 attached to the vehicle structure 20 for controlling an engine throttle 30 shown schematically in FIG. 1. The electronic throttle control 28 is responsive to the pivot 24 and provides a signal 32 that corresponds to pedal arm position as the pedal arm 14 pivots about the pivot axis 26 between rest and applied positions. Thus, the signal 32 will vary as the pedal arm 14 moves from the rest position to the applied position. The electronic throttle control mechanism 28 can be any of various electronic throttle control mechanisms known in the art, as the one described in U.S. Pat. No. 5,819,593 assigned to the assignee of the present invention and incorporated herein by reference.

The electronic throttle control 28 is preferably responsive to the first pivot member 34 to provide the signal 32 that corresponds to pedal arm position. The second pivot member 38 preferably provides pivotal balance for the pedal arm 14 as the pedal arm 14 pivots about the pivot axis 26. It should be understood however that the electronic throttle control 28 could also be mounted on the opposite side of the control pedal assembly 12 such that the second pivot member 38 provides input to product the signal 32 while the first pivot member 34 provides additional balance for the pedal arm 14 as it pivots.

The electronic throttle control mechanism 28 preferably includes a first housing portion 42 and a second housing portion 44, shown in FIG. 4. In the preferred embodiment the housing portions 42, 44 partially serve as the support 18 for the control pedal apparatus 12 and are fixed relative to the vehicle structure 20. The adjustable pedal assembly 22 is supported on a bracket 46 that is mounted to the housing portions 42, 44. The second housing portion 44 includes a first pivotal support 54 and a second pivotal support 56. The first pivotal support 54 receives the first pivot member 34 and the second pivotal support 56 receives the second pivot member 38. As discussed above, the first 34 and second 38 pivot members form the pivot 24 about which the pedal arm 14 pivots.

The bracket 46 includes a first leg 48 and a second leg 50 that extend downwardly from a central base member 52. While the bracket 46 is shown with two legs 48, 50, the bracket 46 could also be configured to have only a single leg or could have additional leg members. The bracket 46 need only provide partial support for the adjustable pedal assembly 22.

The bracket 46 is partially installed within the second housing member 44 such that the first pivotal support 54 is adjacent to the first leg 48 and the second pivotal support 56 is adjacent to the second leg 50. The first housing portion 42 is attached to the second housing portion near the first pivotal support 54 to enclose the electronic throttle control 28. The first housing portion 42 preferably includes tab receivers 58 for snap fit attachment to tabs 60 located on the second housing portion 44.

The bracket 46 pivots about the pivot axis 26 when a force is applied to the pedal arm 14 to move the pedal arm 14 from the rest to the applied position. The electronic throttle control 28 is fixed with respect to the vehicle structure 20 such that the pedal arm 14 moves in fore and aft directions with respect to the electronic throttle control 28 and with respect to the vehicle structure 20. Thus, the adjustable pedal assembly 22 pivots with respect to the vehicle structure 20 and moves the pedal arm 14 in fore and aft directions with respect to the vehicle structure 20, while the electronic throttle control 28 remains fixed with respect to the vehicle structure 20. In other words, the pedal arm 14 moves independently from the electronic throttle control 28. Additionally, the pedal arm 14 moves in fore and aft directions with respect to the pivot 24.

The adjustable pedal assembly 22 includes a guide rod 62 for supporting the pedal arm 14 and which defines a longitudinal axis 64. The pedal arm 14 moves in the fore and aft directions along the longitudinal axis 64. The longitudinal axis 64 is perpendicular to the pivot axis 26. Thus, the guide rod 62 is rotatable about the pivot axis 26 along with the bracket 46 when the pedal arm 14 pivots about the pivot axis 26.

The adjustable pedal assembly 22 further includes a bearing member 66 for slidably supporting the pedal arm 14 on the guide rod 62. The bearing member 66 is preferably a bushing, however, other bearing members well known in the art can be used. In the preferred embodiment, an electric motor is used to drive a screw drive mechanism housed within the guide rod 62, which causes the bearing member 66 and the pedal arm 14 to move along the guide rod 62.

The control pedal apparatus 12 also includes a resilient member 68, shown in FIG. 5, which reacts between the pedal arm 14 and the bracket 46 for providing resistance as the pedal arm 14 is moved from the rest position to the applied position. This resistance provides a "feel" 16 as the pedal arm 14 pivots that corresponds to the feel that a driver experiences in pedal assembly having a cable assembly as part of a mechanical link to the engine throttle 30. The resilient member 68 is preferably a coil spring with a spring center 70 that is concentric with the pivot 24. The spring 68 has a first spring end 72 engaging the pedal arm 14 and a second spring end 74 engaging the bracket 46. In addition to providing resistance as the pedal arm 14 is moved to the applied position, the spring 68 returns the pedal arm 14 to the rest position after a force applied to the pedal arm 14 has been removed.

The spring 68 is supported by a cylindrical portion 76 that extends inwardly from the second housing portion 44 of the electronic throttle control 28, toward the pedal arm 14. Thus, the cylindrical portion 76 is located between the pedal arm 14 and the first leg 48 of the bracket 46.

While the spring 68 is shown as a coil spring that is supported about pivot 24, other spring configurations known in the art could also be used. Also, the spring 68 could be located at a position other than about pivot 24. The main function of the spring 68 is to act upon the pedal arm 14 to provide a feel to the driver as the pedal arm 14 pivots.

A cable attachment member 78 can optionally be supported on one of the pivot members 34, 38 to support a cable assembly for attachment to the engine throttle 30. This configuration would be used in place of the electronic throttle control 28; i.e., the configuration is used with a pedal assembly having a mechanical link to the throttle.

The control pedal apparatus 12 of the subject invention provides both an adjustment apparatus 22 and an electronic throttle control 28 in an assembly that requires less packaging space and which requires fewer components than prior art control pedals. This reduces overall assembly time and reduces material costs. The control pedal apparatus 12 provides the additional benefits of having a single pivot (24) to pivotally support the pedal arm 14 in addition to providing input to the electronic throttle control 28. Thus, the control pedal apparatus 12 allows adjustment of the pedal arm 14 in fore and aft directions without having to move the electronic throttle control unit 28 along with the pedal arm 14, and the electronic throttle control 28 is responsive to the pivot 24 about which the adjustable pedal assembly 22 rotates.

The invention has been described in an illustrative manner, and it is to be understood that the terminology which has been used is intended to be in the nature of words of description rather than of limitation.

Obviously, many modifications and variations of the present invention are possible in light of the above teachings. It is, therefore, to be understood that within the scope of the appended claims, wherein reference numerals are merely for convenience and are not to be in any way limiting, the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. An adjustable pedal assembly for a vehicle comprising;

a support (18) for mounting to a vehicle structure;

an adjustable pedal assembly (22) having a guide member (62) rotatably supported by said support (18) for pivotal movement about a pivot axis (26); and

a pedal arm (14) supported on said guide member (62) for rectilinear movement in fore and aft directions relative to said support (18), said guide member (62) and said pivot axis (26) between various adjusted positions;

an electronic control (28) supported on said support (18) and responsive to pivotal movement of said pedal arm (14) and said guide member (62) about said pivot axis (26),

said electronic control (28) being fixed relative to said support (18) such that said pedal arm (14) moves in fore and aft directions with respect to said electronic control (28), said electronic control (28) being responsive to pivotal movement of said guide member (62) about said pivot axis (26) for providing a signal (32) that corresponds to pedal arm (14) position as said pedal arm (14) pivots said guide member (62) about said pivot axis (26).

2. An assembly as set forth in claim 1 wherein said pedal arm (14) is in sliding engagement with said guide member (62) and extends from said guide member (62) to lower pad end.

3. An assembly as set forth in claim 2 including a drive for moving said pedal arm (14) along said guide member (62).

4. A vehicle control pedal apparatus (12) comprising:

a support (18) adapted to be mounted to a vehicle structure (20);

an adjustable pedal assembly (22) having a pedal arm (14) moveable in force and aft directions with respect to said support (18);

a pivot (24) for pivotally supporting said adjustable pedal assembly (22) with respect to said support (18) and defining a pivot axis (26); and

an electronic control (28) attached to said support (18) for controlling a vehicle system;

said apparatus (12) characterized by said electronic control (28) being responsive to said pivot (24) for providing a signal (32) that corresponds to pedal arm position as said pedal arm (14) pivots about said pivot axis (26) between rest and applied positions wherein the position of said pivot (24) remains constant while said pedal arm (14) moves in fore and aft directions with respect to said pivot (24).

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 6,237,565 B1
DATED : May 29, 2001
INVENTOR(S) : Steven J. Engelgau

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 6,
Line 21, please change “force” to -- fore --.

Signed and Sealed this

Fourth Day of February, 2003

JAMES E. ROGAN
Director of the United States Patent and Trademark Office

Exhibit 6

United States Patent [19]

Asano et al.

[11] Patent Number: 5,010,782

[45] Date of Patent: Apr. 30, 1991

[54] POSITION ADJUSTABLE PEDAL ASSEMBLY

[75] Inventors: Yasushi Asano; Yoshimasa Kataumi, both of Shizuoka, Japan

[73] Assignee: Fuji Kiko Company, Ltd., Tokyo, Japan

[21] Appl. No.: 386,401

[22] Filed: Jul. 28, 1989

[30] Foreign Application Priority Data

Jul. 28, 1988	[JP]	Japan	63-188774
Jul. 28, 1988	[JP]	Japan	63-188775
Jul. 28, 1988	[JP]	Japan	63-188776
Jul. 28, 1988	[JP]	Japan	63-188777

[51] Int. Cl.[5] G05G 1/14

[52] U.S. Cl. 74/512; 74/513; 74/560

[58] Field of Search 74/512, 513, 560, 522, 74/561, 562

[56] References Cited

U.S. PATENT DOCUMENTS

2,936,867	5/1960	Perry	74/513 X
3,151,499	10/1964	Roe	74/512
3,563,111	2/1971	Zeigler	74/512
3,643,524	2/1972	Herring	74/512
3,691,868	9/1972	Smith	74/512
3,757,604	9/1973	Schroeder	74/512
3,861,237	1/1975	Mounts	74/512
4,037,487	7/1977	Ahlschwede et al.	74/512
4,386,537	6/1983	Lewis	74/513 X
4,497,217	2/1985	Hansen	74/512
4,875,385	10/1989	Sitrin	74/513 X

FOREIGN PATENT DOCUMENTS

0256466	2/1988	European Pat. Off.	74/512
50-6694	5/1973	Japan	74/512
50-34814	7/1973	Japan	74/512

Primary Examiner—Vinh T. Luong

Attorney, Agent, or Firm—Ronald P. Kananen

[57] ABSTRACT

In a position adjustable pedal assembly for a vehicle, a pedal pad position is adjustable in a longitudinal direction of the vehicle. A lever is connected to a stationary bracket for a pivotal movement about a pivot axis and is formed with a linear track extending in the vehicular longitudinal direction. A pedal arm is provided with a pedal pad at its lower end and with a guide member at its upper end and is connected to the lever for the pivotal movement with the lever in response to a depression force applied to the pedal pad. An adjust lever is provided on the lever for a relative movement to the lever and is formed with an arc-shaped track. The relative movement of the adjust lever is caused when the guide member moves within the linear track and simultaneously within the arc-shaped track while the pedal pad position is adjusted. The adjust lever is provided with a connecting member which is movable within another arc-shaped track in response to the relative movement of the adjust lever. Accordingly, when the pedal pad position is adjusted to move the guide member, the relative movement of the adjust lever is caused to vary a position of the connecting member corresponding to a magnitude of the movement of the guide member, i.e., corresponding to the variation in a distance from the pivot axis to the pedal pad. The depression force is applied to a vehicle operation system through the connecting member.

12 Claims, 7 Drawing Sheets

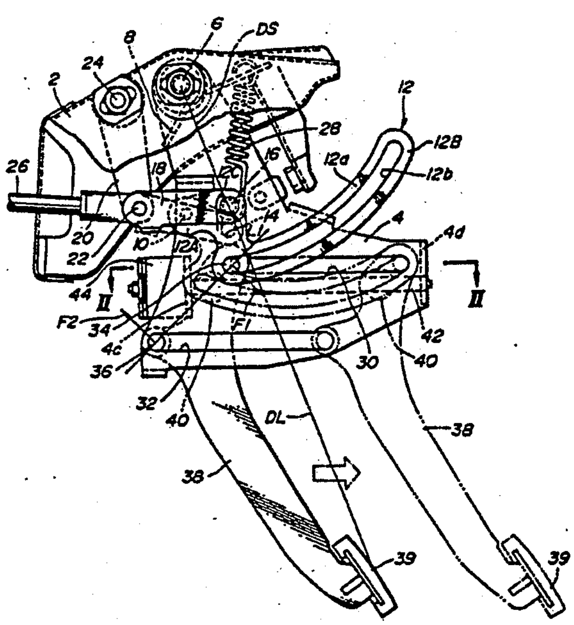
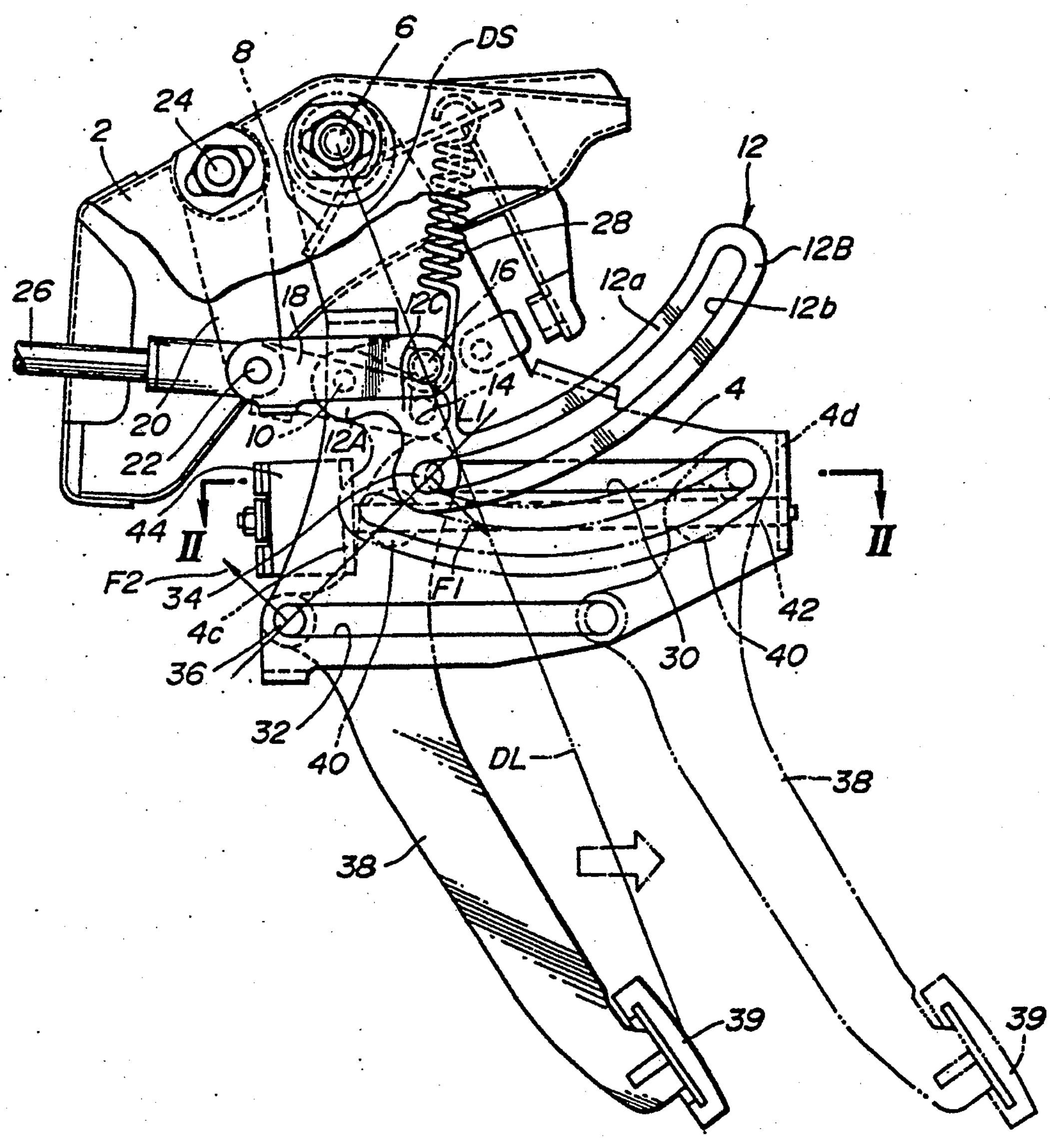


FIG.1


6
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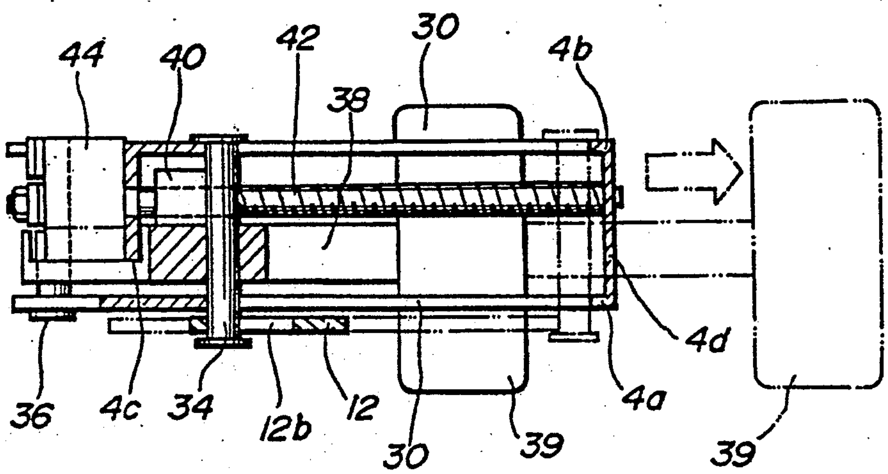
39

FIG.2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42
38
30
4b
4d
36
4c
34
12b
12
30
39
4a
39

FIG.6

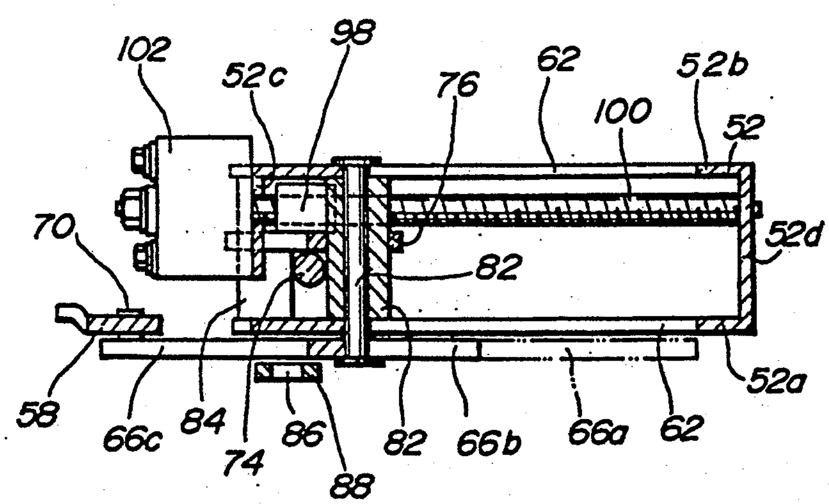
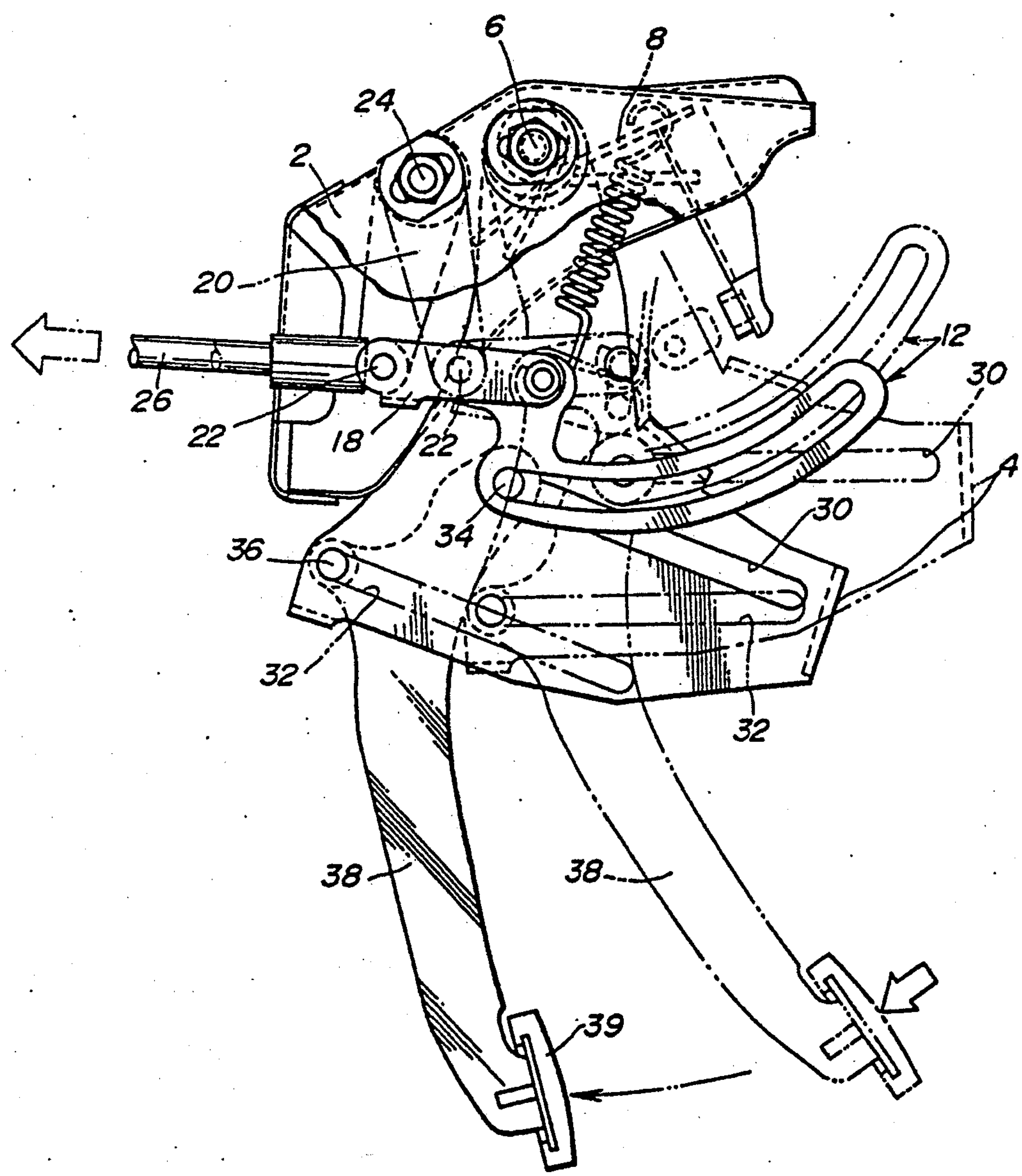

102
52c
98
76
62
100
52b
52
52d
70
82
58
66c
84
74
86
88
82
66b
66a
62
52a

FIG. 3



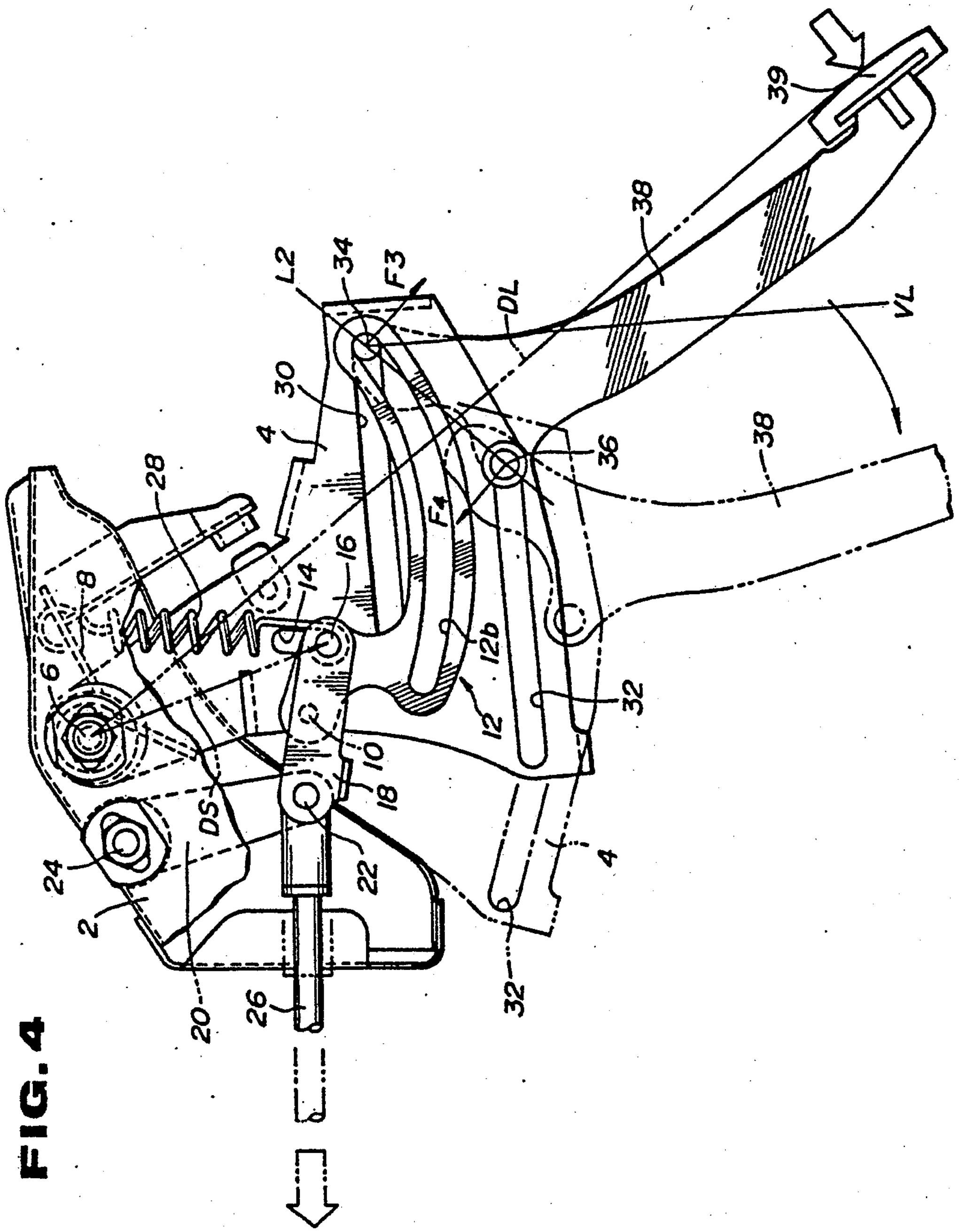
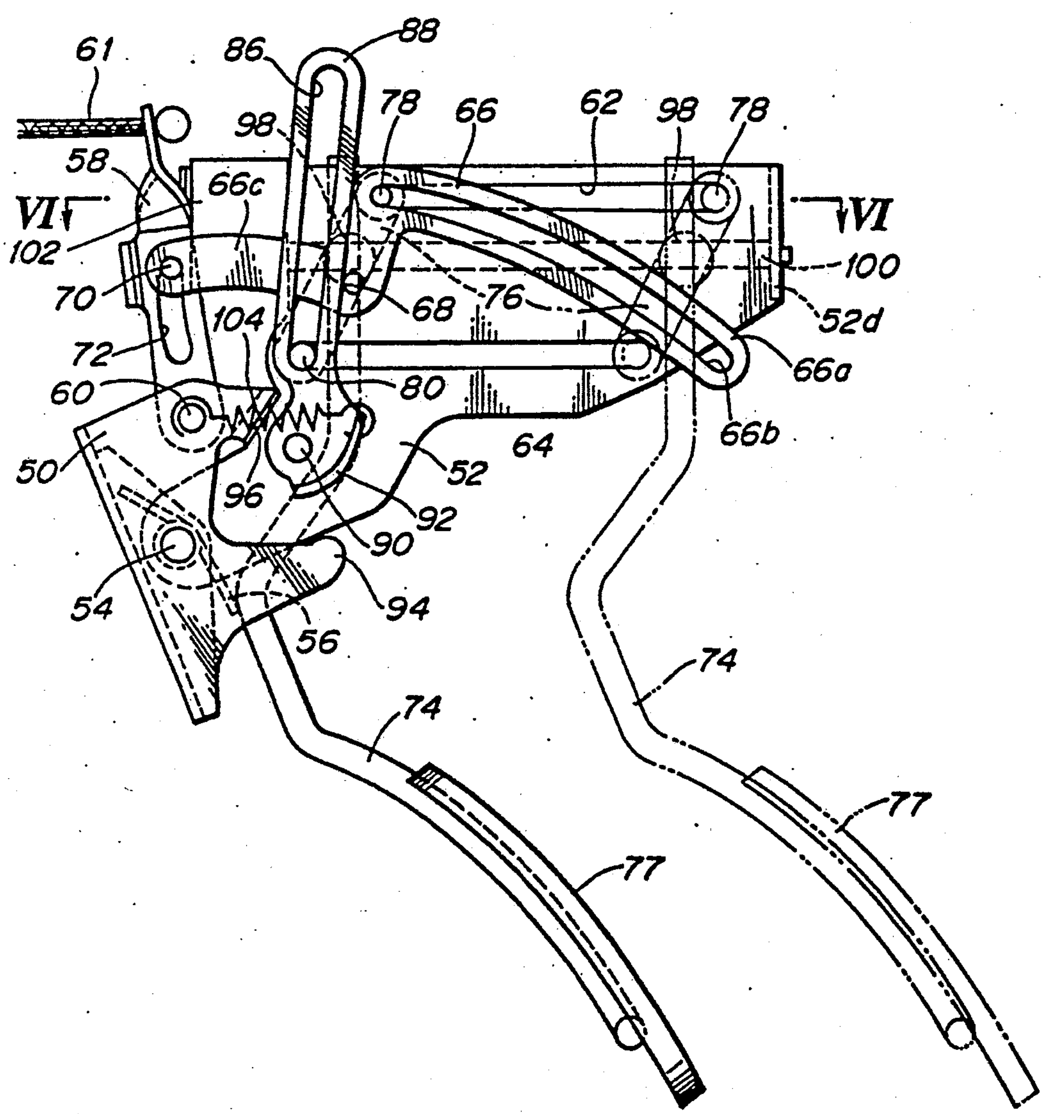

39
38
L2
34
F3
DL
VL
30
4
36
38
28
F4
8
14
16
12b
6
12
32
10
18
DS
24
22
4
2
20
26
32

FIG. 4

FIG. 5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88
98
78
66
62
98
78
58
66c
VI
VI
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100
70
68
76
52d
72
104
66a
60
80
66b
64
50
96
52
92
90
54
94
56
74
74
77
77

FIG.7

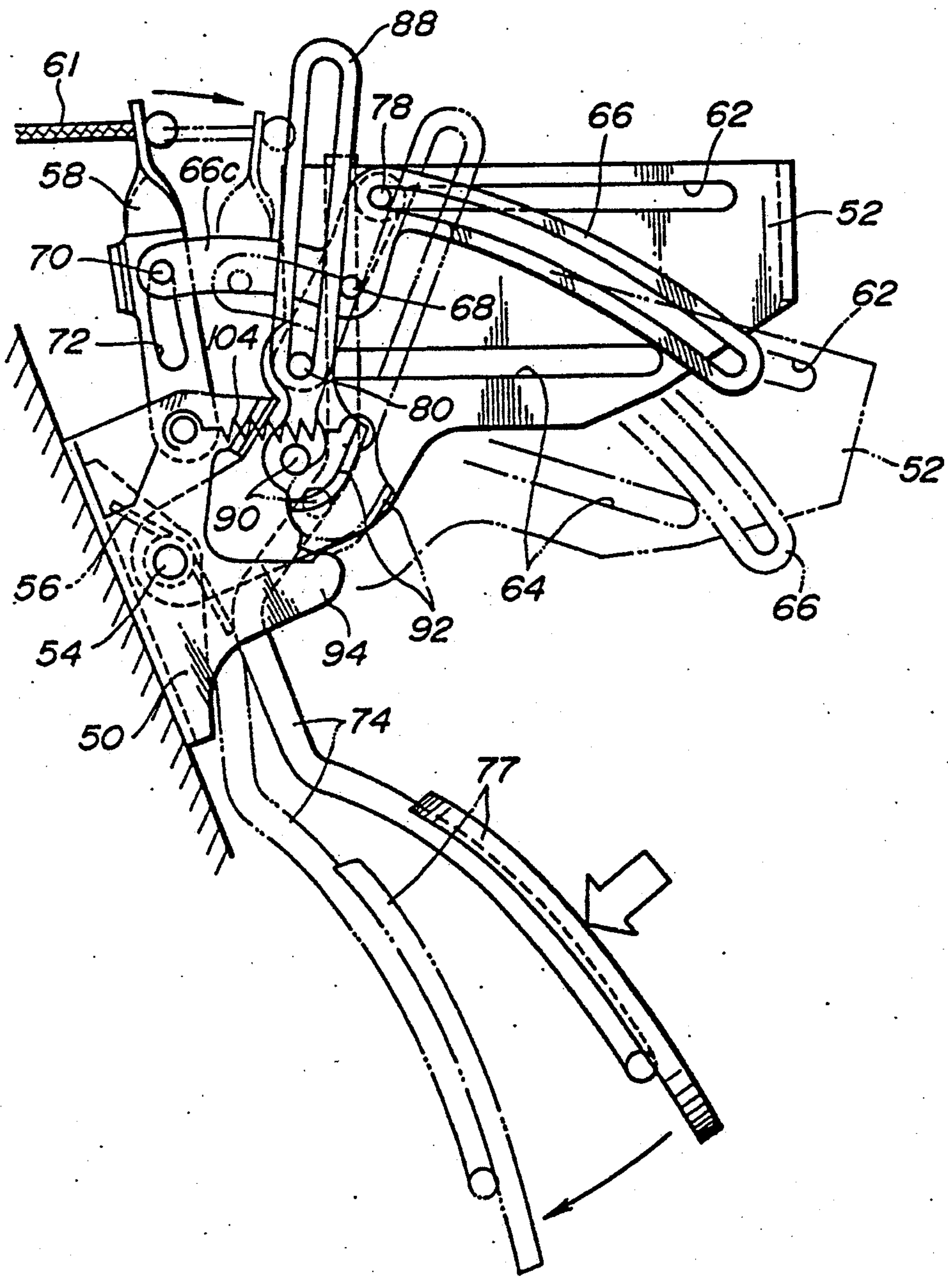
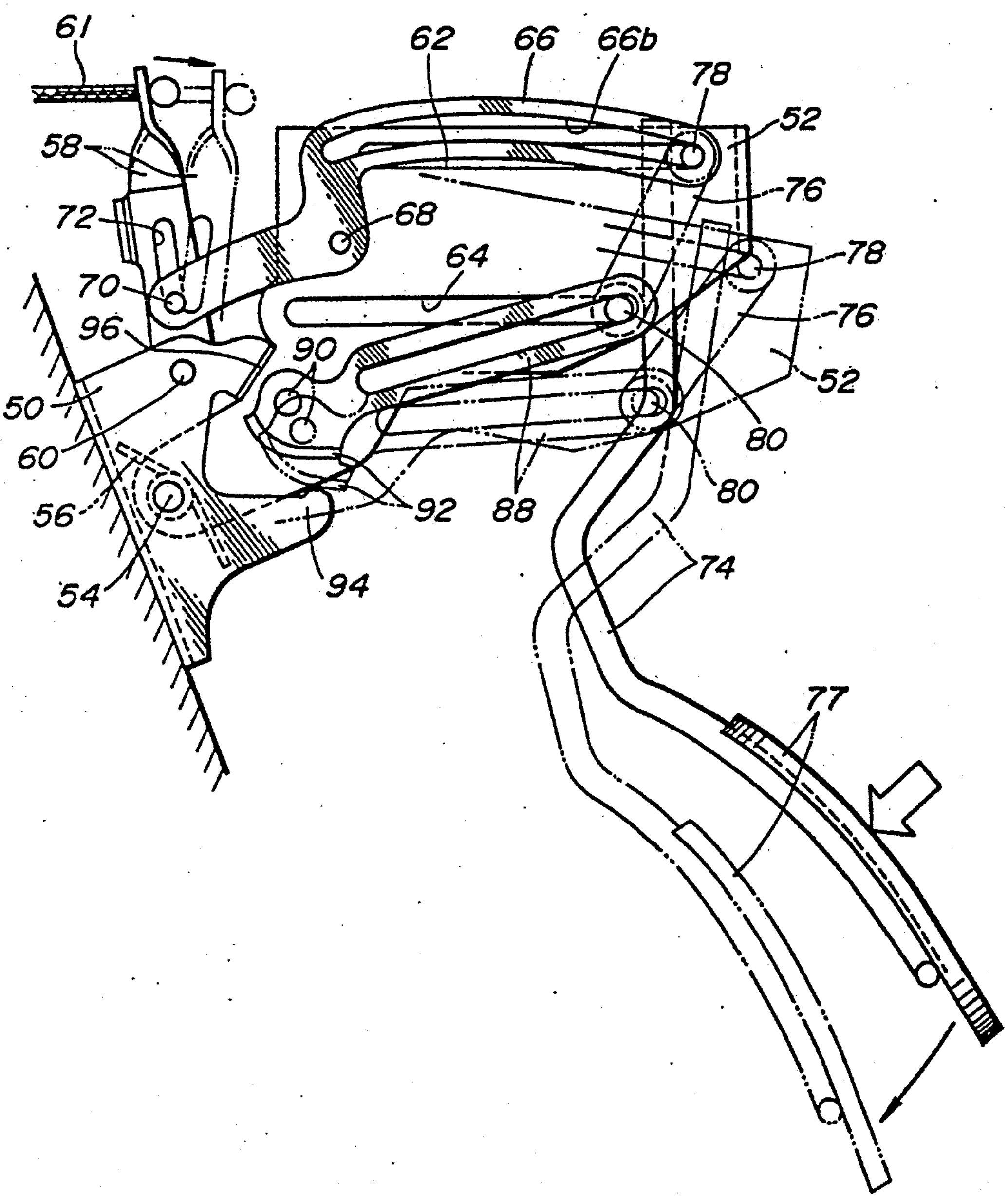

88
61
78
66
62
58
66c
52
70
68
62
72
104
80
52
90
56
64
66
54
92
94
74
50
77

FIG. 8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62
66
66b
78
52
58
76
72
68
64
78
70
76
96
90
52
50
80
60
92
88
80
56
74
54
94
77

POSITION ADJUSTABLE PEDAL ASSEMBLY

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a position adjustable pedal assembly for a vehicle. More specifically, the present invention relates to an automotive position adjustable pedal assembly to be used such as for brake, accelerator and clutch pedals, wherein a position of the pedal is adjustable in the forward and rearward directions of the vehicle.

2. Description of the Background Art

There has been proposed a pedal assembly which enables a driver to adjust a position of the pedal in the forward and rearward directions of the vehicle according to his or her height. This is required since if the driver's seat is adjusted forwardly or rearwardly to match his or her height, the visual field is varied corresponding to the seat position, which is not preferable in view of safety as well as the driving comfortable. Further, if the driver's seat is moved rearwardly, the leg space for a passenger sitting on the rear seat becomes inevitably narrow. Accordingly, there have been required such a pedal assembly which makes it possible to adjust the position of the pedal forwardly and rearwardly.

In the conventional pedal assembly, however, there arises a problem of a variation in force applied to an operating member which is connected to a vehicle operation system, such as a braking system, an engine throttle valve or a clutch system, according to a position of a pedal pad between its adjustable range. Specifically, if an amount or a distance of pivotal displacement of the pedal pad, i.e. of displacement of the pedal pad in the circumferential direction caused by the depression of the pedal pad by the driver is the same, the force applied to the operating member varies according an adjusted position of the pedal pad due to change in a length of a lever between its pivot axis at its upper end and a pedal pad at its lower end where the depression force is appled by the driver.

This variation forces the driver to operate the pedal pad differently according to the adjusted pedal pad position.

SUMMARY OF THE INVENTION

Therefore, it is an object of the present invention to provide a pedal assembly for a vehicle which enables a position of a pedal pad such as a brake pedal pad, an accelerator pedal pad and a clutch pedal pad to be adjusted forwardly and rearwardly of the vehicle, i.e. in a longitudinal direction of the vehicle, wherein a force applied to an operating member which transmits the appled force to a vehicle operation system such as a braking system, an engine throttle valve and a clutch system, is held substantially constant under the same pivotal displacement distance of the pedal pad caused by a driver's depression action of the pedal, irrespective of the adjusted pedal pad position.

Another object of the present invention is to provide a position adjustable pedal assembly, wherein a required depression force or leg power for depressing the pedal pad by the same distance is maintained substantially constant, irrespective of the adjusted pedal pad position.

A further object of the present invention is to provide a position adjustable pedal assembly, wherein a full depression displacement distance of the pedal pad in the circumferential direction is held substantially constant by using adjustable stopper means, irrespective of the adjusted pedal position.

A still further object of the present invention is to provide a position adjustable pedal assembly, wherein a reaction force applied to components of the pedal assembly in the direction along a length of the vehicle, i.e. in the longitudinal direction of the vehicle to be generated in response to the depression force applied to the pedal pad by the driver is considerably reduced so as to attain the strength of the pedal assembly as well as smooth pedal operation feelings.

To accomplish the above-mentioned and other objects, according to one aspect of the present invention, a position adjustable pedal assembly for a vehicle comprises a stationary bracket fixed to a vehicle body, a lever pivotably connected to the stationary bracket about a pivot axis, a pedal arm with a pedal pad at its lower end, the pedal arm being connected to the lever so as to pivot about the pivot axis along with the lever in response to a depression force applied to the pedal pad, first means provided between the lever and the pedal arm for adjusting a position of the pedal pad in a longitudinal direction of the vehicle, second means for transmitting the depression force from the lever to a vehicle operation system, third means provided between the lever and said second means, for varying a point of application of the depressed force relative to said second means from said lever according to an adjusted pedal pad position.

According to a second aspect of the present invention, the third means varies the point of application of the depressed force relative to the second means from the lever in response to variation in a distance between the first pivot axis and a center of the pedal pad.

According to a third aspect of the present invention, the position adjustable pedal assembly may further includes spring means connected to the stationary bracket at its one end and to the lever at its other end, the spring means stretching or compressing in response to the variation of the distance so as to change its spring force applied to the lever and the pedal arm, the change of the spring force absorbing variation in a required depression force to be applied to the pedal pad, the variation of the required depression force being caused by the variation of the distance.

According to a fourth aspect of the present invention, the position adjustable pedal assembly may further include stopper means provided on the lever, the stopper means having an engaging portion of a shape which has a predetermined curvature, said engaging portion being pivotable according to an adjusted pedal pad position so as to contact with the stationary bracket to prevent a pivotal movement of the lever about the pivot axis exceeding a predetermined value in response to a constant pivotal displacement distance of the pedal pad from its non-depressed position irrespective of the adjusted pedal pad position, the predetermined curvature of the engaging portion being non-constant therealong.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be understood more fully from the detailed description given hereinbelow and from the accompanying drawings of the preferred embodiment of the invention, which are given by way of example only, and are not intended to be limitative of the present invention.

In the drawings:

FIG. 1 is a side elevation showing a position adjustable pedal assembly according to a first preferred embodiment of the present invention,

FIG. 2 is a sectional view taken along the line II—II of FIG. 1,

FIG. 3 is a side elevation for showing the operation of the position adjustable pedal assembly of FIG. 1, wherein the pedal pad position is adjusted to its foremost position,

FIG. 4 is a side elevation for showing the operation of the position adjustable pedal assembly of FIG. 1, wherein the pedal pad position is adjusted to its rearmost position,

FIG. 5 is a side elevation showing a position adjustable pedal assembly according to a second preferred embodiment of the present invention,

FIG. 6 is a sectional view taken along the line VI—VI of FIG. 5,

FIG. 7 is a side elevation for showing the operation of the position adjustable pedal assembly of FIG. 5, wherein the pedal pad position is adjusted to its foremost position, and

FIG. 8 is a side elevation for showing the operation of the position adjustable pedal assembly of FIG. 5, wherein the pedal pad position is adjusted to its rearmost position.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A first preferred embodiment of a position adjustable pedal assembly will be described with reference to FIGS. 1 to 4, wherein the pedal assembly is applied to a brake pedal.

In FIGS. 1 and 2, a stationary bracket 2 is fixed to a dash panel of a vehicle body. A lever 4 generally of a triangular shape is pivotably connected at its upper end to the stationary bracket 2 with a pivot pin 6 (i.e., a first pivot axis). As can be seen from FIG. 2, the lever 4 is generally of a hollow cubic shape having a right side wall 4*a*, a left side wall 4*b*, a front wall 4*c* and a back wall 4*d*. A return spring 8 is wound onto the pivot pin 6 for urging the lever 4 counterclockwise in FIG. 1 when a depression force is applied by a driver to push the lever 4 clockwise in FIG. 1. A pin 10 is fixedly provided on the right side wall 4*a* of the lever 4 for pivotably supporting an adjust lever 12. The adjust lever 12 includes a first portion 12A extending generally in a forward direction of the vehicle, a second portion 12B extending generally in a rearward direction of the vehicle and a third portion 12C extending generally vertically to connect the first and second portions 12A and 12B. The lever 4 is formed with a pair of first arc-shaped holes or slots 14 (i.e., a first arc-shaped track) at the right and left side walls 4*a* and 4*b*. A first slide pin 16 (i.e., a connecting member) is inserted into the arc-shaped holes 14 for pivotably supporting the adjust lever 12 and one end of a link member 18 on the right side wall 4*a*. The other end of the link member 18 is pivotably connected to an auxiliary lever 20 through a pivot pin 22 (i.e., a second pivot axis). The auxiliary lever 20 is in turn pivotably connected to the stationary bracket 2 through a pivot pin 24. A brake operating rod 26 is pivotably connected at its one end to the pin 22 to be operated in synchronism with displacement of the link member 18. The operating rod 26 is connected at its other end to a vehicle operation system such as a braking system (not shown).

A tension spring 28 is connected at its lower end to the first slide pin 16 and at its upper end to the stationary bracket 2. In FIG. 1, the tension spring 28 is in a balanced position supporting a weight applied to the first slide pin 16. Accordingly, the return spring 8 is not energized when no depression force is applied to the lever 4. The adjust lever 12 is generally of a Z-shape and is formed with a second arc-shaped hole or slot 12*b* (i.e., a second arc-shaped track) at its arc-shaped elongate section 12*a*. A radius of curvature of the arc-shaped hole 12*b* is not constant therealong, which will be described later.

The right side wall 4*a* of the lever 4 is formed with a pair of first and second elongate holes or slots 30 and 32 (i.e., the first and second linear tracks) which extend in parallel to each other in the longitudinal direction of the vehicle. Forward ends as well as rearward ends of the elongate holes 30 and 32 are not vertically aligned, respectively, which will be described later. As can be seen from FIG. 2, the left side wall 4*b* of the lever 4 is also formed with a pair of holes which just correspond to the elongate holes 30 and 32 formed in the right side wall 4*a*. Second and third slide pins 34 and 36 (i.e., the first and second guide member) are slidably inserted into the elongate holes 30 and 32 of the right and left side walls 4*a* and 4*b*, respectively. A pedal arm 38 is inserted into the lever 4 between the right and side walls 4*a* and 4*b* and is supported by the slide pins 34 and 36 at differenct locations. The slide pin 34 further extends through the arc-shaped hole 12*b* of the adjust lever 12. The pedal arm 38 is provided with a pedal pad 39 at its lower end.

A screw nut 40 (i.e., a driven member) is fixed to the pedal arm 38 and a corresponding screw rod 42 (i.e., a drive member) is rotatably mounted to the front and back walls 4*c* and 4*d*. The screw nut 40 is of a cylindrical shape and formed with a threaded hole through which the screw rod 42 extends so as to be engaged with each other. An electric motor 44 is fixed to the front wall 4*c* and is connected to the screw rod 42 for actuating same. Specifically, the motor 44 is energized to rotate in the normal or reverse direction in response to the driver's switching operation. This rotation of the motor causes the screw rod 42 to rotate in the same direction with the motor 42. The screw nut 40 is guided by the rotation of the screw rod 42 to move along the screw rod 42. This movement of the screw nut 40 causes the pedal arm 38 along with the pedal pad 39 to move along the secrew rod 42, with the slide pins 34 and 36 each moving within the corresponding hole 30 or 32 between its forward and rearwad ends, as shown in FIG. 1 by the solid and dotted lines.

Now the operation of the first preferred embodiment will be described hereinbelow.

FIG. 3 shows the operation of the position adjustable pedal assembly, wherein the pedal pad 39 is adjusted to its foremost position. Specifically, the slide pins 34 and 36 are positioned at the forward ends of the elongate holes 30 and 32, respectively, and the slide pin 34 is also positioned at the forward end of the arc-shaped hole 12*b*. When the pedal pad 39 is depressed by the driver, as shown by the solid line in FIG. 3, the pedal arm 38 and the lever 4 pivot about the pivot pin 6 as one integral unit in the clockwise direction. This causes the link member 18 to move forwardly so as to rotate the auxiliary lever 20 about the pivot pin 24 in the clockwise direction. Accordingly, the pin 22 is displaced forwardly to push the operating rod 26 also forwardly so as to transmit the depressed force applied to the brake pedal pad 39 to the vehicle operation system (not shown) through the operating rod 26.

It is to be noted that since a line L1 is inclined at a predetermined angle to the vertical line VL, force F1 and F2 is applied to the slide pins 34 and 36 as shown in FIG. 1 in response to the depressing force applied to the brake pedal pad 39. Accordingly, the force which is to be applied to the slide pins 34 and 36 in a longitudinal direction of the elongate holes 30 and 32 is considerably reduced. On the other hand, if the slide pins 34 and 36 are vertically aligned, the force F1 and F2 is applied to the slide pins 34 and 36 in the direction along the length of the elongate holes 30 and 32. Accordingly, the strength of the assembly becomes less and the operation of the pedal pad 39 becomes jerky since the slide pin 34 is not engaged with any member in the direction along the force F1.

When the brake pedal pad 39 is released from the depression force, the pedal arm 38 and the lever 4 return to the initial position as one integral unit by means of the energized force of the return spring 8 as shown by the dotted line in FIG. 3.

In order to adjust the pedal position away from the foremost position as shown in FIG. 3 to, for example, the rearmost position, the electric motor 44 is energized to rotate in the normal direction by operating the switch (not shown), which causes the screw rod 42 to rotate in the same direction. Accordingly, the screw nut 40 moves along the screw rod 42 rearwardly to slide the slide pins 34 and 36 within the corresponding elongate holes 30 and 32 also rearwardly, as shown by the solid line in FIG. 4 wherein the pedal position is adjusted to its rearmost position. Simultaneously, the slide pin 34 slides within the arc-shaped hole 12*b* from its forward end to its rearward end, which causes the adjust lever 12 to pivot about the pin 10 in the clockwise direction. This pivotal movement of the adjust lever 12 causes the support pin 16 to move downward within the arc-shaped hole 14. Simultaneously, the link member 18 pivots about the pin 22 in the clockwise direction, which, however, does not cause the auxiliary lever 20 to pivot about the pivot pin 24, i.e. the pin 22 does not move so that no force is applied to the operating rod 26 since a radius of curvature of the arc-shaped hole 14 is the same as a distance between the center of the pin 22 and the center of the support pin 16.

As described before, the radius of curvature of the arc-shaped hole 12*b* is not constant therealong. Specifically, the radii of curvature of the arc-shaped hole 12*b* are selected such that when the first slide pin 16 moves downward or upward within the arc-shaped hole 14 in response to the sliding movement of the slide pin 34 within the arc-shaped hole 12*b* toward its rearward end or its forward end, respectively, a ratio of a distance DS to a distance DL is maintained constant, wherein the distance DS is a distance between the center of the pivot pin 6 and the center of the first slide pin 16 and the distance DL is a distance between the center of the pivot pin 6 and the center of the pedal pad 39. This ratio is maintained constannt irrespective of the position of the slide pin 34 within the arc-shaped hole 12*b*. Accordingly, the force applied to the operating rod 26 and the required depression force or the leg power are kept constant irrespective of the adjusted pedal position under a condition that a distance of the pivotal displacement of the pedal pad 39 from the non-depressed position is the same.

Though the change in the distance DL causes a change in its center of gravity, which varies the required depression force or leg power, this variation is absorbed by means of the tension spring 28 which stretches or compressed according to the position of the first slide pin 16.

As seen from FIG. 4, when the pedal pad 39 is depressed by the driver, the pedal arm 38 and the lever 4 pivot about the pivot pin 6 as one integral unit in the clockwise direction to move the link member 18 forward. Simultaneously, the pin 22 moves forward and the auxiliary lever 20 pivots about the pivot pin 24, so that the applied depression force is transmitted to the operating rod 26.

As seen from FIG. 4, a line L2 is inclined at the predetermined angle to the vertical line VL and force F3 and F4 is applied to the slide pins 34 and 36, respectively. This arrangement provides the same effect as described before with reference to FIGS. 1 and 3.

When the pedal pad 39 is released from the depression force, the pedal arm 38 and the lever 4 return to the initial or the non-depressed position as shown by the solid line by means of the energized force of the return spring 8.

In order to return the pedal arm 38 to the position as shown by the solid line in FIG. 1, the electric motor 44 is energized to rotate in the reverse direction.

Now a second preferred embodiment of the position adjustable pedal assembly will be described with reference to FIGS. 5 to 8, wherein the pedal assembly is applied to an accelerator pedal.

In FIGS. 5 and 6, a stationary bracket 50 is fixed to a dash panel of the vehicle body. A lever 52 is pivotably connected to the stationary bracket 50 by a pivot pin 54 (i.e., a first pivot axis). As can be seen from FIG. 6, the lever 52 is generally of a hollow cubic shape having a right side wall 52*a*, a left side wall 52*b*, a front wall 52*c* and a back wall 52*d*. A return spring 56 is wound onto the pivot pin 54 for urging the lever 52 counterclockwise in FIG. 5 when a depression force is applied by the driver to push the lever 52 in the clockwise direction.

An operating lever 58 is pivotably connected to the stationary bracket 50 by means of a pivot pin 60 at its lower end and is connected to an operating wire 61 at its upper end. The operating wire is in turn connected to a throttle valve of a vehicle operation system (not shown). The lever 52 is formed with a pair of elongate holes 62 and 64 (i.e., a first and second linear tracks) just as in the first preferred embodiment. An adjust lever 66 is pivotably mounted to the lever 52 by means of a pin 68 which is fixed to the right side wall 52*a* of the lever 52. The adjust lever 66 is generally of a reversed-Z-shape and is formed with an arc-shaped hole or slot 66*b* (i.e., a second arc-shaped track) at its arc-shaped section 66*a*. A radius of curvature of the arc-shaped hole 66*b* is not constant, which will be described later. The adjust lever 66 has another arc-shaped section 66*c* which extends in the forward direction and is provided at its forward end with a slide pin 70 (i.e., a connecting member) which engages with an arc-shaped hole or slot 72 (i.e., a first arc-shaped track). A radius of curvature of the arc-shaped hole 72 is the same as a distance between the center of the pin 68 and the center of the slide pin 70 so as to prevent the operating lever 58 from pivoting about the pivot pin 60 when the adjust lever 66 is pivoted about the pin 68 for adjusting the pedal position, which will be described later.

A pedal arm 74 is inserted into the lever 52 between the right and left side walls 52*a* and 52*b* and is provided with a bracket 76 at its upper portion. The pedal arm 74 is provided with an accelerator pedal pad 77. The bracket 76 is fixed to the pedal arm 74 and is provided with a pair of slide pins 78 and 80 (i.e., the first and second guide member) at its upper and lower ends, respectively. Collars 82 and 84 are placed between the bracket 76 and the corresponding slide pins 78 and 80 as shown in FIG. 6. The slide pin 78 is inserted through the elongate holes 62 of the lever 52 and further through the arc-shaped hole 66*b* of the adjust lever 66. The slide pin 80 is inserted through the elongate holes 64 of the lever 52 and further through an elongate hole 86 formed in a stopper lever 88 which is pivotably connected to the lever 52 through a pivot pin 90. The elongate hole 86 is long enough to allow the the slide pin 80 to move within the elongate hole 64 between its forward and rearward ends. The stopper lever 88 is formed with an engaging portion 92 at a side opposite to the elongate hole 86 with respect to the pivot pin 90. The engaging portion 92 is engageable with an arc-shaped projection 94 of the stationary bracket 50, which projection 94 is formed at a lower rearward end of the stationary bracket 50. The engagement of the engaging portion 92 with the arc-shaped projection 94 prevents a clockwise pivotal movement of the lever 52 exceeding a predetermined value which is caused by the depression force applied by the driver. Curvature of the engaging portion 92 is not constant therealong. Specifically, the curvature of the engaging portion 92 is selected such that the engaging portion 92 engages with the arc-shaped projection 94 to stop the clockwise pivotal movement of the lever 52 exceeding the predetermined value in response to a constant distance of the pivotal displacement of the pedal pad 77 irrespective of the adjusted position of the pedal pad 77. The stationary bracket 50 is further formed with a stopper projection 96 at its upper rearward end. The stopper projection 96 is engageable with a corresponding forward end of the lever 52 so as to prevent a counterclockwise pivotal movement of the lever 52 exceeding a predetermined value.

A screw nut 98 (i.e., a driven member) is fixed to the bracket 76 and a corresponding screw rod 100 (i.e., a drive member) is rotatably mounted to the front and back walls 52*c* and 52*d*. The screw nut 98 is of a cylindrical shape and formed with a threaded hole through which the screw rod 100 extends so as to be engaged with each other. An electric motor 102 is fixed to the front wall 52*c* and is connected to the screw rod 100 for actuating same. Specifically, the motor 102 is energized to rotate in the normal or reverse direction in response to the driver's switching operation. This rotation of the motor causes the screw rod 100 to rotate in the same direction with the motor 102. The screw nut 98 is guided by the rotation of the screw rod 100 to move along the screw rod 100. This movement of the screw nut 98 causes the bracket 76, i.e. the pedal arm 74 along with the pedal pad 77 to move along the secrew rod 100, with the slide pins 78 and 80 each moving within the corresponding hole 62 or 64 between its forward and rearwad ends, as shown in FIG. 5 by the solid and dotted lines.

A tension spring 104 is connected to the pivot pin 60 at its forward end and to the stopper lever 88 at its rearward end. The tension spring 104 is in a balanced position supporting a weight applied to the tension spring 104.

Now the operation of the second preferred embodiment will be described hereinbelow.

FIG. 7 shows the operation of the position adjustable pedal assembly, wherein the pedal pad 77 is adjusted to its foremost position. Specifically, the slide pins 78 and 80 are positioned at the forward ends of the elongate holes 62 and 64, respectively, and the slide pin 78 is also positioned at the forward end of the arc-shaped hole 66*b*. When the pedal pad 77 is depressed by the driver, as shown by the dotted line in FIG. 7, the pedal arm 74 and the lever 52 pivot about the pivot pin 54 as one integral unit in the clockwise direction. Simultaneously, the adjust lever 66 pulls the operating lever 58 so that the operating lever 58 pivots about the pivot pin 60 in the clockwise direction to pull the operating wire 61 in the rearward direction, which in turn operates the throttle valve of the vehicle operation system (not shown).

When the clockwise pivotal movement of the lever 52 and the pedal arm 74 exceeds the predetermined value, the engaging portion 92 of the stopper lever 88 engages with the arc-shaped projection 94 of the stationary bracket 50 to prevent the further pivotal movement of the lever 52 and the pedal arm 74. On the other hand, when the depression force is released, the lever 52 and the pedal arm 74 pivot about the pivot pin 54 counterclockwise by means of the energized force of the return spring 56 to return to the initial position as shown by the solid line in FIG. 7.

In order to adjust the pedal position away from the foremost position as shown in FIG. 7 to, for example, the rearmost position, the electric motor 102 is energized to rotate in the normal direction by operating the switch (not shown), which causes the screw rod 100 to rotate in the same direction. Accordingly, the screw nut 98 moves along the screw rod 100 rearwardly to slide the slide pins 78 and 80 through the bracket 76 within the corresponding elongate holes 62 and 64 also rearwardly, as shown by the solid line in FIG. 8 wherein the pedal position is adjusted to its rearmost position. Simultaneously, the slide pin 78 slides within the arc-shaped hole 66*b* from its forward end to its rearward end, which causes the adjust lever 66 to pivot about the pin 68 in the counterclockwise direction. This pivotal movement of the adjust lever 66 causes the the slide pin 70 to move downward within the arc-shaped hole 72. The sliding movement of the slide pin 70 within the arc-shaped hole 72 does not cause the operating lever 58 to pivot about the pivot pin 60 so that no force is applied to the operating wire 61 since a radius of curvature of the arc-shaped hole 72 is the same as a distance between the center of the slide pin 70 and the center of the pivot pin 68.

As described before, the radius of curvature of the arc-shaped hole 66*b* is not constant therealong. Specifically, the radii of curvature of the arc-shaped hole 66*b* are selected such that when the slide pin 70 moves downward or upward within the arc-shaped hole 72 in response to the sliding movement of the slide pin 78 within the arc-shaped hole 66*b* toward its rearward end or its forward end, respectively, a distance between the center of the pivot pin 60 and the center of the slide pin 70 becomes in reverse proportion to a distance between the center of the pivot pin 54 and the center of the pedal pad 77. Accordingly, the force applied to the operating wire 61 and the required depression force or the leg power are kept constant irrespective of the ajusted pedal position under a condition that a distance of the pivotal displacement of the pedal pad 77 from the non-depressed position is the same.

As the slide pin 80 moves rearward within the elongate hole 64, the stopper lever 88 starts to pivot about the pivot pin 90 in the clockwise direction, which causes the engaging portion 92 also to pivot about the pivot pin 90. As described before, the curvature of the engaging portion 92 is not constant therealong. Specifically, the curvature of the engaging portion 92 is selected to allow the engaging portion 92 to contact with the arc-shaped projection 94 when the pedal pad 77 performs a pivotal displacement of a predetermined constant distance from the non-depressed position of the pedal pad 77, irrespective of an adjusted pedal position.

As seen from FIG. 8, when the pedal pad 77 is depressed by the driver, the pedal arm 74 and the lever 52 pivot about the pivot pin 54 as one integral unit in the clockwise direction to actuate the operating lever 58 through the adjust lever 66. Accordingly, the operating lever 58 pivots about the pivot pin 60 clockwise to pull the operating wire 61 rearwardly, so that the throttle valve of the vehicle operation system is in turn actuated. The pivotal movement of the lever 52 and the pedal arm 74 exceeding the predetermined value is prevented by means of the engagement between the engaging portion 92 and the arc-shaped projection 94. When the pedal pad 77 is released from the depression force, the pedal arm 74 and the lever 52 pivot about the pivot pin 54 counterclockwise to return to the initial or non-depressed position as shown by the solid line in FIG. 8 by means of the energized force of the return spring 56. A further counterclockwise movement is prevented by means of the engagement between the stopper projection 96 and the forward end of the lever 52.

In order to return the pedal arm 74 to the position as shown by the solid line in FIG. 5, the electric motor 102 is energized to rotate in the reverse direction.

As in the first preferred embodiment, the center of the slide pin 78 and the center of the slide pin 80 are not vertically aligned, which can provide the same effect as described in the first preferred embodiment.

It is to be understood that the invention is not to be limited to the embodiments described above, and that various changes and modifications may be made without departing from the spirit and scope of the invention as defined in the appended claims.

What is claimed is:

1. A position adjustable pedal assembly for a vehicle comprising:

a stationary bracket fixed to a stationary portion of the vehicle;

a lever connected to said stationary bracket for a pivotal movement relative to said stationary bracket about a first pivot axis;

a pedal arm with a pedal pad at its lower end, said pedal arm connected to said lever for pivotal movement with said lever as one integral unit in response to a depression force applied to the pedal pad;

pedal position adjusting means including a drive member and a driven member, said drive member adapted to be activated by a vehicle driver's operation, said driven member mounted on said pedal arm to be selectively driven by said drive member to move in a longitudinal direction of the vehicle along with said pedal arm relative to said lever so as to adjust a position of the pedal pad in the longitudinal direction of the vehicle;

an adjust lever provided on said lever, said adjust lever being allowed a relative movement to said lever and having a connecting member which is adapted to move within a first arc-shaped track in response to the relative movement of said adjust lever;

a second arc-shaped track formed on said adjust lever;

a first linear track formed on said lever and extending in the longitudinal direction of the vehicle;

a first guide member provided on said pedal arm, said first guide member adapted to move within said first linear track, and simultaneously within said second arc-shaped track formed on said adjust lever when said pedal arm is driven to move in the longitudinal direction of the vehicle via said pedal position adjusting means, said movement of the first guide member changing a distance from said first pivot axis to said pedal pad corresponding to a magnitude of the movement of said first guide member and simultaneously allowing said relative movement of the adjust lever to change a position of said connecting member within said first arc-shaped track corresponding to said magnitude of the movement of said first guide member; and

operating member means connected to said connecting member for receiving therefrom the depression force applied to said pedal pad via said pedal arm and said lever and for transmitting said depression force to a vehicle operation system to operate same.

2. The position adjustable pedal assembly as set forth in claim 1, wherein said relative movement of the adjust lever changes the position of said connecting member to provide a predetermined ratio relationship between said distance and a distance from said first pivot axis to said connecting member.

3. The position adjustable pedal assembly as set forth in claim 2, wherein said drive member includes a screw rod rotatably supported on said lever and extending in parallel to said first linear track, and said driven member includes a nut fixed to said pedal arm and having a threaded hole therethrough which receives said screw rod therethrough for mutual engagement therebetween, said nut being allowed to move in the longitudinal direction of the vehicle along with said pedal arm when said screw rod is actuated to rotate.

4. The position adjustable pedal assembly as set forth in claim 2, wherein said connecting member includes a first slide pin connected to said adjust lever, and said first arc-shaped track includes a first arc-shaped slot formed in said lever, said first slide pin being allowed to slide within said first arc-shaped slot in response to said relative movement of the adjust lever.

5. The position adjustable pedal assembly as set forth in claim 4, wherein said first pivot axis is provided at an upper end of said lever, and said first arc-shaped slot is oriented substantially in a vertical direction to provide said predetermined ratio relationship in which a ratio between said distance from the first pivot axis to the pedal pad and said distance from the first pivot axis to the first slide pin is maintained constant irrespective of an adjusted position of the pedal pad which is adjusted by said pedal position adjusting means.

6. The position adjustable pedal assembly as set forth in claim 5, further comprising spring means connected to said stationary bracket at its upper end and to said first slide pin at its lower end, said spring means stretching or compressing in response to said movement of said first slide pin within said first arc-shaped slot so as to change its spring force applied to said pedal pad via said slide pin, said lever and said pedal arm, said change of the spring force absorbing variation in a required depression force to be applied to said pedal pad, said variation in the required depression force being caused by variation in said distance from the first pivot axis to the pedal pad due to the adjustment of the pedal pad position via said pedal position adjusting means.

7. The position adjustable pedal assembly as set forth in claim 5, wherein said operating member means includes a link member and an operating rod, said link member being connected to said first slide pin at its rearward end and connected to said operating rod at its forward end for a pivotal movement relative to said operating rod about a second pivot axis, and wherein said first arc-shaped slot has a radius of curvature which is the same as a distance from the first slide pin to said second pivot axis for preventing displacement of the operating rod while the first slide pin moves within said first arc-shaped slot due to the adjustment of said pedal pad by means of said pedal position adjusting means.

8. The position adjustable pedal assembly as set forth in claim 7, wherein radii of curvature of said second arc-shaped track formed on said adjust lever are preselected to maintain said distance ratio to be constant irrespective of a position of said first guide member within said second arc-shaped track.

9. The position adjustable pedal assembly as set forth in claim 8, wherein said first guide member is a second slide pin which is fixed to said pedal arm at its portion opposite to said pedal pad, and said first linear track is a first linear slot which is formed in said lever, and wherein said second slide pin is engaged into said first linear slot and further into said second arc-shaped slot formed in said adjust lever.

10. The position adjustable pedal assembly as set forth in claim 9, further comprising a second guide member in a form of a third slide pin fixed to said pedal arm below said second slide pin, said second and third slide pins being vertically disaligned from each other, and a second linear track in a form of a second linear slot formed in said lever below said first linear slot, said first and second linear slots extending in parallel to each other vertically disaligned from each other, said third slide pin being engaged into said second linear slot for a sliding movement therewithin when said pedal arm is driven to move in the longitudinal direction of the vehicle.

11. A position adjustable pedal assembly for a vehicle comprising:

- a stationary bracket fixed to a stationary portion of the vehicle;
- a lever connected to said stationary bracket for a pivotal movement relative to said stationary bracket about a first pivot axis;
- a pedal arm with a pedal pad at its lower end, said pedal arm connected to said lever for pivotal movement with said lever as one integral unit in response to a depression force applied to the pedal pad;
- pedal position adjusting means including a drive member and a driven member, said drive member adapted to be activated by a vehicle driver's operation, said driven member mounted on said pedal arm to be selectively driven by said drive member to move in a longitudinal direction of the vehicle along with said pedal arm relative to said lever so as to adjust a position of the pedal pad in the longitudinal direction of the vehicle;
- an adjust lever being generally of a Z-shape having a first portion extending generally in a forward direction of the vehicle, a second portion extending generally in a rearward direction of the vehicle and a third portion extending generally vertically to connect said first and second portions, said first portion being connected to said lever at its forward end for a pivotal movement relative to said lever and being connected to a first slide pin at its rearward end, said first slide pin engaging into a first arc-shaped slot formed in said lever for sliding movement therewithin in response to the pivotal movement of said first portion, said second portion being formed with a second arc-shaped slot having a predetermined curvature;
- operating member means including a link member and an operating rod, said link member being pivotally connected to said first slide pin at its rearward end and pivotably connected to said operating rod at its forward end for receiving the depression force from said first slide pin and for transmitting the depression force to said operating rod to operate a vehicle operation system; and
- said pedal arm provided with a second slide pin at its upper portion which is inserted into a first elongate slot formed in said lever and extending in the longitudinal direction of the vehicle, and into said second arc-shaped slot such that when said second slide pin slides within said first elongate slot and said second arc-shaped slot in the longitudinal direction of the vehicle so as to adjust the pedal pad position, the cooperation of the second slide pin and the second arc-shaped slot forces said first slide pin to slide within said first arc-shaped slot so as to vary a point of application of the depressed force relative to said link member via said first slide pin, said first arc-shaped slot having a predetermined curvature such that the sliding movement of said first slide pin within said first arc-shaped slot is prevented from displacing said operating rod.

12. The position adjustable pedal assembly as set forth in claim 11, wherein said lever is further formed with a second elongate slot below said first elongate slot, said second elongate slot extending in parallel to said first elongate slot, forward and rearward ends of said first and second elongate slots are vertically disaligned, respectively, and said pedal arm is further provided with a third slide pin below said second slide pin, said third slide pin being inserted into said second elongate slot for sliding movement therewithin, said second and third slide pins being vertically disaligned from each other.

* * * * *

Exhibit 7

US005998892A

United States Patent [19]

Smith et al.

[11] Patent Number: 5,998,892

[45] Date of Patent: Dec. 7, 1999

[54] ROTARY POSITION SENSOR WITH INSERT MOLDED COIL WINDING

[75] Inventors: Scott D. Smith, South Bend; John Pillow, III, Elkhart; Murray Kaijala, Elkhart; John R. Gietzen, Elkhart; Stephen V. Stepke, Elkhart; Steve E. Villaire, Elkhart; Jeffrey A. Fritz, Goshen; Michael J. Smith, Nuneaton, all of United Kingdom

[73] Assignee: CTS Corporation, Elkhart, Ind.

[21] Appl. No.: 09/034,764

[22] Filed: Mar. 4, 1998

Related U.S. Application Data

[63] Continuation of application No. PCT/US96/14524, Sep. 4, 1996

[60] Provisional application No. 60/003,221, Sep. 5, 1995.

[51] Int. Cl.[6] H02K 11/00

[52] U.S. Cl. .... 310/68 B; 251/129.01; 251/129.11

[58] Field of Search .... 310/68 B, 67 R; 338/118, 162, 184, 190; 251/129.01, 129.11

[56] References Cited

U.S. PATENT DOCUMENTS

2,462,761	2/1949	Momberg	310/169
3,480,812	11/1969	Hershberger	310/168
4,139,831	2/1979	Ortlieb et al.	33/128
4,398,135	8/1983	Busch et al.	318/443
4,463,291	7/1984	Usry	318/254
4,601,271	7/1986	Ejiri et al.	123/361
4,853,567	8/1989	Muramatsu et al.	310/67 R
5,111,098	5/1992	Peck et al.	310/268
5,113,172	5/1992	Lang	338/171
5,689,994	11/1997	Nagai et al.	74/89.15
5,738,072	4/1998	Bolte et al.	123/399

FOREIGN PATENT DOCUMENTS

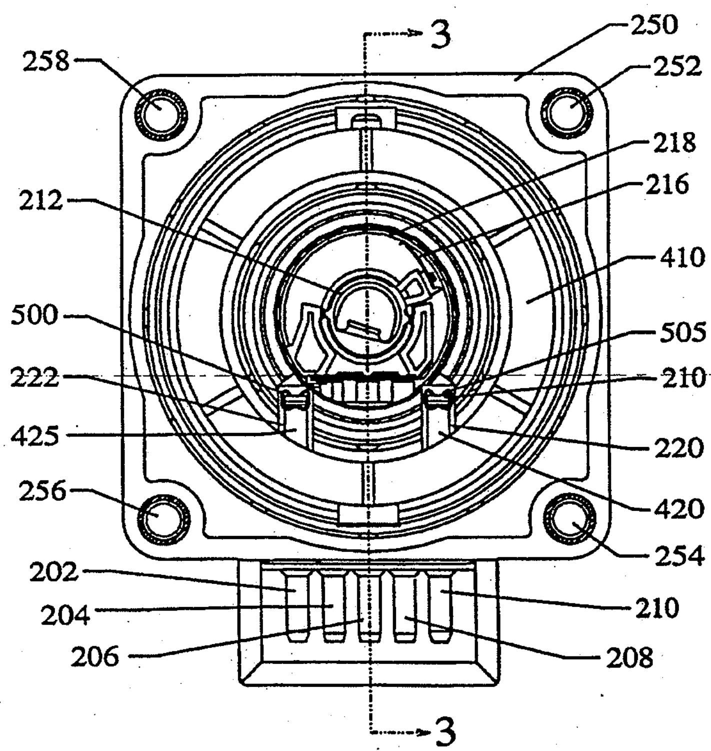
0 375 050 B1 12/1989 European Pat. Off..

Primary Examiner—Nestor Ramirez
Assistant Examiner—Joseph Waks
Attorney, Agent, or Firm—Albert W. Watkins; Mark R. Bourgeois; Michael W. Starkweather

[57] ABSTRACT

A motor stator 400 is integrated with a position sensor 200 through a novel attachment ring 600. Electrical connection to the integrated device is through terminals 202, 210 that pass through the position sensor housing 250. The stator 400 is preferably overmolded, though other suitable forms of encapsulation are contemplated. The attachment ring 600 is preferably ultrasonically bonded to the sensor 200 during manufacture, prior to insertion of the motor armature 430. Other methods of attachment are contemplated, and various types of motors and sensors are also contemplated.

16 Claims, 3 Drawing Sheets



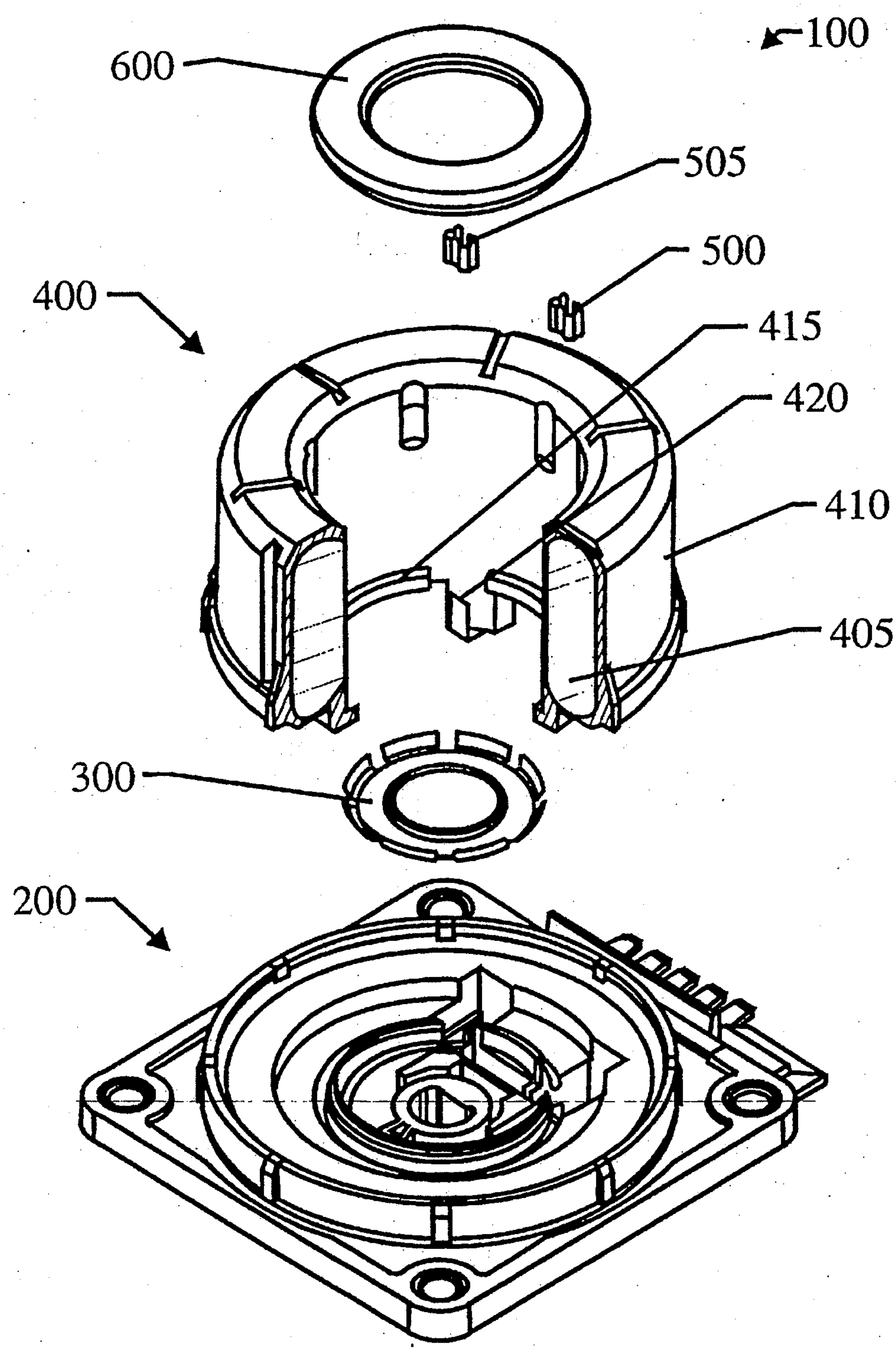


FIGURE 1

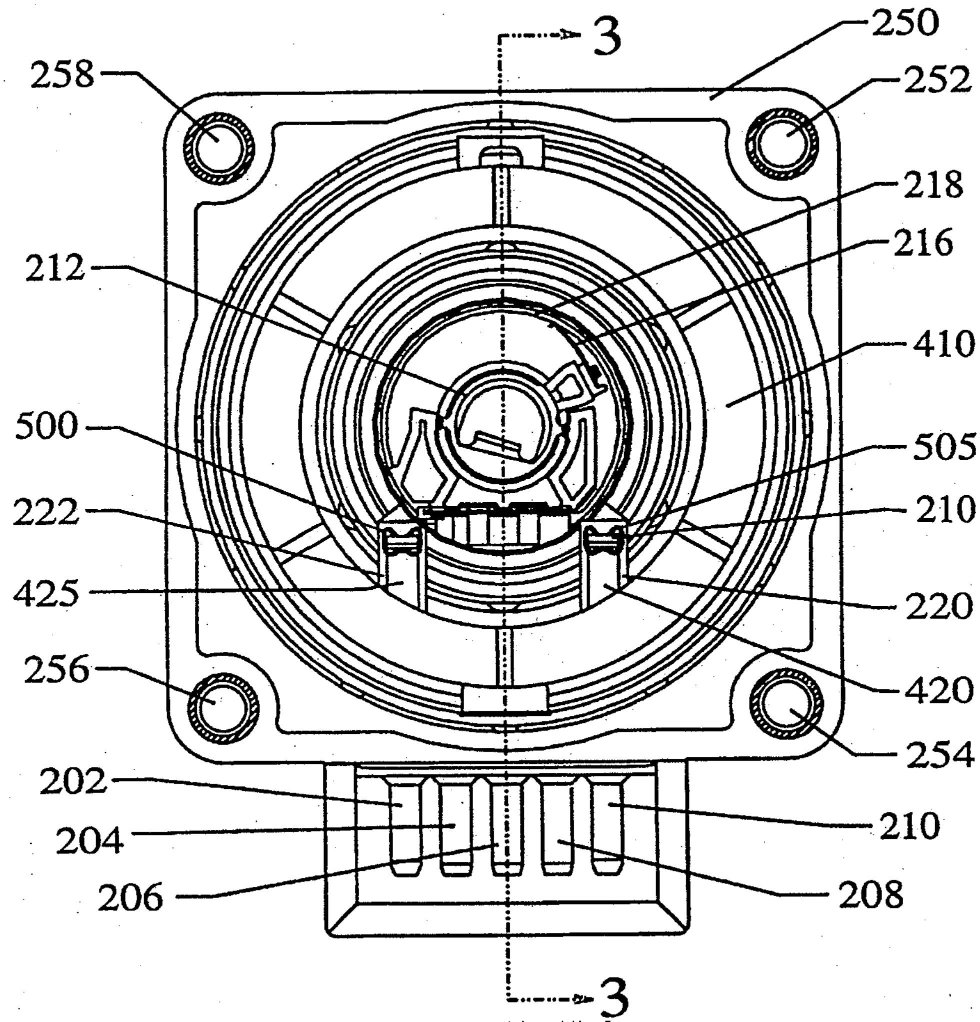

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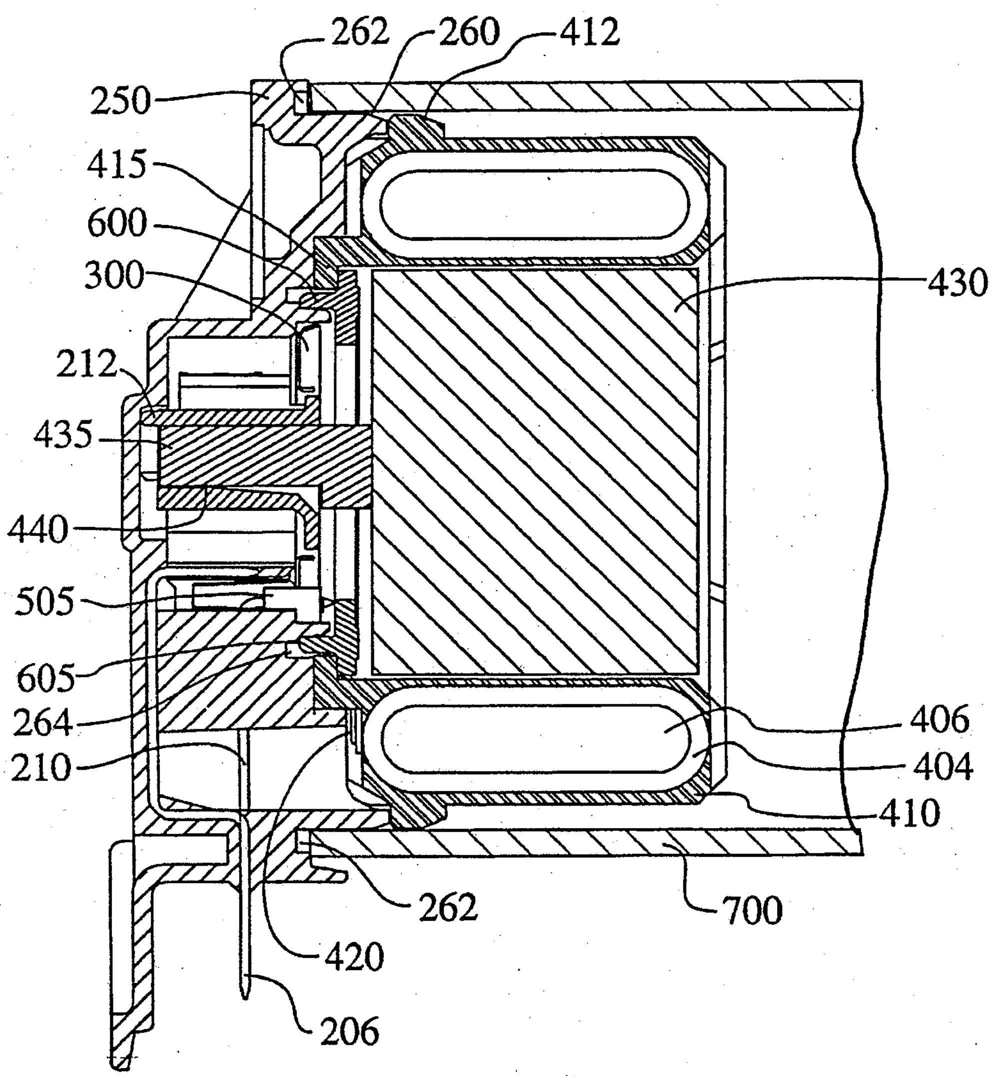
FIGURE 2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260
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600
300
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430
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700
420
206

FIGURE 3

ROTARY POSITION SENSOR WITH INSERT MOLDED COIL WINDING

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation of international application number PCT/US96/14524, filed Sep. 4, 1996, (status, pending, etc.); incorporated in entirety by reference hereby.

This application is a continuation in part of U.S. application 06/003,221, filed Sep. 5, 1995, entitled "Rotary Position Sensor with Insert Molded Coil Winding".

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention pertains to servomotors and servomechanisms generally, and in one facet, to throttle position sensors integrated with throttle actuator motors.

2. Description of the Related Art

For many years, man has relied upon motors to assist in various work functions. With the advent of more advanced electrical and electronic circuits, motors have been controlled by these circuits to improve efficiencies, provide precision placements or timings, and perform other various monitoring and control functions. Motor control has enabled man to use motors in applications beyond those strictly requiring great force or enduring power.

Motors today are used for positioning with more precision in space or time than obtainable with hand manipulation, and in environments which are inhospitable to human presence. These motors, commonly referred to as servomotors, form a part of a servomechanism. The control of the servomotor is often derived from a sensor directly attached to the motor, and may also be derived from other remote sensors. The servomotor may include a rotary, linear or other type of motor, depending upon the requirements of each specific application.

Machines as complex as most transportation vehicles today have many applications for servomechanisms. One specific application involves the control of internal combustion engine throttle. Control of throttle in passenger cars and trucks is usually dependent upon the position of an accelerator pedal, which represents vehicle operator demand. The accelerator pedal position, or demand, is then linked to the engine throttle. Accelerator pedal movement was transmitted for many years through mechanical linkages consisting of solid rods and ball joints. In some applications, the solid rod linkage was replaced by a cable within a sleeve, referred to in the trade as a Bowden cable. These mechanical linkages are prone to problems which tend to affect all mechanical systems, such as sticking, freezing, breakage, and other ~~mishaps. In addition, adaptation of the mechanical linkages~~ to allow for special features such as more efficient energy utilization, reduced emissions, idle speed control, and "limp-home" modes of operation are generally not practical, or even possible in some cases.

By using a sensor to sense accelerator demand, a servomotor to control the throttle position, and a computer system to control operation of the throttle relative to the input from the accelerator pedal sensor and other various sensed inputs, a variety of special features may be incorporated into the accelerator-throttle linkage. In these computer-assisted systems, the throttle linkage is commonly referred to as a "drive-by-wire" system, since the linkage is electrical.

The servomechanism becomes a remote control system, since a vehicle operator within a climate controlled passenger compartment controls a throttle located in the harsh climate of an engine compartment. In fact, remote control is a very common use for servomechanisms. The control of functions ranging from TV and radio tuners to space shuttle door releases and valve controls all are remote control applications. Once again, the desire for remote control may stem from precision in timing or positioning achievable from the servomechanism, or from the need to control a function in a harsh environment where human interventions may not be practical.

Each of these applications require a motor, and also a sensor to sense the position of the motor. A number of schemes have been devised for coupling the sensor to the motor, including magnetic coupling, where the sensor detects the magnetic flux produced by certain section of the armature optical coupling, where a toothed wheel breaks a passage of light or a reflective surface reflects the light during rotation; mechanical coupling, where the motor armature is used to directly drive the sensor or drive the sensor through such mechanical devices as gears, and other known methods. Each of these different coupling methods has benefit in specific applications.

In addition to coupling the sensor and the motor, the sensor must also be physically positioned relative to the motor. Direct integration between the motor stator, also sometimes referred to as the field winding, and the sensor is desirable, since parts counts are reduced and common functions may be removed to avoid duplication and reduce cost. In the prior art, direct integration often involved the placement of an open frame sensor, often of the resistive or magnetic field sensing type, directly within a servomotor housing designed to contain both the motor and the sensor. The relatively light weight sensor is easily carried within the more rugged motor housing, and the housing does not need to be duplicated for both components. Unfortunately, in this type of prior art servomotor, the sensor is exposed to contaminants from the motor which are adverse to the life and reliability of the sensor. In addition, less control is available over the contactor, paint and lubricant. All three must be carefully controlled to ensure long life and reliability of the sensor. For example, a sensor designed to operate through tens or hundreds of millions of cycles will fail after only a few million cycles if the contactor is bent. In addition, the motor may be destroyed if some part of the sensor should detach, flow or bend and interfere with motor movement.

An alternative prior art design combines a fully housed, assembled and tested sensor with a similarly housed and assembled motor. The sensor is merely driven from the motor shaft, with no other interaction between the two components. This design eliminates any concerns about contamination of the sensor or motor. Unfortunately, the ~~parts which must be handled, inventoried, and serviced is~~ also greater, as is the cost of the components. Furthermore, the fully housed sensor of the prior art generally includes a separate set of bearings from the motor, leading to potential axial misalignment of bearings, which will result in early failure of the sensor bearings. In fact, proper axial alignment is very crucial to the longevity of a servomotor.

SUMMARY OF THE INVENTION

A position sensor is combined with a coil by a novel retaining ring. Electrical connection of the coil is achieved entirely through the position sensor, which is housed separately from the coil. In one facet of the invention, the coil is cylindrical and coaxial with the position sensor, and the position sensor is a rotary type potentiometer. In another facet of the invention, the retaining ring is ultrasonically bonded to the potentiometer housing and clamps a lip on the coil housing to retain the coil to the position sensor. In another facet of the invention, a throttle shaft is actuated by a servomotor which is formed as an integral structure and terminated through terminals extending from the servomotor position sensor housing.

OBJECTS OF THE INVENTION

A first object of the invention is the integration of a sensor and motor to form a servomotor. Another object of the invention is to form a reliable servomotor which is capable of exposure to harsh and rugged environments while still retaining high reliability and long life. Yet another object of the invention is a reduced piece part servomotor which may be produced with high yield in modular fashion with minimal waste and maximum yield. These and other objects of the invention are achieved in the preferred embodiment, which may be understood from the following description and drawing figures.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates a preferred embodiment servomotor in accord with the invention from an exploded perspective view.

FIG. 2 illustrates the servomotor of FIG. 1 from a top view with the cover and retainer ring removed for improved viewing detail.

FIG. 3 illustrates a cross-section view of the servomotor of FIG. 2 taken along section line 3, with the cover and retaining ring in place.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIGS. 1–3 illustrate servomotor 100, with FIG. 1 shown from an exploded view, without an armature for purposes of illustration. Therein, sensor 200 forms a base upon which the additional components may be assembled. Sensor 200 is very similar to those illustrated in U.S. Pat. Nos. 5,460,035 and 5,520,044 to Pfaffenberger and assigned to the present assignee, the teachings of which are incorporated herein by reference. Other sensors of the Hall effect type which can be adapted to the teachings of the present invention are illustrated in copending U.S. patent applications Ser. Nos. 08/206,982, 08/206,474, and 08/206,568 each filed Mar. 4, 1994 and assigned to the present assignee, and each incorporated herein by reference.

Into sensor 200 a cover 300 is placed, and onto sensor 200 stator 400 is placed. Stator 400 includes a wound coil 405 which has been overmolded with a plastic shell 410. While overmolding with plastic is illustrated, one of skill in the art will understand that molding is one of many alternatives available for encapsulating wound coil 405, and that shell 410 may be formed by potting or any other suitable alternative. Stator 400 additionally includes a retention lip 415 and electrical terminations 420 and 425 (termination 425 is visible in FIG. 2). Retention lip 415 is generally circular, but does not extend adjacent terminations 420 and 425, thereby ensuring as much access as possible to terminations 420, 425 during assembly. Termination clips 500 and 505 will assist in making electrical connection between terminations 420, 425 and the appropriate terminals within sensor 200. Retainer 600 fits along its outer diameter within stator 400 but not past retention lip 415.

Stator 400 is assembled to sensor 200 by first guiding terminals 420 and 425 into alignment passageways 220 and 222, and ultimately into contact with sensor terminals 202 and 210. Electrical connection between sensor terminal 210 and termination 420 is achieved with bow tie shaped termination clip 505, and electrical connection between sensor terminal 202 and termination 425 is similarly achieved with bow tie termination clip 500. Termination clips 500, 505 are pressed from the position shown in FIG. 1 into engagement with respective terminals 202, 210 and terminations 425, 420, where they provide a spring force to maintain each terminal in sound electrical contact with the respective termination. Other methods of electrical interconnection besides the bow tie design clips 500, 505 are contemplated, including other clip geometries and other methods such as soldering, spot welding and other known methods, depending upon the requirements for the specific application. However, bow tie termination clips 500 and 505 are preferred for ease of assembly.

Once electrical interconnection between sensor 200 and stator 400 is achieved, mechanical support is required. Mechanical support is obtained in the preferred embodiment through the attachment of stator shell 410 to sensor 200. While various methods were contemplated for this attachment, including direct attachment between stator shell 410 and sensor 200, in the preferred embodiment of the invention retainer 600 is used. Retainer 600 passes within the inner diameter of plastic shell 410. but not within retention lip 415. Retainer 600 is shaped to extend beyond retention lip 415 to engage sensor 200. In the preferred embodiment, retainer 600 is placed adjacent retention lip 415 and then pressed against sensor 200. Next, retainer 600 is ultrasonically welded to sensor 200. The space available for a motor armature on the inner diameter of stator 400 provides access for electrical connection with termination clips 500, 505, and also provides access required for the ultrasonic welding process. While ultrasonic welding is preferred due to the rapid assembly achieved. relatively low cost, and cleanliness of operation, other known methods of adhesion may also be used, such as gluing, heat staking, etc. However, the attachment method must take into consideration the desire to not disturb the components and features within sensor 200, so as to preserve the life and reliability of sensor 200.

The assembled servomotor 100 is illustrated in FIGS. 2 and 3. FIG. 2 shows from a top view the assembled servomotor, with cover 300, retainer 600 and armature 430 removed. to allow viewing of the many elements therein. FIG. 3 shows a cross-section of servomotor 100 with cover 300. retainer 600 and armature 430 in place, and also including throttle body barrel 700, otherwise taken along section line 3 of FIG. 2. Terminals 202 and 210 provide electrical connection to wound coil 405, which consists of winding 404 and coil core 406. Electrical connection is accomplished from terminal 210 to termination 420 with the aid of termination clip 505. Termination 420 may be soldered, spot welded, wire-wrapped or otherwise attached to winding 404, preferably prior to forming of plastic shell 410. Terminal 202 comprises the other electrical connection to winding 404, through termination clip 500 and termination 425. The additional terminals 204, 206 and 208 provide positive and negative supply voltage and sensed position output. It will be understood that one or more of these terminals can be combined, depending upon the requirements of each individual application.

Rotor cup 212 engages armature shaft 435 and is featured to be properly positioned therewith along shaft locator flat 440. As armature 430 is rotated, rotor cup 212 will also be rotated. This in turn causes movement of contactor 216, which provides electrical connection on resistance element 218. the position which is represented by a voltage which is transmitted through one of terminals 204–208. Sensor 200 additionally includes a housing 250 which has four mounting holes 252, 254, 256 and 258 therein. Mounting holes 252–258 are used to retain sensor 200 and stator 400 in place, and so are heavier than would normally be found on a prior art sensor.

Most visible in FIG. 3 are the press-fit diameters 260 and 412, and mounting stop 262. The present servomotor is designed specifically for throttle applications, and is designed to fit within barrel 700 on the side of a throttle body. Barrel 700 is cylindrical, so plastic shell 410 will be inserted first into barrel 700, then press-fit 412, next press-fit 260, and finally mounting stop 262 will engage barrel 700, thereby ensuring tight fit and proper mounting placement. Other features will be provided by one skilled in the art for other mounting geometries.

Also visible in FIG. 3 is the placement of retainer 600 into retainer groove 264. The inside diameter of welding protrusion 605 is slightly smaller than the inside diameter of retainer groove 264, causing interference between the two. Ultrasonic energy is used in the preferred embodiment to cause the interfering material to be flowed out as retainer 600 is welded to sensor housing 250. Retainer 600 also engages retention lip 415, thereby holding stator 400 to sensor 200. In this preferred embodiment, retainer 600 is placed inside stator 400. However, one of skill in the art will observe from the teachings herein that other placements are available, such as around the outer diameter of stator 400. When retainer 600 is placed inside stator 400, cover 300 may be formed integrally with retainer 600 as opposed to being formed separately as illustrated. By forming integrally, assembly is simplified and piece part count is further reduced.

Direct mechanical coupling between armature 430 and sensor 200 is illustrated in the preferred embodiment, though other coupling methods will be apparent to those skilled in the art. A variety of sensor types may be also used, including resistive, magnetoresistive, Hall cell, etc., depending upon the requirements of each particular servomotor application. Furthermore, shaft 435 may be the throttle shaft, onto which armature 430 has been placed.

It is very important that stator 400 be placed coaxially with rotor cup 212 and housing 250. Optimum motor performance requires an absolute minimum of clearance between stator 400 and armature 430. Lack of concentricity will either increase minimum tolerances required therebetween, or will lead to interference, which would adversely affect motor performance. To ensure concentricity, the coil and housing are fixtured together on a common pilot during ultrasonic welding.

While the foregoing details what is felt to be the preferred embodiment of the invention, no material limitations to the scope of the claimed invention are intended. Further, features and design alternatives that would be obvious to one of ordinary skill in the art are considered to be incorporated herein. The scope of the invention is set forth and particularly described in the claims hereinbelow.

We claim:

1. A position sensor combined with a motor stator coil energizable to rotate a motor rotor or armature comprising:

a position sensor housing encompassing said position sensor and including a housing mounting portion for mounting said position sensor housing to a throttle body, said position sensor housing mounted to said throttle body adjacent an opening thereon and covering said opening;

a motor stator coil housing encompassing said motor stator coil;

connecting means for electrically connecting said motor stator coil through said position sensor housing; and

retaining means for retaining said motor stator coil housing to said position sensor housing.

2. The position sensor coil combination of claim 1 wherein said motor stator coil is cylindrical with a center bore therethrough, having an inner circumference within said center bore and an outer circumference, said retaining means having a smaller inner diameter than said inner circumference of said center bore.

3. The position sensor coil combination of claim 2 wherein said retaining means further comprises a generally flat disc having a hole therethrough and a flange, said disc hole generally concentric to said center bore but of a smaller diameter, said disc further having an outer diameter greater than said retaining means inner diameter.

4. The position sensor coil combination of claim 3 wherein said flange is bonded to said position sensor housing.

5. The position sensor coil combination of claim 3 wherein said flange is ultrasonically bonded to said position sensor housing.

6. The position sensor coil combination of claim 4 wherein said position sensor is a rotary position sensor.

7. The position sensor coil combination of claim 1 further comprising:

electrical sensor terminals attached to said position sensor and passing through said position sensor housing; and

electrical motor terminals attached to said motor stator coil and electrically coupled to said connecting means.

8. The position sensor coil combination of claim 7 wherein said connecting means comprises one of said electrical sensor terminals.

9. The position sensor coil combination of claim 8 further comprising an external electrical connector housing attached to said sensor housing for electrically coupling said electrical sensor terminals and said connecting means to at least one external device.

10. The position sensor coil combination of claim 1 further comprising a retention protrusion extending from said motor stator coil housing for engagement with said retaining means.

11. The position sensor coil combination of claim 1 wherein said motor stator coil and said position sensor share a common electrical ground within said connecting means.

12. The position sensor coil combination of claim 1 wherein said housing mounting portion further comprises a mounting hole.

13. The position sensor coil combination of claim 1 wherein said housing mounting portion further includes said connecting means.

14. The position sensor coil combination of claim 1 wherein said opening in said throttle is a barrel.

15. A throttle body servomechanism located within a barrel extending from a throttle body for rotating a throttle butterfly about a throttle shaft comprising:

a rotary position sensor having an opening receiving said throttle shaft therein and having electrical terminals extending therefrom and further having sensor locating means to locate said rotary position sensor relative to said barrel;

a motor stator electrically connected to said electrical terminals, said motor stator coaxial with said throttle shaft and having said throttle shaft passing therethrough, said motor stator having motor stator locating means to locate said motor stator relative to said barrel, wherein said rotary position sensor covers said barrel;

a motor armature mechanically connected to said throttle shaft and coaxial therewith, said motor armature concentric and inside of said motor stator; and

a retainer means for retaining and rigidly attaching said motor stator to said rotary position sensor.

16. The throttle body servomechanism of claim 15 further comprising a resistance element and a contactor within said rotary position sensor which provide a potentiometric indication of a relative rotary position of said throttle shaft.

* * * * *

Exhibit 8

US005408899A

United States Patent [19]

Stewart

[11] Patent Number: 5,408,899

[45] Date of Patent: Apr. 25, 1995

[54] FOOT PEDAL DEVICES FOR CONTROLLING ENGINES

[75] Inventor: Joseph L. Stewart, Dearborn Heights, Mich.

[73] Assignee: Brecom Subsidiary Corporation No. 1, Warren, Mich.

[21] Appl. No.: 75,885

[22] Filed: Jun. 14, 1993

[51] Int. Cl.[6] F02D 11/10; G05G 1/14

[52] U.S. Cl. 74/513; 74/514; 74/560; 123/399

[58] Field of Search 74/513, 514, 560; 123/361, 399; 180/335

[56] References Cited

U.S. PATENT DOCUMENTS

Re. 34,302 7/1993 Imoehl 123/399
Re. 34,574 4/1994 Imoehl 123/399
4,582,653 4/1986 Blanchard et al. .
4,869,220 9/1989 Imoehl .
4,915,075 4/1990 Brown .
4,944,269 7/1990 Imoehl .
4,958,607 9/1990 Lundberg .
5,233,882 8/1993 Byram et al. 74/514

FOREIGN PATENT DOCUMENTS

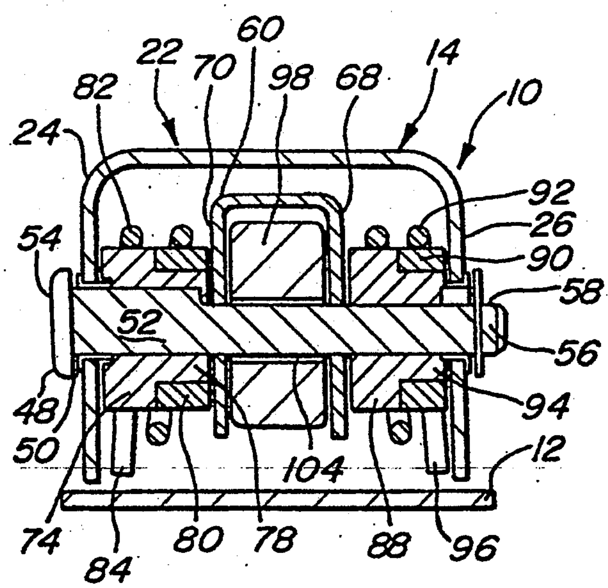
4-128519 4/1992 Japan 74/513

Primary Examiner—Richard M. Lorence
Attorney, Agent, or Firm—Krass & Young

[57] ABSTRACT

An accelerator pedal for electronic, "by wire" control which provides the customary feel of mechanical control systems heretofore predominantly in use including a hysteresis effect. Readily available simple mechanical components coupled to a sensing and transmitting device are employed.

14 Claims, 4 Drawing Sheets



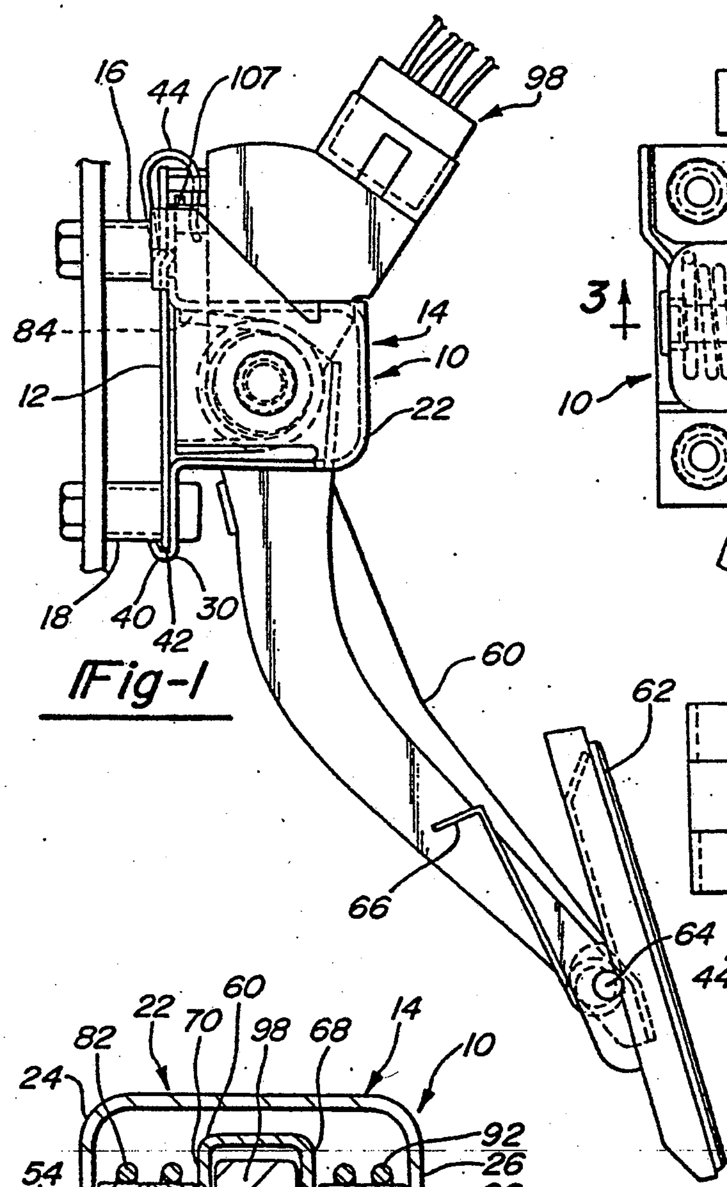


Fig-1

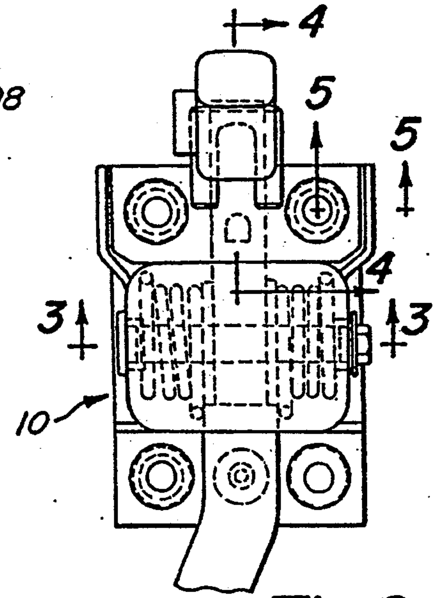


Fig-2

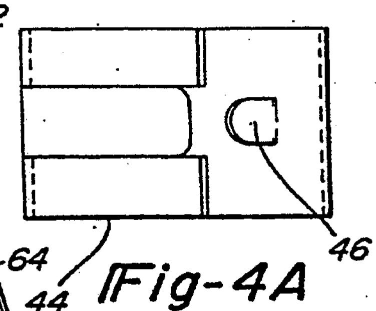


Fig-4A

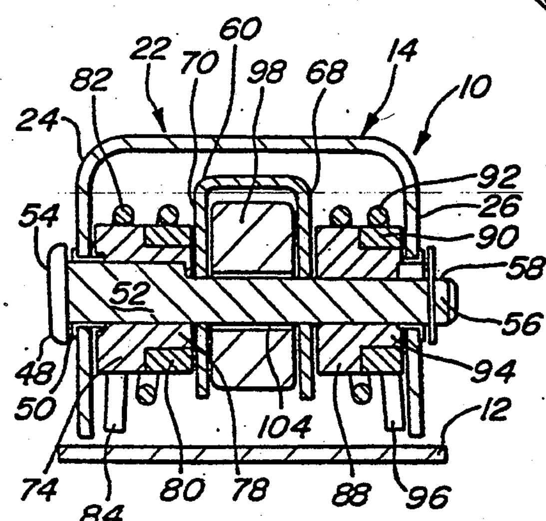


Fig-3

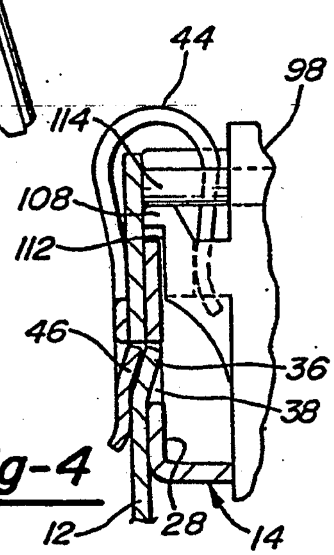


Fig-4

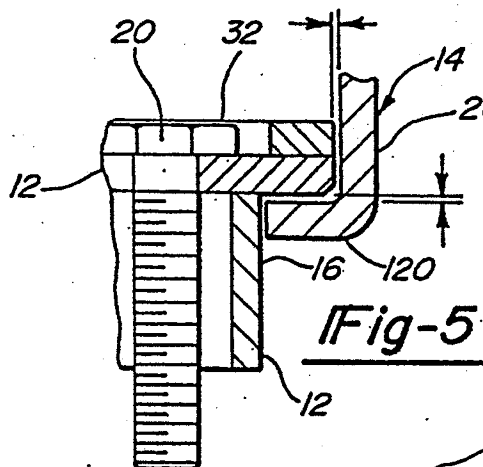


Fig-5

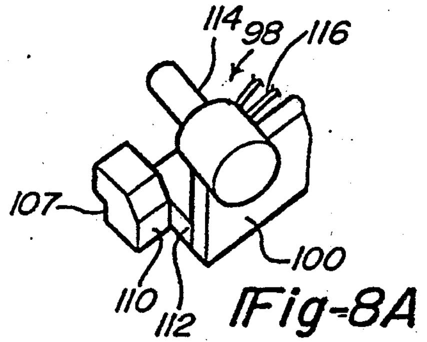


Fig-8A

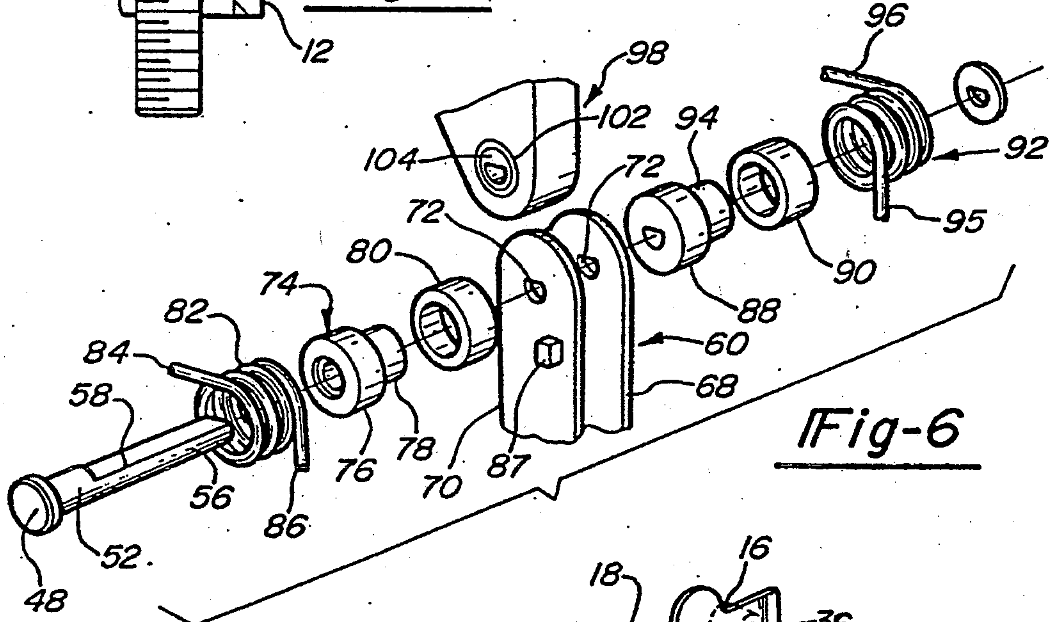


Fig-6

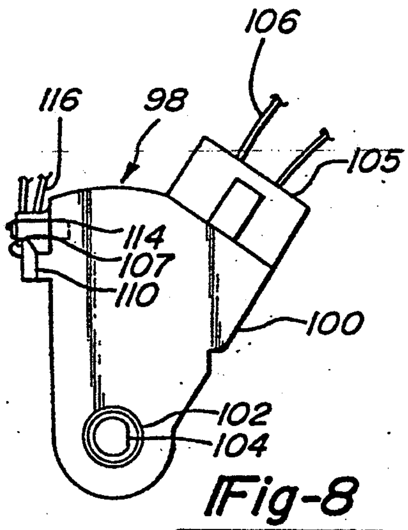


Fig-8

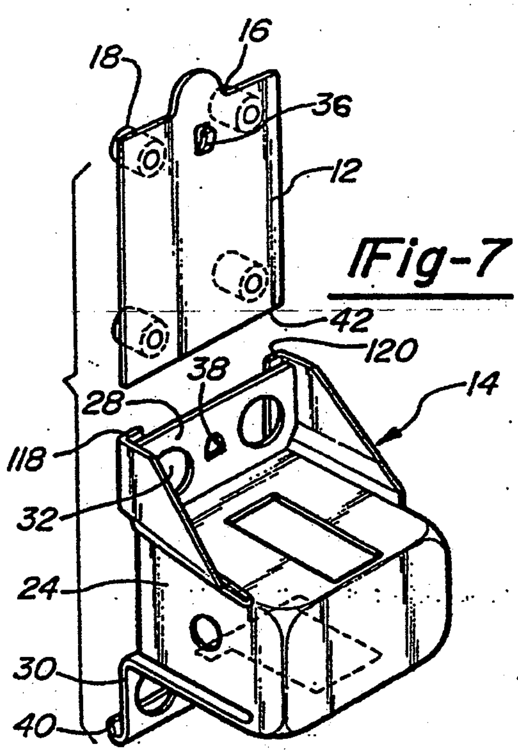


Fig-7

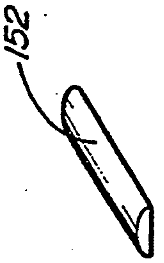


Fig-11

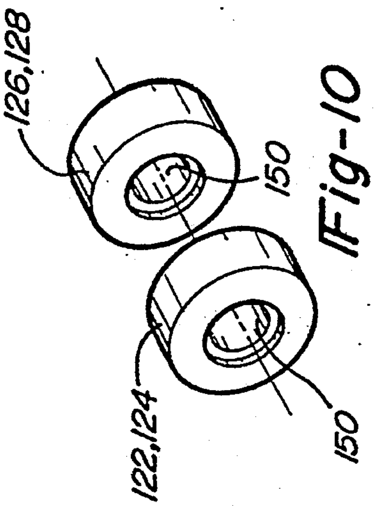


Fig-10

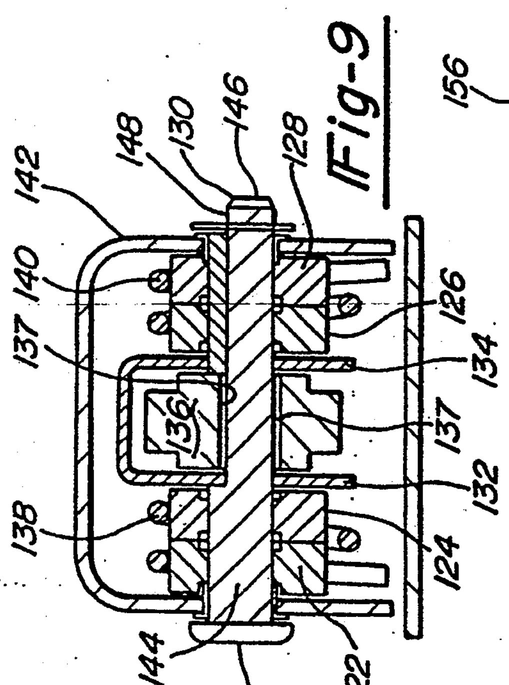


Fig-9

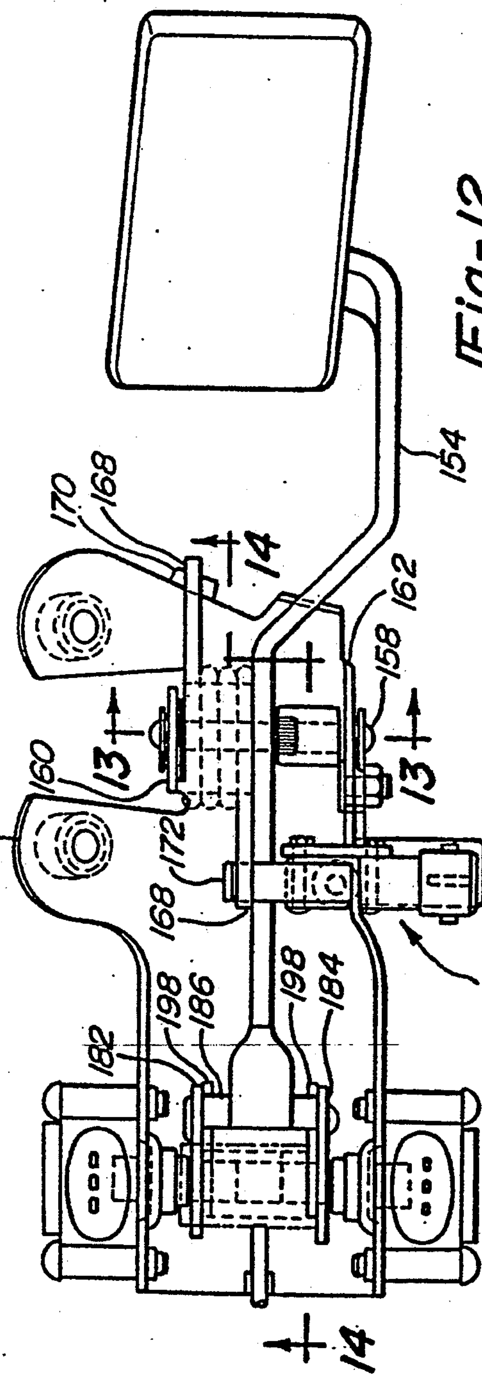


Fig-12

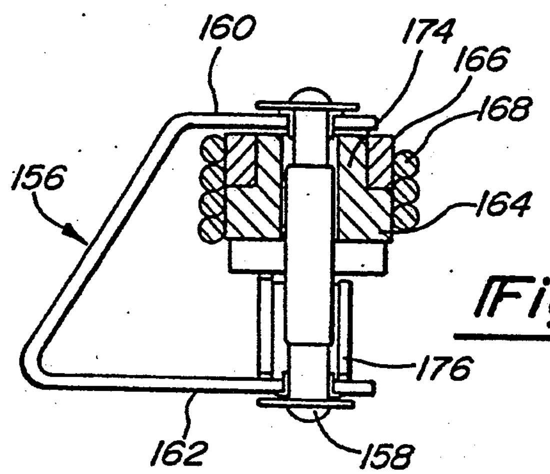


Fig-13

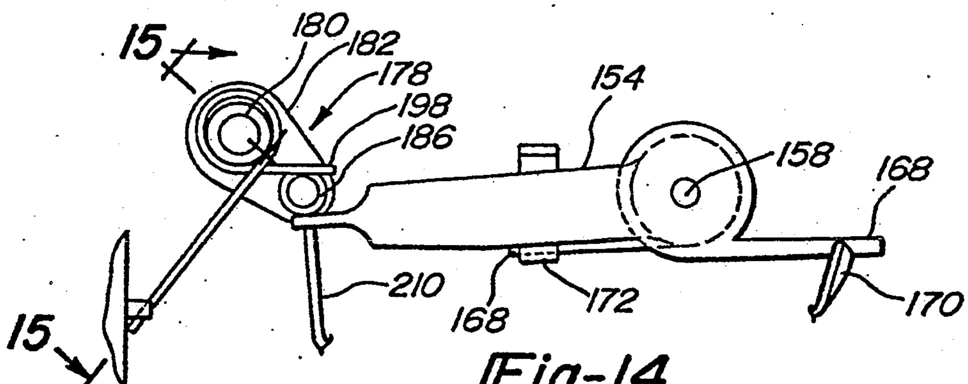


Fig-14

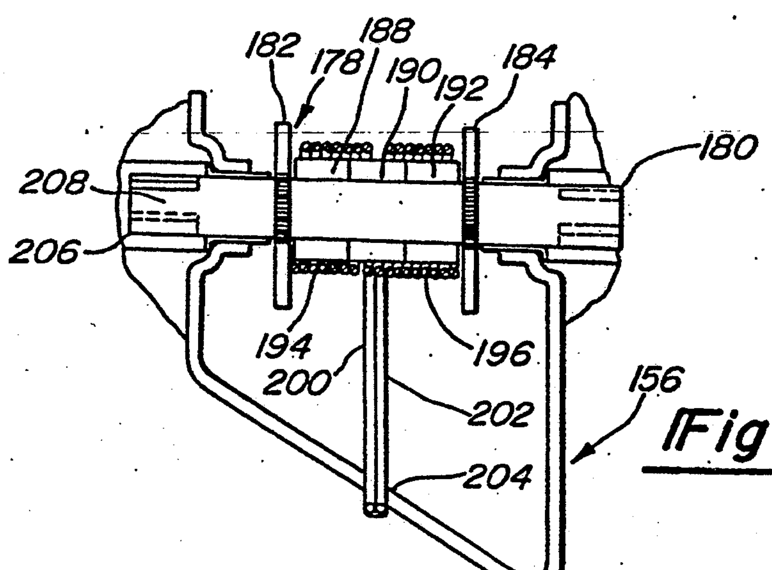


Fig-15

FOOT PEDAL DEVICES FOR CONTROLLING ENGINES

BACKGROUND OF THE INVENTION

1. Field Of The Invention

This invention relates to foot pedal devices for controlling engines such an internal combustion engines, and more particularly, to means for providing control without the need for direct mechanical connection between the pedals and the engines. The invention is particularly directed to providing means and methods for control by wire, i.e., by electrical or electronic means rather than by mechanical links. In the automotive art, accelerator type foot pedals are employed for controlling the flow of fluids to the engines. These usually include a pedal mounting affixed to the vehicle body and a series of links and levers, or bowden wires, connecting the pedal to the carburetor, fuel injector, controller or the like. These link connections usually must be designed to withstand and accommodate engine movements relative to the vehicle frame, as well as to provide accurate control despite such movements. In addition, space must be provided for the linkages to function properly. The choices for routing of the mechanical control rods or wires are limited by their nature. With electrical sensing means directly associated with the pedal, the connection to a carburetor or the like can be accomplished with electrical wiring which relatively speaking, can free the connection problems from the special physical relationships of the older mechanical systems.

Wire type throttle control for motor vehicle engines has been known heretofore. Some construction vehicles, buses and large trucks have used some form or the other for some time. In these instances, however, pedal or other lever control means can be designed without regard to some of the restraints that apply to automobile use. Pedals can be more rugged, higher pedal pressure can be tolerated and less responsive action can be overlooked. Generally, the requirements reflect the usage of the vehicle. For example, the requirement of a system for a rough off-road vehicle would likely reflect its prospective usage. With passenger cars pedal pressures and reaction times are more critical. The pedal system must be one that provides a customary feel and performance for the "typical" driver. Safety of operation with rapid yet controlled return from a high load position to a lower idle position are important considerations, as is the amount of force needed to maintain a desired speed setting. The pedals must function responsively and quickly to the operator's commands and also provide an acceptable non-fatiguing resistance. Drivers are accustomed to applying and releasing pressure on a pedal-like arrangement and become accustomed to the resistance to application of force to the pedal as well as to the rate of withdrawal as the applied pressure is relaxed. With the instant invention, the customary feel during the application of force to increase speed and while maintaining speed, as well as the familiar deceleration movement of the pedal can be duplicated in a wire type control.

With the typical auto, the pedal pressure required when advancing the accelerator pedal is greater than that required to maintain a fixed position. This difference is often referred to as due to the hysteresis effect. This "effect" is important in maintaining the accelerator pedal in position while driving at a relatively constant speed, and it must also be considered in achieving a desired deceleration time. The pressure which must be applied in accelerating is easily borne but if the back pressure of an accelerator spring produced the same effect during the time it was required to retain or maintain speed it would soon become uncomfortable for the operator to maintain a relatively constant speed. The hysteresis effect provides relief. It lessens the load required to maintain a setting of the accelerator yet there is still force to cause reverse pedal action when the foot applied pressure is removed. This invention provides means for insuring a hysteresis effect which will give the desired reduction in pressure while maintaining speed, as contrasted to the resistance experienced in accelerating, and yet with which there will be insured an appropriate force to return the system to idle.

FEATURES OF THE INVENTION

According to the invention in a preferred form the accelerator pedal is supported by a shaft mounted in a bracket which can be easily placed in the desired position on the vehicle for comfortable use by an operator. An electronic sensing device also preferably mounted in the bracket is mechanically associated with the pedal or its supporting shaft so as to sense the movement of the pedal. The sensed movement is transmitted electrically to an engine controller. A torsion spring is used to exert force between the bracket and the pedal constantly urging the pedal toward idle position. The spring must be supported along its length. Thus the spring coils are supported by an arrangement mounted on the shaft in the form of at least a pair of spacers. The spring closely fits the spacers and contacts the spacers. The spring coils bear directly against the spacers and the spacers are rotatably mounted on the shaft which supports the pedal thus the spring is also supported by the shaft. Further the torsion spring is locked at each end with one end being fixed relative to the bracket and the other to the pedal. The spring ends bear heavily against the spacers in their locked positions and this in turn causes frictional contact between the spacers and their support on the shaft. As the spring is twisted when the pedal rotates the coils offer resistance to the movement of the lever. Furthermore the interaction between the coil spring and the spacers and the spacers and the shaft produces a frictional resistance to movement which adds to the natural resistance of the spring coil itself during movement of the pedal in an accelerating effort. This frictional resistance encountered during acceleration also plays a part if the coils start to unwind or if the decision of the driver is to maintain a constant speed. It is this frictional resistance in the coil-spacer-shaft association that provides the hysteresis effect. This effect and the resistance to the initial downward movement of the pedal can be controlled by selection of components and their physical relationships.

With the use of at least a pair of spacers the desired friction resistance can be obtained, the coil properly supported and yet the life expectancy of the system greatly improved. The use of at least two spacers, as will be explained hereinafter, reduces the amount of wear caused by rubbing of the spring upon its supports and of its supporting elements such as spacers with respect to a shaft, as contrasted to the wear that would occur if a single unitary support for the spring along its whole length was used.

Reliability over long periods of time with little or no maintenance is also critical with passenger car equipment. Often virtual neglect of maintenance is the choice of many owners. Unlike commercially well maintained vehicles ordinary passenger cars must go for extended period without service or even an inspection for preventive maintenance. Travel of the spring coil upon the surface of a pair of spacers rotatably supported upon a shaft will be less then upon a single spacer or a shaft itself. With use of at least a pair of spacers the desired frictional and supportive relationship of the spring to the lever can be obtained, the hysteresis effect can be more readily adjusted and life expectancy can be greatly improved.

A further feature of the invention is that commonly available components can be used in incorporating its concepts.

A further requirement for an engine controller is insurance of a return to neutral or idle position whenever the pedal is released. According to the instant invention the very nature of a unique pedal mounting can be utilized to ensure a return to idle even should there be a failure elsewhere. According to the invention a normally functioning pedal control as well as an override idle control are contained in one single readily attachable unit having a mounting bracket. A single mounting bracket can thus be employed yet maximum reliability achieved. Both the normal pedal actuated return to idle and the idle override function upon the release of the pedal. Yet the override function is independent of and operates regardless of any slow moving sequence which might occur via the pedal to controller channel or in the event of a complete failure of the controller system. According to the invention the bracket can be formed of two relatively movable elements with one element fixed and the other movable upon application of pedal pressure, coupled with an idle override means which senses their relative positions. This is in addition to the sensing means associated with the pedal which normally signals for an idle position whenever the pedal is released. Upon actuation of the pedal to increase speed one of the bracket parts will move relative the other deactivating the override feature. However, upon release of the pedal the bracket parts return to their idle position relationship causing the idle override to reinitiate the idle override signal. Even if the pedal to control System should cease functioning and or stick in a higher than idle position the relaxation of pressure on the pedal also relieves pressure on the bracket and the idle override will become effective.

These and other advantages and objects will become apparent from the following description and the accompanying drawings wherein:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevation of an accelerator pedal including a supporting bracket;

FIG. 2 is a front elevation of an accelerator pedal;

FIG. 3 is a fragmentary section taken along line 3—3 of FIG. 2;

FIG. 4 is fragmentary section taken along line 4—4 of FIG. 2;

FIG. 4*a* is a plan view of a spring;

FIG. 5 is a fragmentary section taken along line 5—5 of FIG. 2;

FIG. 6 is a fragmentary perspective view showing pairs of spacers and torsion springs in association with a pedal and a sensing device;

FIG. 7 is a fragmentary perspective view of a bracket;

FIG. 8 is a side elevation of a sensor;

FIG. 8*a* is a fragmentary perspective view of the sensor;

FIG. 9 is a fragmentary section view similar to FIG. 3 but showing a second form of spacer-pedal-bracket-spring arrangement;

FIG. 10 is a perspective view showing a pair of spacers;

FIG. 11 is a perspective view showing a shaft insert;

FIG. 12 is a top plan view of another form in which the invention is embodied;

FIG. 13 is a section taken along line 13—13 of FIG. 12;

FIG. 14 is a section taken along line 14—14 of FIG. 12; and

FIG. 15 is a section taken along line 15—15 of FIG. 14.

DESCRIPTION OF A PREFERRED EMBODIMENT

Referring now in particular to FIGS. 1–7 of the drawings, a preferred form of the invention comprises a pedal support bracket 10 formed of two relatively movable members, plate 12 and pedal support member 14. Plate 12 is in the form of a rectangular plate. The plate has sleeves 16 and 18 adapted to bear against a vehicle structure and through which fastening means such bolts 20, FIG. 5, can be inserted to fasten plate 12 and thus the bracket to a vehicle. Pedal support member 14 comprises a housing 22 formed of a U-shaped plate having side panels 24 and 26, and upwardly extending flange 28, and a downwardly extending flange 30. Flanges 28 and 30 face and are adapted to bear against plate 12.

Flanges 28 and 30 are held against plate 12 when the pedal is in idle position as hereinafter described. Openings 32 in flanges 28 and 30 provide clearances for heads of bolts such as 20, FIG. 5.

Plate 12 has a section pressed out therefrom to form a ledge 36, see FIGS. 4 and 7. This is received in mating opening 38 formed in flange 28 and serves as a vertical support and guide for pedal support member 14 when plate 12 is supported vertically as indicated in FIG. 1 on a vehicle member. Flange 30 of bracket member 14 has a lower lip 40 which receives and engages lower edge 42 of plate 12, see FIGS. 1 and 7. The connection is such that bracket member 14 can rotate relative plate 12 about their juncture. The edge 42 of plate 12 forms a fulcrum for rotation of bracket member 14.

A bifurcated retainer spring 44 urges the bracket members into contact along their vertical facing surfaces. Retainer spring 44, see FIGS. 4 and 4*a*, has a projecting locking member 46 formed in it which fits into the opening resulting from the formation of ledge 36 in plate 2 and, as will be explained hereinafter, helps maintain the members in position.

Side panels 24 and 26 rotatably support pivot shaft 48 and suitable bushings 50, FIG. 3. Shaft 48 has a cylindrical section which is adjacent its headed end 54, and a cylindrical section 56, together with a flat surface 58 formed thereon extending to the other end of the shaft. Accelerator pedal lever 60 supports a foot pad 62 through a suitably connected pivot 64, and a spring 66 which in conjunction with a stop functions to position the foot pad in appropriate position.

The pedal has a pair of upper arms 68 and 70 provided with D-shaped openings 72, FIG. 6, which fixedly position the pedal on the shaft 48.

On the cylindrical side 52 of the shaft there is rotatably supported a first spacer 74, see FIGS. 3, 4 and 6. Spacer 74 has a cylindrical outer section 76 and a rightwardly extending, as viewed in FIGS. 3 and 6, stub shaft cylindrical section 78. Upon stub shaft 78 there is rotatably mounted a second spacer or ring 80. Upon the two spacers 74 and 80 there is supported a helical torsion spring 82. The ends 84 and 86 of spring 82 are locked respectively to bracket member 14 and the pedal 60. Spring end 86 bears against stop 87 on lever 60, FIG. 6, and end 84 bears against the upper inner surface of the pedal support member 14, FIG. 1. The spring is held under torsional load tending to urge the pedal and shaft 48 to the idle position, as shown in FIG. 1. The two spacers support the spring and the opposite spring ends because of the locked relationship they bear with the lever and the lever support, respectively bear firmly against the two spacers. Spacer 80 is thus forced firmly against the stub shaft 78 of spacer 74 and spacer 74 is urged against the shaft 52 by the force of the spring.

The components are designed so that the pressure of spring end 84 prevents rotation of spacer 74 and shaft 48 rotates within spacer 74. At the same time, the force of spring end 86 on spacer 80 forces the later to rotate with pedal 60 and shaft 48 and upon sub shaft 78. The force of the spring ends is such, by design, as to result in frictional resistance between the two spacers and between spacer 74 and shaft 52. By selecting proper fits and the general design of the components the amount of the resistant achieved can be controlled.

The spacers thus provide support for the torsionally loaded spring, maintaining it circumferentially around shaft 48, and at the same time they provide a selected resistance to motion which provides the hysteresis effect desired during pedal operation. The frictional resistance created by the spacers adds to the resistance offered by the coil spring in advancing the pedal toward a higher output level. However this frictional resistance provided by the spacers will oppose the torsional load of the spring as foot pressure is relaxed. This gives relief from the resistance felt during advancing of the pedal which is desirable when operating at a steady speed condition or in reducing the speed level. Adequate pressure to return to idle upon complete release of the pedal however is retained through proper design of the components. The pair of spacers provide yet another advantage, namely ease of assembly. The spacers make it easy to mount the spring upon the shaft and particularly when they are designed as shown in the instant form with one spacer mounted on the other. The spacers can be readily inserted into the spring and placed upon the shaft. Further the spacers lessen the wear by spreading it over a broader surface. If the shaft was not provided with a pair of spacers one on the spring ends would wear a groove in the shaft as one end of the spring rotated relative to the other. With the instant invention the likelihood of wear at any one point due to friction is at least cut in half by virtue of the shaft rotating within one spacer end or one of the spacers rotating on the other.

To improve action, equalize the load on both arms of the lever, increase safety and lessen the possibility for complete failure, a second set of spacers 88 and 90 is mounted on the right semi-cylindrical end of the shaft as viewed in FIGS. 3 and 6 and coupled with a second torsion spring 92. The spacer 88 in this instance has a stub shaft 94 which is rotatably received in the spacer 90. Spacer 88 has a central D shaped opening which mates with the flat section 58 on shaft 48, and the semi-cylindrical surface of shaft 48. Thus spacer 88 is locked by one end of spring 92 to the pedal arm 68 by a stop on arm 68 of the same shape and size as stop 87. Pedal arm 68 is also locked to shaft 48, and spacer 88 is also locked directly to shaft 48 by the flat surface 58 on the shaft 48 and the D shaped configurations in pedal 68 and spacer 88. The other end 96 of spring 92 locks spacer 90 to bracket member 14. As a result when pedal 60 rotates shaft 48 spacer 88 rotates within spacer 90. Friction between the spacers 88 and 90 contributes to the hysteresis effect which counters the force of the coil spring urging the pedal to return, but which adds to the force of the spring in resisting pedal movement to increase speed.

A position sensor and transmitter 98 is also mounted on shaft 48 between the pedal arms 68 and 70, FIGS. 3, 4, 6, 8 and 8*a*. The sensor has a housing 100 having bearing 102 in which there is rotatably supported a sleeve 104. Sleeve 104 has a D shaped interior mating with the flat semi-circular section of shaft 48. Within housing 100 there is motor driven by sleeve 104 and other components that sense the position of shaft 48. Electrical coupler 105 serves to connect these components via leads 106 to the electrical source and to transmit the sensed information. The sensor-transmitter is available commercially from the Robertshaw Company, and CTS Corporation and the nature of its internal sensing components plays no part in the present invention except to function as a sensor transmitter. The housing and bearing has however been particularly designed to mate with the components of the instant invention. Further there is, as hereinafter described, an idle switch feature which is unique to the instant invention.

In the latter regard the housing 100 comprises a pair of arms 107, 108, FIGS. 1, 4, 8 and 8*a*. As shown, the sensor 98 is positioned with its two arms facing the plate 12. The arms project outwardly from the side of the housing 100 and present rearwardly facing, as compared to the surface of plate 12, vertical surfaces 110 on which the legs of spring 44 bear, FIGS. 4 and 4*a*. Spring 44 thus urges sensor 100 against plate 14. The outwardly extending arms form part of a projection 112 from housing 100.

The idle switch feature includes a second sensing means comprising plunger 114 which is connected to an on/off switch, of known design, and which is mounted within housing 100. Plunger 114 is normally urged by an internal spring within the sensing means to open the on-off switch. The arrangement is such that plunger 114 is forced into housing 100 by plate 12 when support member 14 is in idle position under the influence of the retainer spring 44 the internal switch operated by the plunger 114 will close signaling that the engine should be brought to idle condition. The switch will send a signal to the controller via leads such as 116. This will be an addition to the signal sent by rotation of sleeve 104 in the sensing device when it returns to the idle position illustrated in FIG. 1. The idle signal given by the idle override switch through actuation by plunger 114 will override any signal that may be still given by the sensing device 58. In the event that for some reason the pedal-coil spring-spacer-sensor system 98 has failed the override signal will come into effect and cause return of the engine to the desired idle condition. Bracket pedal support member 14 has affixed to flange 28 a pair of limit arms 118 and 120, FIGS. 5 and 7, which limit the pivotal movement of member 14 relative plate member 12 about ledge 42 of plate 12. Spring 44 maintains both sensor 98 and bracket pedal support member 14 in the idle position shown in FIGS. 1, 2, 3, 4 and 5.

The operation of the electronic pedal assembly when the pedal is moved away from idle condition is as follows: when the pedal 60 is pressed downward the pedal support member 14 initially moves away from plate 12 under the urging of the increased pressure from the torsion spring ends engagement with member 14. The pressure on the pedal overcomes the spring retainer 44. The contact between the pedal support member 14 and projection 112 on the sensor forces the sensor 98 to move with the pedal support member 14. After a move of about 0.5 mm, away from plate 12 the arms 118 and 120 on support 114 prevent further movement of pedal support member 14 and sensor 98 away from plate 12. The shaft 48 however can continue to rotate driving the sensing unit within the Sensor 98. This initial movement also is sufficient to disable the plunger actuated idle override switch since the plunger is free to move to open the switch when member 14 moves away from plate 12. The torsion spring-spacers-lever support members now function as described above.

When pressure is released from the pedal sufficiently to permit lowering to the idle condition again the torsion spring will return the elements in the pedal support member 14 to neutral condition, and at the same the spring 44 will bring sensor 98 and plunger 114 and the pedal support member to the neutral position of FIGS. 1 and 4 in which the idle override signal will be effective. If the pedal-torsion spring connections or the controller itself should fail retainer spring 44 will nonetheless bring the two bracket member together and the idle override switch will still function to bring the engine to idle condition. Engine controllers suitable for use with pedal devices embodying the instant invention are well known in the art.

Referring now to FIGS. 9, 10 and 11 wherein a second form of spacers and spring arrangement according to the invention is shown: spacers 122, 124, 126 and 128 are provided in conjunction with the shaft 130 to which is attached the pedal arms 132 and 134 and the sleeve 137 of sensor 136, which sleeve is similar to the sleeve 102 of FIGS. 3 and 8. Torsion springs 138 and 140 are supported by the spacers, and, as in the form shown in ~~FIG. 3, the opposite ends of the springs 138 and 140 are~~ locked to the pedal support 142 and the pedal arms 132 and 134. Shaft 130 is constructed with a complete cylindrical section 144 to the left and a right section 146 having a flat 148. Spacers 122 and 124 have cylindrical centers 150 which mate with the cylindrical end of the shaft. Spacers 126 and 128 also have cylindrical central sleeves which mate with the shaft 130 and a semi-cylindrical key 152 which fills the flattened portion of cylinder 130 between the spacers 126 and 128. In the same manner as those shown in FIGS. 1–8, spacers 124 and 126 rotate with the lever while spacers 122 and 128 move with bracket member 142.

FIGS. 12–15 show yet another embodiment of the invention including yet another embodiment of spacer-torsion spring-pedal arrangement. Referring thereto: pedal 154 is rotatably supported in bracket 156 on a shaft 158, FIGS. 12 and 14. The opposite ends of the spring 168 are, respectively, locked to the bracket 156 at stop 170, and lever stop 172, FIGS. 12 and 14. The arrangement is such that the spring ends bear against the spacers with the force against the spacer 164 locking spacer 164 to the lever, and the force of the spring end on spacer 166 locking the latter spacer 166 to the bracket 156.

As shown in FIG. 13 spacer 164 has a stub shaft 174 on which spacer 166 is rotatably mounted, as in the form shown in FIG. 6. As a result spacer 164 rotates with the lever 154, with the stub shaft rotating within but frictionally bearing against spacer 166. Lever 154 is locked to shaft 158 upon knulled sections of shafts 158. Only one set of torsion springs and spacers are mounted on shaft 158 on one side of the lever. On the other side a simple spacer 176 is freely rotatably mounted to assist in maintaining the horizontal position of lever 154 on shaft 158.

Lever 154 is actually part of a bell crank control system including a bell crank 178, FIGS. 14 and 15 comprising a pair of links 182 and 184 affixed to shaft 180 which is rotatably supported in bracket 156. The cranks may be affixed to the shaft through the use of knulled sections and force fits. The bell crank includes a sleeve 186 affixed to and fixedly spacing the links.

Three spacers 188, 190 and 192 having cylindrical bores are rotatably supported on the shaft 158 between the links and adjacent to each other and the links respectively. A pair of coiled torsion springs 196 are supported by the spacers and each spring has an outer end 198 bearing against cylindrical sleeve 186 and an inner end 200 and 202 respectively as seen in FIGS. 14 and 15, bearing against a stop 204 on the bracket 156. The stop is formed in this instance by an opening in bracket 156 into which the spring ends are inserted. The arrangement is such that the spring ends 198 adjacent to the links 182 and 184 are locked to the sleeve 186, and the pressure against the sleeve 186 lock spacers 188 and 192 to the bell crank 178. The force of the spring ends 200 and 202 effectively lock the spacer 190 to the bracket 156. As a result although shaft 180 rotates within spacer 190, there is frictional resistance to such movement producing a hysteresis effect as discussed above. The frictional resistance occurs because the spring ends 200 and 202 force the spacer 190 into contact with the shaft 180 to such a extent as to create the frictional resistance.

Electrical sensing devices of a known kind 206 are affixed to the shaft end 208 and motion of the pedal is transmitted by wire to the engine control as described heretofore. The lever 154 bears against sleeve 186 and ~~transmits motion to the bell crank member through the~~ sleeve. A stop 210 limits the movement of the lever at the idle condition. Further an idle override is mounted in bracket 156. When the pedal pressure is relieved to return to neutral this override switch will function to return the engine to idle level regardless of the position of the spring-spacer system.

Having described my invention, many modifications thereto will become apparent to those skilled in the art to which it pertains without deviation from the spirit of the invention as defined by the scope of the appended claims.

What is claimed is:

1. An accelerator pedal assembly for an electronic throttle control comprising

a shaft, a pedal supported on said shaft, a bracket supporting said shaft for pivotal movement of said pedal, said pedal having an idle engine throttle position and being movable therefrom to power increasing throttle positions;

a coiled torsion spring having one section thereof affixed to said bracket and one section affixed to said pedal and continuously urging said pedal to idle throttle position, means supporting said spring and maintaining its relationship to said pedal comprising a pair of longitudinally aligned spacers positioned within and supporting said spring, said spacers being supported by said shaft and each spacer being engaged with one of the portions of said spring affixed to said bracket and to said pedal respectively, with one of said spacers being held in fixed relationship to said bracket by said spring, the other of said spacers being held in fixed relationship to said pedal and being pivotal therewith, with said one of said spacers being rotatably mounted with respect to said shaft and to said other of said spacers by means providing frictional resistance to relative rotation of said other of said spacers with respect to each other and of said other of said spacers with respect to said shaft,

whereby one of said spacers pivots with said pedal and the section of said spring supported by the latter one of said spacers upon rotation of said pedal while the other of said spacers remains substantially fixed with respect to said bracket and the section of said spring supported by the latter other of said spacers, and the latter other of said spacers offers frictional resistance to movement of said pedal which frictional resistance adds to the resistance of said spring to movement of said pedal from idle throttle position toward power increasing throttle positions, but opposes the force of said spring urging said pedal to return to idle position.

2. The accelerator pedal assembly of claim 1 wherein said one of said spacers is rotatably mounted on the other of said spacers.

3. The accelerator pedal assembly of claim 1 wherein said one of said spacers is rotatably mounted on said shaft.

4. The accelerator pedal assembly of claim 3 wherein said other of said spacers is rotatably mounted on said shaft.

5. The accelerator pedal assembly of claim 1 including a second set of spacers and a second torsion spring with said second set of spacers supporting said second torsion spring, said second set of spacers being supported by said shaft, with one of said second set of spacers being rotatably supported with respect to said shaft and to said other of said second set of spacers, with said second set of spacers being affixed, respectively, one to said lever and the other to said bracket by respective sections of said second spring, and

with one of said second set of spacers being rotatably supported by means providing frictional resistance to rotation relative said shaft which will augment the resistance to rotational movement of the first mentioned other of said spacers imposed by the association between the latter spacer and its support.

6. The accelerator assembly of claim 1 including means for sensing the rotational position of said pedal with respect to said bracket and transmitting the information sensed to a receiving means.

7. The accelerator assembly of claim 1 wherein said bracket is formed of two members one of which serves as a mounting plate for said pedal assembly and the other of which bracket members rotatably supports said shaft and said lever,

means supporting said other of said bracket members on said one of said bracket members for rotation with respect to said one of said bracket members about an axis extending parallel to but spaced transversely of the axis of pivotal movement for said pedal,

said means supporting said other of said bracket members comprising means forming a pivotal connection between said members, and means for maintaining said pivotal connection including means resiliently urging said members into a first position corresponding to an idle engine throttle position of said pedal and resiliently resisting movement of said other of said members relative said one of said members from said idle engine throttle position.

8. The accelerator assembly of claim 7 including means for sensing the relative rotational position between said bracket members and including means for transmitting sensed information to a receiving means.

9. An accelerator pedal comprising

a supporting bracket

an acceleration pedal rotatably supported in said bracket for movement from an idle fuel position to a maximum fuel input position

means for sensing the rotational position of said pedal relative said bracket and means for transmitting such sensed information to an engine control element

means for resisting movement of said pedal from the idle fuel position toward the maximum fuel input position and operative upon movement of said pedal from idle fuel position to return said pedal to the idle fuel position upon release of pressure on said pedal comprising;

a helically coiled spring having a first end member engaging said bracket and a second end member engaging said lever in a relationship to each other which places said spring under torsional load along its length when said pedal is in idle position and such as to increase said torsional load on said spring and said pedal as said pedal moves from idle toward maximum fuel position,

said spring constantly urging said lever to said idle position,

means maintaining said spring in relatively fixed position relative the axis of rotation of said pedal and for creating a hysteresis effect on the torsional load of said spring whereby the force resisting movement of said pedal from idle position toward maximum fuel position will be greater than the force urging said pedal to idle position upon relaxation of force upon the pedal urging the pedal toward maximum fuel position, comprising

a pair of axially aligned cylindrical spacers positioned within and supporting said spring, one of said spacers being in frictional engagement with the one of said spring ends bearing against said bracket, the other of said spacers being in frictional engagement with the other of said spring ends engaging and bearing against said lever,

means supporting said other of said spacers for relative rotation with respect to said one of said spacers about a common axis, the latter means being in frictional contact with said other of said spacers whereby, when said spring is torqued under influence of movement of said pedal the said other of said spacers will be forced to rotate upon its support despite the frictional resistance to such movement provided by engagement with said means supporting said other of said spacers, and whereby when pressure on said pedal urging said pedal toward a maximum fuel input position is relaxed the frictional engagement of the latter spacer with its supporting means will resist the torsional force of said spring urging said pedal to return to idle fuel position.

10. A pedal assembly for an electronic throttle control comprising

a pedal, a bracket for mounting said pedal, means supporting said pedal on said bracket for movement from an idle position to a maximum power position and return, helical spring means for resisting movement of said pedal toward a maximum power position and returning said pedal to said idle position

said helical spring means including spring sections respectively reacting against said bracket and said pedal so as to maintain a torsional load on said spring and constantly urge said pedal toward said idle position,

second means for resisting movement of said pedal from said idle fuel position toward said maximum power position and resisting return movement of said pedal to said idle position comprising

a pair of cylindrical spacers positioned within and supporting said helical spring

one of said spacers frictionally engaging a spring section reacting against said bracket and supporting the latter spring section and a portion of the helical coils of said spring in position with respect to said bracket,

the other of said spacers frictionally engaging a second spring section reacting against said lever and supporting the latter spring section and a second portion of the helical coils of said spring and maintaining the latter spring section in position with respect to said lever,

whereby said spring exerts a torsional force against said pedal and is supported in a substantially fixed helically coiled condition,

means supporting said spacers so as to maintain a frictional contact between said spacers and their respectively engaged sections of said spring resisting rotational movement of said spacers relative their respectively engaged said sections,

said means supporting said spacers rotatably supporting said one of said spacers, with the contact between said one of said spacers and its support means providing frictional resistance to said rotation of said one of said spacers relative to its support means, the latter frictional resistance being less then the frictional resistance to movement provided by engagement between the end of said spring reacting against said bracket and said one of said spacers,

whereby upon movement of said pedal said other of said spacers will move with said pedal while said means supporting the latter said one of said spacers will rotate within said one of said spacers,

and the frictional resistance to rotation of said the latter spacer with respect to said means supporting the latter spacer will add to the torsional force of said spring resisting movement of said lever toward a maximum power position, but will act against the force of said spring tending to return said pedal to idle fuel position upon relaxation of force exerted upon said pedal urging said pedal to a maximum power position.

11. The pedal assembly of claim 10 wherein said spacers are supported on a common shaft.

12. The pedal assembly of claim 10 wherein said shaft rotatably supports said pedal in said bracket.

13. The pedal assembly of claim 10 wherein said spacers are both supported directly upon said shaft.

14. The pedal assembly of claim 10 wherein one of said spacers is rotatably supported upon the other of said spacers.

* * * * *

Exhibit 9

US005241936A

United States Patent [19]

[11] Patent Number: 5,241,936

[45] Date of Patent: Sep. 7, 1993

Byler et al.

[54] FOOT PEDAL ARRANGEMENT FOR ELECTRONIC THROTTLE CONTROL OF TRUCK ENGINES

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[73] Assignee: Williams Controls, Inc., Portland, Oreg.

[21] Appl. No.: 756,430

[22] Filed: Sep. 9, 1991

[51] Int. Cl.^{5} F02D 11/10

[52] U.S. Cl. 123/399; 74/513; 180/335

[58] Field of Search 123/399; 74/513; 180/335

[56] References Cited

U.S. PATENT DOCUMENTS

4,831,985	5/1989	Mabee et al.	123/399
4,944,269	7/1990	Imoehl	123/399
4,958,607	9/1990	Lundberg	123/399

Primary Examiner—Andrew M. Dolinar

Attorney, Agent, or Firm—Robert L. Harrington

[57] ABSTRACT

An accelerator foot pedal suspended from a support structure affixed to the front wall of a vehicle cab, a drum at the proximal end of the foot pedal defining, with the support structure, an enclosure which houses an internal rack-and-pinion gearing. A sensor mounted to the support structure generates a control signal representing the angular position of the foot pedal, the rack and pinion translating rotational movement of the foot pedal to an input of the sensor.

12 Claims, 2 Drawing Sheets

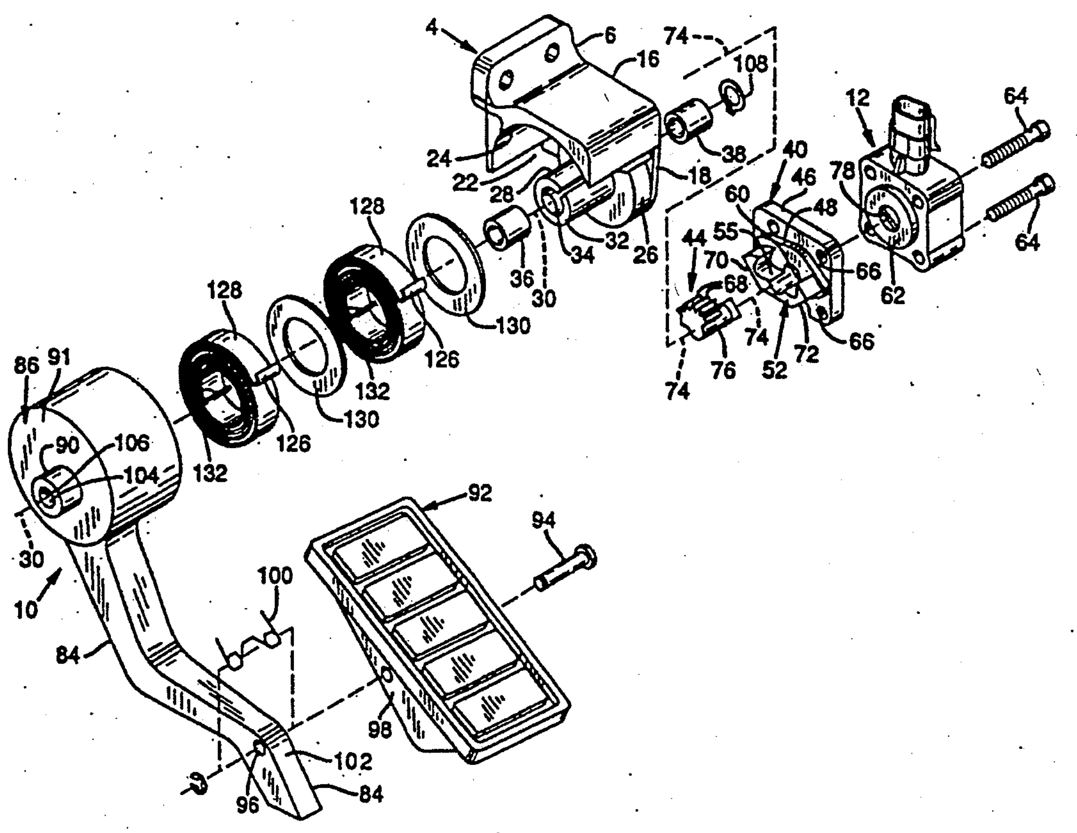


FIG. 1

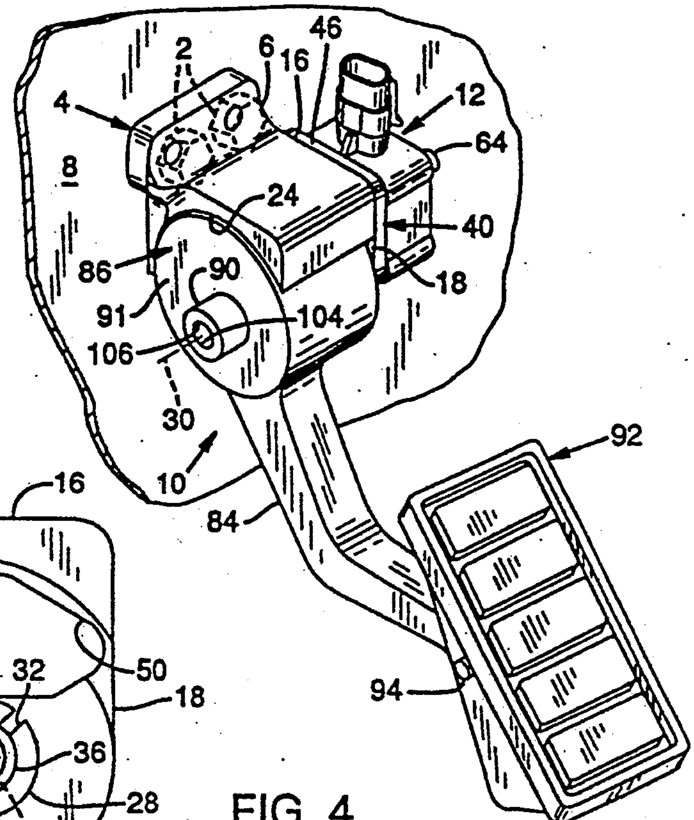


FIG. 2

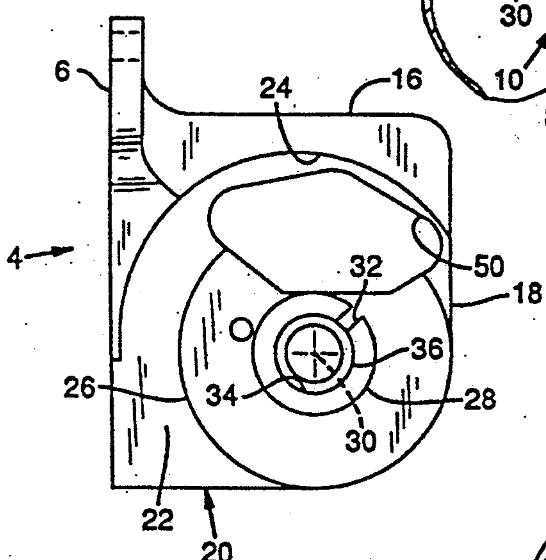


FIG. 4

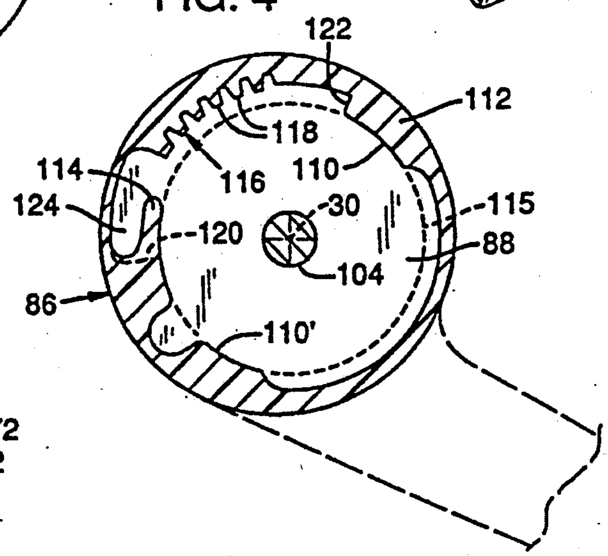
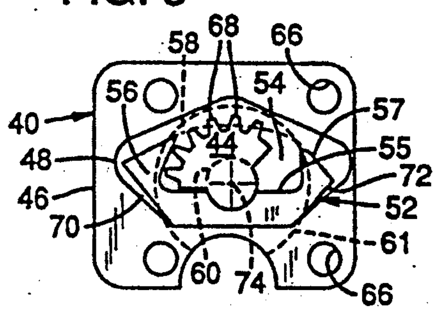


FIG. 3



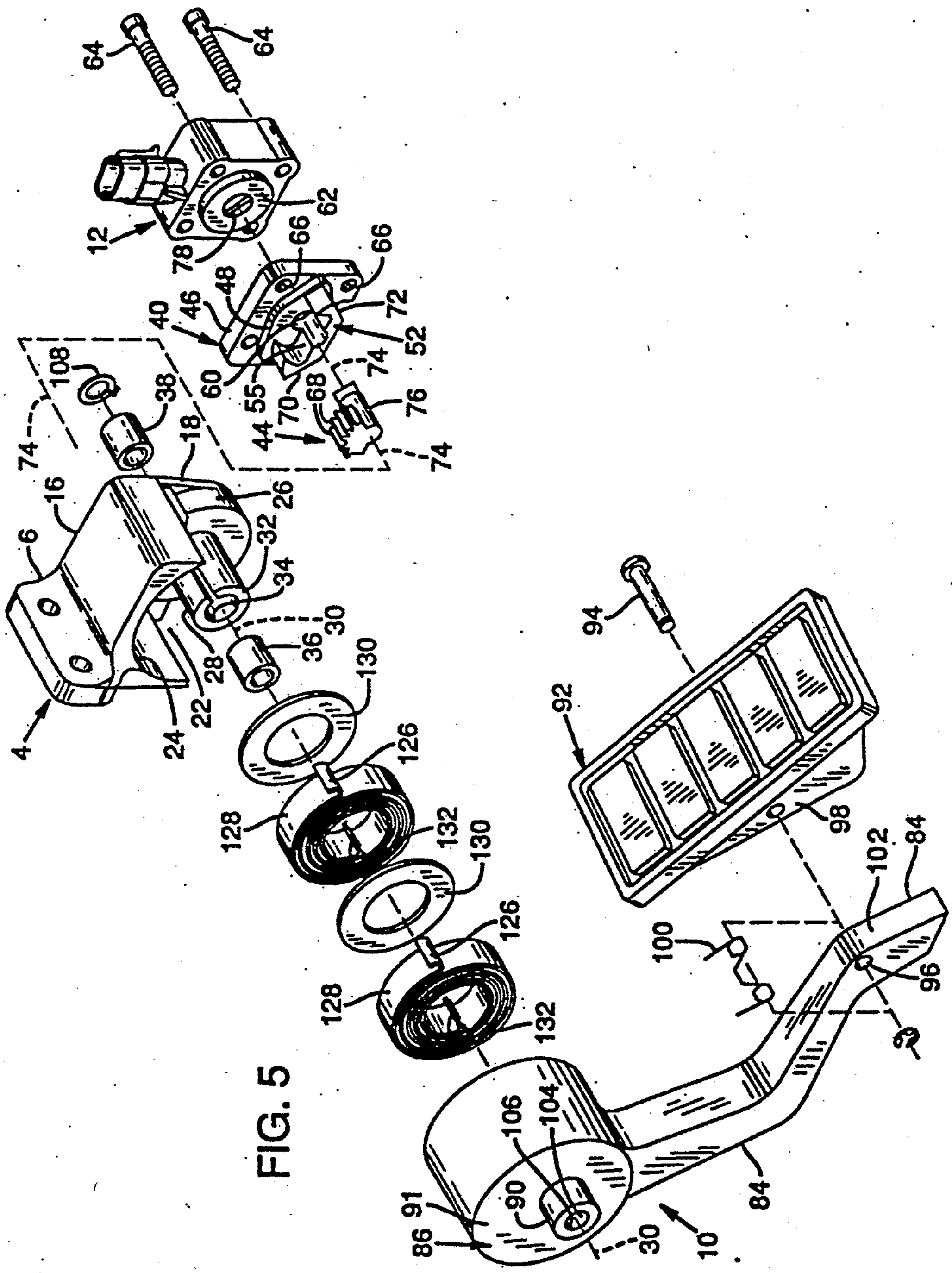

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FIG. 5

FOOT PEDAL ARRANGEMENT FOR ELECTRONIC THROTTLE CONTROL OF TRUCK ENGINES

BACKGROUND OF THE INVENTION

This invention relates generally to controls, and more particularly to a foot pedal control coupled to a fuel dispensing system of an internal-combustion engine.

Actuation of a foot pedal coupled to a fuel dispensing system of an engine alters the output of fuel discharged by the fuel dispensing system. Conventionally, the unactuated foot pedal is held in a home or idle position by a spring arrangement, and the operator, by depressing the pedal causes an increase of the fuel output from the fuel dispensing system, thereby increasing engine RPM and/or power output of the engine.

An important feature of diesel engines as well as many spark-ignition engines is the fuel-injection system, consisting of pumps that meter and place the fuel under injection pressure, the injection nozzles and the governing controls. Controlling the rate of fuel dispensed to the cylinders of an internal combustion engine, commonly referred to as throttle control, is accomplished in a fuel-injection system by adjusting the output of a fuel pump or a system of fuel pumps that supply the cylinders. Fuel controls have evolved from mechanical linkages coupling a foot pedal to a control rack of a fuel pump system, to an electronic linkage coupling the foot pedal to a computer, the computer monitoring, inter alia, a sensor that detects incremental movement of the foot pedal, and responsive to such detected movement and other input data, controlling the output of the fuel pump system.

Many modern internal-combustion engines are computer controlled. For example, a fuel pump system is suitably operated by one or more servomechanisms responsive to control signals from a computer, which monitors an input signal provided by a sensor coupled to the foot pedal. The foot-pedal sensor, suitably a potentiometer, is actuated in response to depression of the foot pedal by the operator of the vehicle. The computer thus controls fuel flow to the engine, generating appropriate control signals in response to monitored input signals from the foot-pedal potentiometer as well as other input signals from sensors which detect both internal and external engine operating parameters such as temperature, humidity, barometric pressure, engine RPM and load, etc., providing increased engine efficiency, fuel economy and reduced emission of pollutants to the atmosphere.

An early design of an electronic control system located the movement detecting sensor in the engine compartment near the fuel pump; however, this arrangement proved undesirable due to the complex mechanical linkage required to connect the foot pedal to the sensor. Moreover, the harsh operating environment of the engine compartment exposed the sensor to heat, oil and dirt, which can contribute to premature failure of sensitive components. Subsequent designs thus located the sensor in the cab or operator compartment, the sensor being incorporated in a foot pedal arrangement that included a means for providing rotative motion of a potentiometer in response to depression of the foot pedal. A foot pedal, its support structure, sensors such as a potentiometer and the various interconnecting components are collectively 10 referred to herein as a "foot pedal arrangement". One such implementation shown in U.S. Pat. No. 4,958,607, which is assigned to the same assignee as the instant invention, provides a suspended pedal configuration, which is a desirable arrangement; however, many of the mechanical elements are disposed exteriorly on the support structure, and the pivot of the foot pedal is spaced apart from the front wall farther than desirable in the limited space of the truck cab. Particularly, the foot-pedal pivot is situated relatively far from the front wall of truck cab, well beyond the pivot of the potentiometer actuating mechanism. It is desirable to locate the pivot point of the foot pedal as close to the front wall as possible in order to conserve space in the often cramped confines of a truck cab. Further, in the '607 arrangement, torque was applied by coil springs to the shaft that actuated the potentiometer, consequently the coil springs were required to rotate through the same arc as the potentiometer shaft, resulting in a pedal pressure differential from idle to full throttle that was higher than desirable for optimum operator comfort.

It is therefore a principal object of the present invention to provide a improved foot pedal arrangement.

A more specific object of the present invention is to provide a foot pedal arrangement with improved pedal pressure differential.

Another object of the instant invention is to provide an improved foot pedal arrangement which locates the pivot of the foot pedal close to the front wall of the truck cab.

It is another object of the present invention to provide an improved foot pedal arrangement requiring reduced force to hold the pedal actuated, thereby increasing operator comfort.

Another object of the invention is to provide an improved compact foot pedal arrangement with an aesthetically pleasing, uncluttered appearance, and having fewer moving components virtually all of which are internally disposed for safer operation and for protection from dirt and contaminants.

SUMMARY OF THE INVENTION

The present invention utilizes a sensor to generate a signal representative of foot-pedal depression, which is monitored by a computer. The unique arrangement of the components and the means for translating rotary motion of the foot pedal to the input of the sensor allows mounting the pedal closer to the front wall of the truck cab than wa possible in previous arrangements.

A support structure provides a housing in which the pivot of a suspended foot pedal is journaled, and on which a sensor is mounted. The housing, and a pivotally mounted cylindrical drum of the foot pedal conjoined with the housing, provide an enclosure containing a spring which applies rotative resistant bias to the foot pedal, and interconnecting elements which translate pedal movement into sensor input. An internal gear defined on the annular rim of the foot-pedal drum meshes with a pinion having an axial shaft journaled in the housing, the shaft providing input to the sensor, thereby translating foot-pedal movement into sensor output.

BRIEF DESCRIPTION OF THE DRAWING

While the invention is set forth with particularity in the appended claims, other objects, features, the organization and method of operation of the invention will become more apparent, and the invention will best be understood by referring to the following detailed description in conjunction with the accompanying drawing in which:

FIG. 1 is a perspective view of a foot pedal arrangement in accordance with the present invention;

FIG. 2 is a side view of the support structure of the foot pedal arrangement in accordance with the invention;

FIG. 3 is a plan view of the pinion bearing/lever stop element of the foot pedal arrangement;

FIG. 4 is a section view, taken near its open end, of the foot-pedal drum according to the present invention; and

FIG. 5 is an exploded perspective view, partially cut away, illustrating the various components of the foot pedal arrangement of FIGS. 1 through 4.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the various views of the drawing for a more detailed description of the components, materials, construction, function, operation and other features of the instant invention by characters of reference, a foot pedal assembly 10 incorporates a support structure 4, which is suitably machined or die cast from aluminum, and which includes a base plate 6 configured to be mounted and rigidly attached to a front wall 8 of a cab of a diesel engine powered truck, e.g., by bolts 2 (shown in dash line). The features and configuration of the support structure 4, described in detail below, provide support for a foot-pedal assembly 10, a potentiometer 12 and internal interconnecting elements that translate foot-pedal movement into rotational movement of the potentiometer shaft.

Top wall 16 and side wall 18 elements of the support structure 4 extend outwardly from the base plate 6, and with the base plate 6 define a housing 20 open on one side and having a formed recess 22 with a cylindriform interior surface 24. Interiorly of the housing 20, a cylindrical boss 26 and a cylindrical sleeve 28 having a common axis 30 with the boss 26 extend into the recess 22 from the closed side wall 18. A longitudinal groove 32 defined in the periphery of the sleeve 28 extends the length thereof, and a common central bore 34 extends through the sleeve 28, the boss 26 and the side wall 18. A needle bearing 36 is pressed into the bore 34 at the distal end of the sleeve 28, while a second needle bearing 38 is pressed into the opposite end of the bore 34 from the side wall 18.

A pinion bearing/lever stop element 40, suitably machined or die cast from aluminum, is adapted to be fastened to the side wall 1 of the housing 20 and provides a mounting means for the potentiometer 12 exteriorly of the housing 20, a seat inside the housing 20 for a pinion 44, and interconnection between the pinion 44 and potentiometer 12, later described. The pinion bearing/lever stop element 40 comprises a mounting pad 46 adapted for attachment outside the side wall 18 of the housing 20, the pad 46 being positioned with respect to the side wall 18 by an irregularly shaped locating boss or dowel 48 extending from the pad 46 into an aperture 50 machined or die cast in the side wall 18, the boss 48 having essentially the same thickness as the side wall 18 and being received closely in the aperture 50, which has essentially the same shape as the boss 48 such that the boss forms a closure of the side wall aperture 50. Extending into the housing 20 from the boss 48 and integral with the element 40, a configured pillow block 52 provides a seat for the pinion 44 in a generally cylindriform recess 54 defined in the block 52. The recess 54 is defined by a platform or base 55 and upwardly extending ears 56, 57 interiorly contoured in cylindrical form commensurate with the shape of the pinion 44. Top surfaces of the ears 56, 57 define an arc (designated in FIG. 3 by dashed line 58) concentric with the axis 30. A bore 60 laterally intersects the base 55 and extends through the boss 48 and pad 46. A counterbore 61 defined exteriorly in the pad 46 coaxially with the bore 60 receives cylindrical protrusion 62 of the potentiometer 12, the potentiometer being attached to the side wall 18 by suitable fasteners 64 extending through apertures 66 in the pad 46.

The pinion 44, which seats rotatably inside the recess 54, is formed with peripheral gear teeth 68, six in the presently described embodiment of the invention, that subtend an angle of approximately 135 degrees about an axis 74 of the pinion; an axial shaft 76 of the pinion 44 extends through the bore 60 and engages an input shaft 78 of the potentiometer 12. The pinion 44 is suitably formed from a rigid polymeric material such as glass reinforced nylon. The configuration of the recess 54 allows a rotational throw of about 55 degrees of the pinion 44 seated therein. The pinion gear teeth 68, as they rotate through a position normal to the platform 55, project below the arc 58. Bearing surfaces 70, 72 defined at either end of the configured block 52 beneath the ears 56, 57 provide lever stops which limit rotational movement of the foot pedal as described hereinafter.

The foot-pedal assembly 10 includes a drive lever 84 extending from and affixed at its proximal end to a configured drum 86, which is in the shape of cylinder normal to the drive lever 84 and open at one end to a cavity 88. A hub 90 formed at the closed end 91 of the drum 86 is eccentric with respect to the cylindrical periphery of the hub. The drive lever 84 and drum 86 are suitably formed as a unitary element from a rigid polymeric material such as glass reinforced nylon. A conventional pedal 92 is pivotally attached to the drive lever 84 by a pin 94 extending through an aperture 96 in the lever 84 and a clevis 98 on the underside of the pedal. A spring 100 urges the pedal against an angled landing 102 on the lever 84. A pivot 104, which is affixed to the hub 90 as by pressing into an aperture 106, projects into the cavity 88 such that when the drum 86 is inserted into the formed recess 22 of the housing 20 the pivot 104 slides into the central bore 34 and is journaled in the needle bearings 36, 38, thus providing pivotal motion of the pedal drive lever 84 and drum 86 about the pivot 104 and the axis 30. The pivot 104 is axially retained in the housing 20 by a snap ring 108.

The drum 86 and housing 20 conjoined form an enclosure, the drum 86 and the housing 20 each closing the other, which encloses and protect the internal interconnecting elements that translate rotative foot-pedal movement into rotational movement of the potentiometer shaft 78. Although the periphery of the drum 86 is circular and conforms generally with the cylindriform interior surface 24 of the housing 20, the drum rotates eccentrically with respect to the surface 24 because of the eccentricity of the axis 30 with respect to the periphery of the drum 86. However (see FIG. 4), the cavity 88, defined by internally projecting nubs 110, 110' of cylindrical wall 112 of the drum 86 and the internal surface of a lobe 114 is configured concentrically (as indicated in FIG. 4 by dashed line 115) with the pivot 104 about the axis 30, so as to loosely and slidably envelop the boss 26 of the support structure 4, when the drum 86 and housing 20 are conjoined.

A rack 116 having six gear teeth 118 defined integrally in the wall 112 of the drum 86 interiorly and concentrically with the pivot 104 meshes with gear teeth 68 of the pinion 44. Rotation of the drum 8 about the pivot is limited by engagement of radial limit stops 120, 122, respectively, against bearing surfaces 70, 72 of the pillow block 52. The lobe 114 defines a slot 124 open to the cavity 88 of the drum 86. The slot 124 extends substantially the depth of the drum beyond the radial limit stop 120 and is configured to receive external catches 126 of a pair of coil springs 12 disposed inside the cavity 88 of the drum 86 when the foot-pedal assembly and the support structure 4 are conjoined. Washers 130 separate the springs from each other and from the face of the pillow block 52. Internal catches 132 of the springs 128 are inserted into the longitudinal groove 32 of the sleeve 28. The springs 128 installed under tension apply torque to the drum 86 in a counterclockwise direction with reference to FIG. 4, the rotation of the drum 86 being checked by engagement of the limit stop 122 against bearing surface 72 of the pillow block 52; in such position of the drum 86, the foot pedal, under spring pressure or bias, is said to be in a home or idle position. Likewise the pinion 44 (as shown in FIG. 3) and the potentiometer shaft, which is coupled by way of the rack-and-pinion gearing arrangement to the foot pedal, are in the home position.

In operation, the foot pedal 92 is depressed moving the foot pedal from the home position, pivoting the drum 86 about the axis 30, clockwise with reference to FIG. 4. As the rack 116 rotates clockwise through a predetermined arc, the pinion 44 rotates, the shaft of which in turn rotates the potentiometer 12. Rotation of the drum 86 continues as the foot pedal is further depressed until the radial limit stop 120 engages the lever stop 70 of the pillow block 52. A computer 134 coupled to the potentiometer 12 by a bus 136 periodically monitors the output signal of the potentiometer, detecting incremental movement of the foot pedal, and generates appropriate control signals for controlling fuel flow to the engine, based in part on foot-pedal position. The degree of rotation between the limit stops 120, 122 is determined by the rotational specifications of the potentiometer in ranging from minimum to maximum output signal value. In the presently described embodiment of the invention, the potentiometer rotates 53 degrees, while the foot-pedal drive lever pivots approximately 20 degrees. The torque springs 128 act directly on the foot-pedal drum applying resistant force to the element having the lesser degree of rotation, the force differential between home position or idle and full throttle being therefore substantially reduced to approximately 10 pounds.

The foot pedal arrangement can be reconfigured to provide for sensors having different rotational requirements, or to provide greater or lesser rotational movement of the foot pedal. For example, decreasing the gear ratio between the rack and the pinion by decreasing the radius of the rack 116 without altering the radius of the pinion 44 would increase the rotational throw of the pot, while increasing the radius of the pinion would decrease the rotational throw of the potentiometer. Reconfiguring the limit stops changes the rotational throw of both the foot pedal and the potentiometer at the same ratio of movement.

The rack 116 of the rack-and-pinion gearing is an internal gear, which facilitates locating the axis 74 of the pinion 44 proximate to the pivot of the foot pedal. Translation of foot-pedal rotative motion to potentiometer rotation by way of such internally disposed gearing allows placement of the foot-pedal assembly much closer to the front wall of the vehicle than was possible with earlier foot pedal arrangements, the drum 86 being adjacent to the front wall 8; such arrangement further provides a compact, uncluttered structure. The rack-and-pinion arrangement is, therefore, a bi-directional coupling between the sensor and the foot pedal for driving the sensor in an appropriate direction and magnitude of angular rotation in response to corresponding movement of the foot pedal. Thus, the rack-and-pinion arrangement drives the sensor in both directions.

While the principles of the invention have now been made clear in the foregoing illustrative embodiment, there will be immediately obvious to those skilled in the art many modifications of structure, arrangement, proportions, the elements, material and components used in the practice of the invention, and otherwise, which are particularly adapted for specific environments and operating requirements without departing from those principles. The appended claims are, therefore, intended to cover and embrace any such modifications, within the limits only of the true spirit and scope of the invention.

We claim:

1. In a throttle control system of a vehicle having an internal combustion engine and a throttle controlling computer, a foot pedal arrangement providing input to the throttle controlling computer and including a support structure adapted for mounting onto an upright wall of a vehicle cab, a foot pedal suspended from the support structure and having a pivot journaled to the support structure, sensor means mounted to the support structure for generating a control signal representative of the angular position of the foot pedal, the throttle controlling computer coupled to the sensor means whereby the control signal generated by the sensor means is monitored by the computer for controlling the engine throttle, and means for translating pivotal movement of the foot pedal to an input of the sensor means, the improvement comprising:

the foot pedal and the support structure being conjoined to define an enclosure containing the journaled pivot and the pivotal movement translating means, the pivotal movement translating means moving said sensor input through a first range of angular movement in response to movement of said foot pedal through a second range of angular movement, the first range of angular movement being greater than the second range of angular movement.

2. The foot pedal arrangement of claim 1 wherein the enclosure contains a spring intermediate the foot pedal and the support structure, the spring applying a spring bias to the foot pedal with respect to the support structure.

3. The foot pedal arrangement of claim 2 wherein the spring is a coil spring coaxial with the pivot of the foot pedal.

4. In a throttle control system of a vehicle having an internal combustion engine and a throttle controlling computer, a foot pedal arrangement providing input to the throttle controlling computer and including a support structure adapted for mounting onto an upright wall of a vehicle cab, a foot pedal suspended from the

support structure and having a pivot journaled to the support structure, sensor means mounted to the support structure for generating a control signal representative of the angular position of the foot pedal, the throttle controlling computer coupled to the sensor means whereby the control signal generated by the sensor means is monitored by the computer for controlling the engine throttle, and means for translating pivotal movement of the foot pedal to an input of the sensor means, the improvement comprising:

the pivotal movement translating means comprising a rack-and-pinion gearing.

5. The foot pedal arrangement of claim 4 wherein the rack-and-pinion gearing comprises a rack integral with the foot pedal and concentric with the pivot, and a pinion coupled to the input of the sensor means, the pinion being journaled to the support structure.

6. The foot pedal arrangement of claim 4 wherein the rack of the rack-and-pinion gearing is an internal gear interiorly disposed in the support structure.

7. In a throttle control system of a vehicle having an internal combustion engine and a throttle controlling computer, a foot pedal arrangement providing input to the throttle controlling computer, the foot pedal arrangement comprising:

a support structure having a base for mounting onto an upright wall of a vehicle cab, the support structure having an open cylindriform housing with a side wall;

a foot-pedal assembly pivotally suspended from the support structure and including a drive lever, a pedal at a distal end of the drive lever, a drum having an open end and a closed end and conforming generally with the shape of the open cylindriform housing, and a pivot axially disposed in the drum and affixed to the closed end of the drum, the pivot being journaled in the support structure such that the drum and the housing conjoined form an enclosure, the drum and the housing each closing the other;

sensor means mounted on the support structure for generating a control signal representing an angular position of the drive lever of the foot-pedal assembly, the throttle controlling computer coupled to the sensor means whereby the control signal generated by the sensor means is monitored by the computer for controlling the engine throttle; and

means disposed inside the enclosure for translating pivotal movement of the foot-pedal assembly to an input of the sensor means, the pivotal movement translating means being coupled to and responsive to rotation of said drum by causing corresponding rotation of said sensor input, the pivotal movement translating means moving said sensor input through a first range of angular movement in response to movement of said foot pedal through a second range of angular movement, the first range of angular movement being greater than the second range of angular movement.

8. In a throttle control system of a vehicle having an internal combustion engine and a throttle controlling computer, a foot pedal arrangement providing input to the throttle controlling computer and including a support structure adapted for mounting onto an upright wall of a vehicle cab, a foot pedal suspended from the support structure and having a pivot journaled to the support structure, sensor means mounted to the support structure for generating a control signal representative of the angular position of the foot pedal, the throttle controlling computer coupled to the sensor means whereby the control signal generated by the sensor means is monitored by the computer for controlling the engine throttle, and means for translating pivotal movement of the foot pedal to an input of the sensor means, the improvement comprising:

the foot pedal and the support structure being conjoined to define an enclosure containing the journaled pivot and the pivotal movement translating means, the pivotal movement translating means comprising of rack-and-pinion gearing.

9. The foot pedal arrangement of claim 8 wherein the rack-and-pinion gearing comprises a rack integral with the foot pedal and concentric with the pivot, and a pinion having a shaft journaled to the support structure and coupled to the input of the sensor means.

10. In a throttle control system of a vehicle having an internal combustion engine and a throttle controlling computer, a foot pedal arrangement providing input to the throttle controlling computer, the foot pedal arrangement comprising:

a support structure having a base for mounting onto an upright wall of a vehicle cab, the support structure having an open cylindriform housing with a side wall;

a foot-pedal assembly pivotally suspended from the support structure and including a drive lever, a pedal at a distal end of thereof, the drum having an open end and a closed end and conforming generally with the shape of the open cylindriform housing, and pivot axially disposed in the drum and affixed to the closed end of the drum, the pivot being journaled in the support structure such that the drum and the housing conjoined form an enclosure, the drum and the housing each closing the other;

sensor means mounted on the support structure for generating a control signal representing an angular position of the drive lever of the foot-pedal assembly, the throttle controlling computer coupled to the sensor means whereby the control signal generated by the sensor means is monitored by the computer for controlling the engine throttle; and

means disposed inside the enclosure for translating pivotal movement of the foot-pedal assembly to an input of the sensor means, the pivotal movement translating means comprising a rack on an interior wall of the drum and a pinion meshed with the rack and having a shaft journaled to the support structure, the shaft being coupled to the input of the sensor means.

11. In a throttle control system of a vehicle having an engine and a throttle controlling computer, a foot pedal arrangement providing input to the throttle controlling computer, the foot pedal arrangement comprising:

a pedal portion moveable through a first range of angular rotation and spring biased toward an idle extreme of said first range of angular rotation whereby upon urging of said pedal through said first range of angular rotation to a full throttle extreme of said first range of angular rotation said pedal returns under said spring bias to said idle extreme of said first range of angular rotation;

a sensor portion moveable through a second range of angular rotation substantially greater than said first range of angular rotation, an idle extreme of said second range of angular rotation corresponding to said idle extreme of said first range of angular rotation, a full throttle extreme of said second range of angular rotation corresponding to the full throttle extreme of said first range of angular rotation whereby coordinated movement of said sensor through said second range of angular rotation provides sensor output corresponding to pedal positioning within said first range of angular rotation; and

a bi-directional pivotal translation mechanism coupling said pedal portion and said sensor portion whereby movement of said pedal portion from said idle extreme through said full throttle extreme of said first range of angular rotation moves by way of said mechanism said sensor portion from said idle extreme through said full throttle extreme of said second range of angular rotation, and further upon return of said pedal from said full throttle extreme to said idle extreme of said first range of angular rotation under said spring bias said mechanism moves said sensor portion from said full range extreme to said idle extreme of said second range of angular rotation.

12. In a throttle control system of a vehicle having an engine and a throttle controlling computer, a foot pedal arrangement providing input to the throttle controlling computer, the foot pedal arrangement comprising:

a pedal portion moveable through a first range of angular rotation and spring biased toward an idle extreme of said first range of angular rotation whereby upon urging of said pedal through said first range of angular rotation to a full throttle extreme of said first range of angular rotation said pedal returns under said spring bias to said idle extreme of said first range of angular rotation;

a sensor portion moveable through a second range of angular rotation substantially greater than said first range of angular rotation, an idle extreme of said second range of angular rotation corresponding to said idle extreme of said first range of angular rotation, a full throttle extreme of said second range of angular rotation corresponding to the full throttle extreme of said first range of angular rotation whereby coordinated movement of said sensor through said second range of angular rotation provides sensor output corresponding to pedal positioning within said first range of angular rotation; and

a pivotal translation mechanism coupling said pedal portion and said sensor portion whereby movement of said pedal portion from said idle extreme through said full throttle extreme of said first range of angular rotation moves said sensor portion from said idle extreme through said full throttle extreme of said second range of angular rotation, and further upon return of said pedal from said full throttle extreme to said idle extreme of said first range of angular rotation under said spring bias said coupling moves said sensor portion from said full range extreme to said idle extreme of said second range of angular rotation, said coupling mechanism comprising a rack-and-pinion gearing.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 5,241,936
DATED : Sep. 7, 1993
INVENTOR(S) : Byler, et al

It is certified that error appears in the above-indentified patent and that said Letters Patent is hereby corrected as shown below:

Col. 8, line 29, after "of", insert --the drive lever, a drum normal to the drive lever at a proximal end--.

Signed and Sealed this

Nineteenth Day of April, 1994

Attest:

Bruce Lehman

BRUCE LEHMAN

Attesting Officer

Commissioner of Patents and Trademarks

Exhibit 10

US005385068A

United States Patent [19]

White et al.

[11] Patent Number: 5,385,068

[45] Date of Patent: Jan. 31, 1995

[54] **ELECTRONIC ACCELERATOR PEDAL ASSEMBLY WITH PEDAL FORCE SENSOR**

[75] Inventors: **James E. White**, Warsaw; **John Zdanys, Jr.**, Elkhart, both of Ind.

[73] Assignee: **CTS Corporation, Elkhart, Ind.**

[21] Appl. No.: **993,141**

[22] Filed: **Dec. 18, 1992**

[51] **Int. Cl.**[6] **G05G 1/14**

[52] **U.S. Cl.** **74/512**; 74/513; 74/560

[58] **Field of Search** 74/512, 513, 514, 560, 74/523, 533, 535

[56] **References Cited**

U.S. PATENT DOCUMENTS

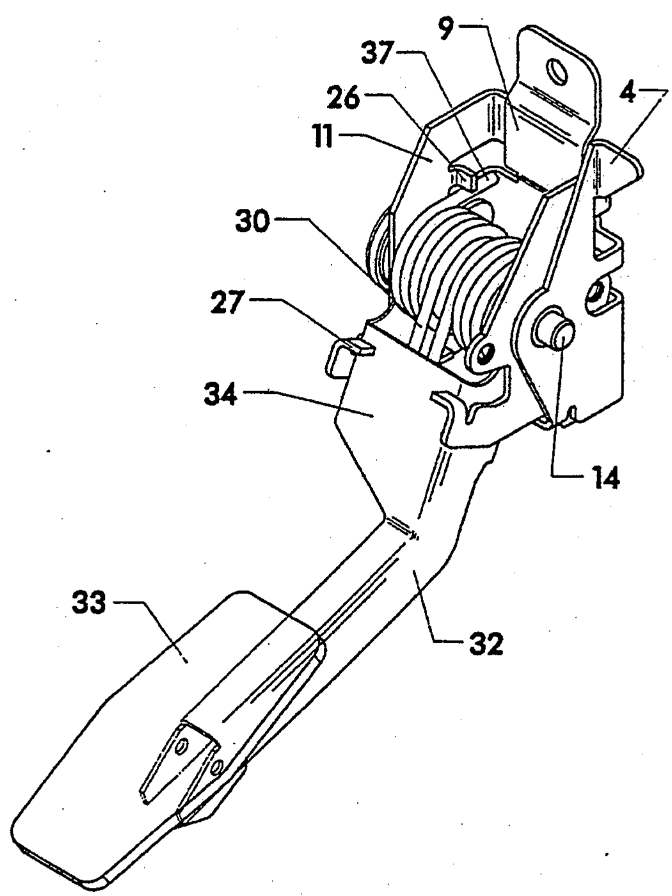
2,192,714	3/1940	Norman et al.	137/139
2,207,435	7/1940	Jones	74/513
2,825,418	4/1958	Kershman	74/514
2,936,867	5/1960	Perry	74/513
3,088,331	5/1963	Bachman	74/513
4,047,145	9/1977	Schwehr	338/67
4,355,293	10/1982	Driscoll	338/184
4,528,590	7/1985	Bisacquino et al.	338/153
4,621,250	11/1986	Echasseriau et al.	338/162
4,693,111	9/1987	Arnold et al.	73/118.1
4,841,798	6/1989	Porter et al.	74/512
4,864,886	9/1989	Burgei	74/535
4,869,220	9/1989	Imoehl	123/399
4,881,424	11/1989	Clark et al.	74/523
4,944,269	7/1990	Imoehl	123/399
4,958,607	9/1990	Lundberg	74/513 X
4,976,166	12/1990	Davis et al.	74/512
5,010,782	4/1991	Asano et al.	74/513 X
5,133,225	7/1992	Lundberg et al.	74/560
5,133,321	7/1992	Hering et al.	123/399
5,211,072	5/1993	Barlas et al.	74/535 X
5,217,094	6/1993	Walter et al.	74/535 X

Primary Examiner—Vinh T. Luong
Attorney, Agent, or Firm—Albert W. Watkins

[57] **ABSTRACT**

A pedal bracket assembly translates pedal motion into a first switching motion without change of position being sensed by a position sensor. Additional pedal motion does not further change the switch position, but is translated into motion sensed by the position sensor. In this way, the switching function and position transducer functions are maintained independent one from the other, while allowing the two functions to be combined into a single sensor assembly.

7 Claims, 3 Drawing Sheets



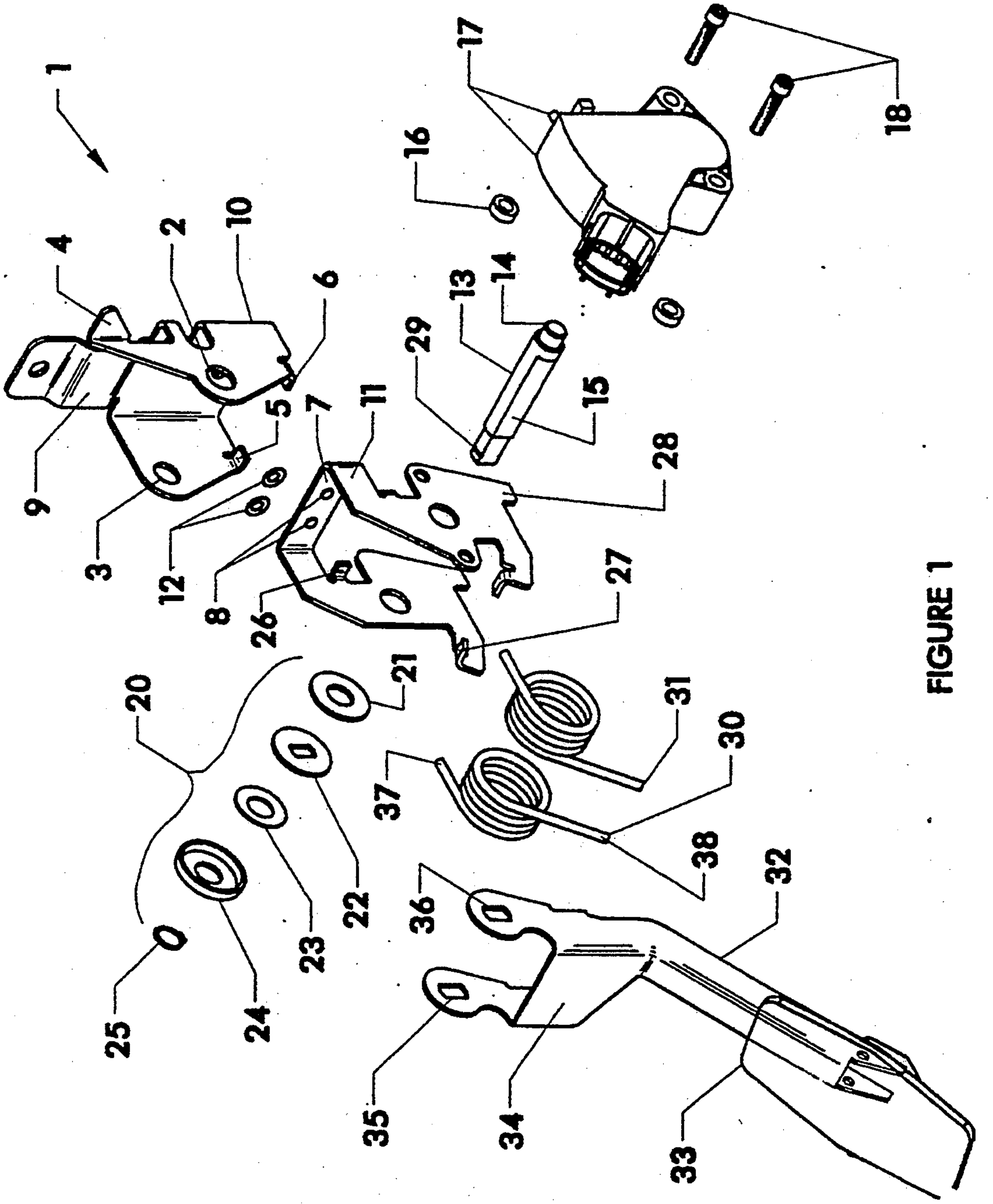

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FIGURE 1

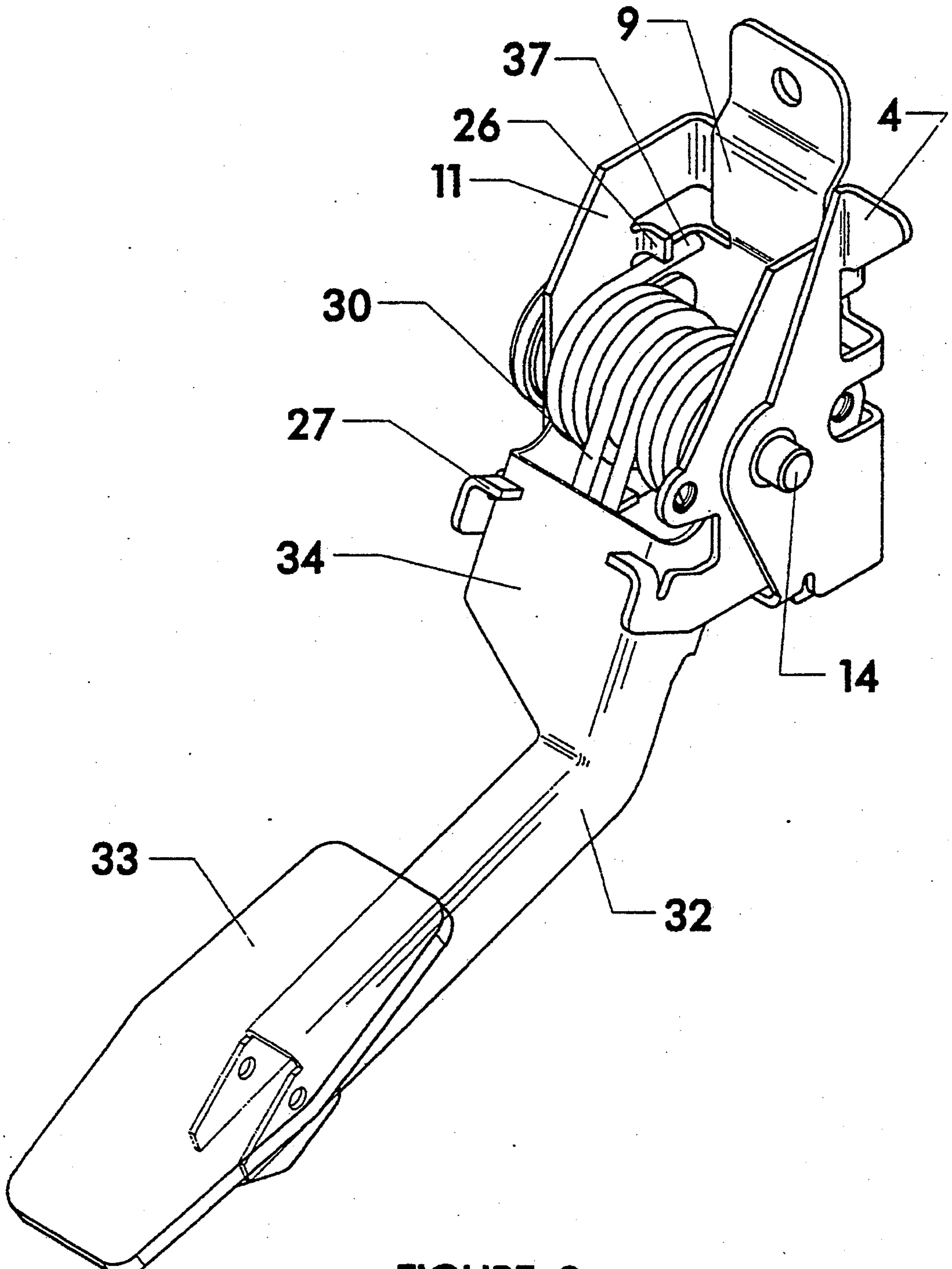


FIGURE 2

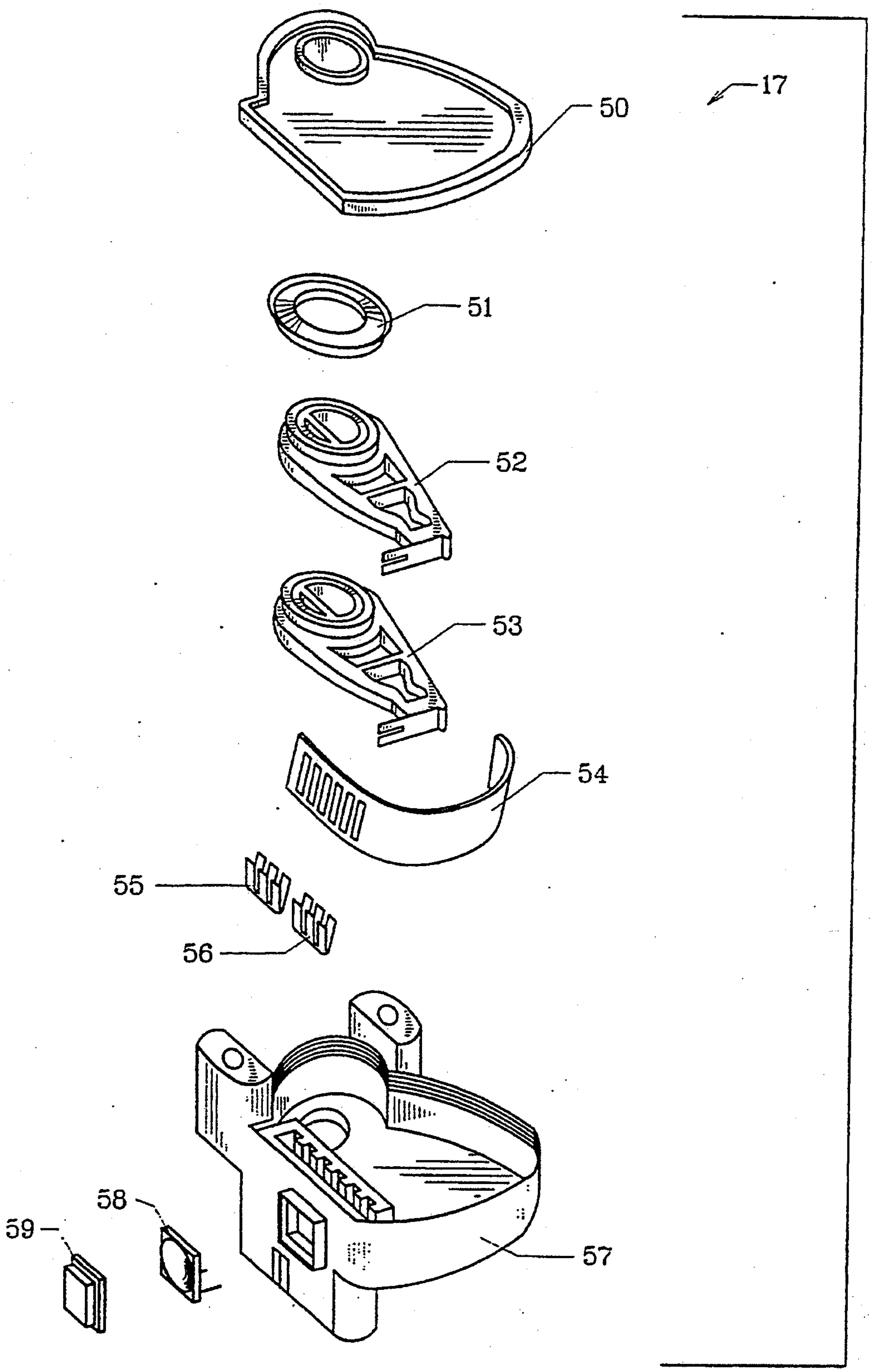


FIGURE 3

ELECTRONIC ACCELERATOR PEDAL ASSEMBLY WITH PEDAL FORCE SENSOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention pertains generally to pedal brackets and more specifically to bracket structures cooperatively mated with electrical devices such as position sensors and force sensors.

2. Description of the Related Art

In the control of motors and machinery there are a number of interfaces that have been proposed through the years. These interfaces have sought to ease man's ability to perform the functions required in the operation of the machines with as little extraneous action and hardware as possible. In this way, an operator may perform as many functions as possible with minimal hinderance and with maximum control. That way, safety and efficiency are at a maximum.

One way of controlling a machine is with the use of pedals. These pedals allow input to the machine by use of an operator's foot, while simultaneously keeping hands free for other typically more complex tasks. These pedals are found in a variety of machines including pianos, sewing machines, and motive equipment such as automobiles and trucks.

The pedals used to control these devices in some cases are mechanical, typically incorporating a cable or various gears and other transmission devices to convert the limited rotary motion available from the pedal into useful mechanical motion to control the machine. Other pedals incorporate some type of position sensor that converts the mechanical position into an electrical signal. In the field of locomotion, particularly pertaining to automobiles and trucks, a mechanical bracket using a cable, often referred to as a Bowden cable, is the standard method for controlling the throttle of internal combustion engines. These pedal assemblies have a desirable feel and functionality and, with a few refinements, are extremely reliable. This type of pedal assembly defines many pedals today.

As noted above, through time there have been a number of attempts at different types of pedal devices to control machines. One major attempt has been to introduce an electrical linkage between the pedal and the device to be controlled. This is desirable since the gear assemblies are bulky, expensive and limited due to their inherent size to those applications where the pedal is very close to the controlled device. Mechanical linkages are not particularly flexible and are prone to sticking or binding. While the Bowden cable has proved generally reliable, the penetration of moisture and other contaminants may still cause the cable to bind. A cable less prone to failure is more expensive and bulky, and still inherently limited.

One early attempt at an electrical throttle controller is illustrated in U.S. Pat. No. 2,192,714. Therein, the throttle valve of an internal combustion engine could be controlled either by foot using a pedal or by hand using a knob. A second construction, illustrated for use with a forklift, is disclosed in U.S. Pat. No. 4,047,145. This second construction offers an ability to adjust the device for variances in manufacturing and performance among various assemblies.

More recently, there have been proposed devices that offer added safety features. This appeal is readily understood in view of the potential for harm of a several tone vehicle irreversibly set to full throttle. Even momentary loss of control, such as might occur with the false transmission of acceleration while in a line at a stoplight, may result in substantial damage. There has been sought a way to offer the desirable feel of the Bowden cable while improving reliability to ensure the safety of an operator and associated equipment. Heretofore, such a combination of features was not available for a price competitive with the Bowden cable.

In an effort to obtain the desired reliability, dual functions have been proposed in the prior art. The first of these is a pedal force switch or, performing a similar function, an idle validation switch. Exemplary patents illustrating such a combination are U.S. Pat. Nos. 5,133,225 and 4,869,220. However, each of these prior art patents forces movement of the position sensor to occur together with activation of the switch. Such a limitation does not allow for totally separate and independent functioning of the two devices and can lead to undetected failure modes. As noted, such undetected failure modes can cause much damage and may even lead to fatalities. The present invention seeks to overcome the limitation of the prior art.

SUMMARY OF THE INVENTION

The present invention overcomes the limitations of the prior art by incorporating a dual pivot structure into the pedal assembly. A first bracket provides rigid support for the entire pedal assembly and has extending therethrough a generally cylindrical shaft. About this shaft a second rotary moving bracket is supported that carries a combination of springs, hysteresis assembly, position sensor and force switch. The switch and sensor, while carried in one package, are actuated independently one from another, providing a ready way to validate correct operation of each device.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates by exploded view a preferred embodiment of the entire pedal assembly.

FIG. 2 illustrates the preferred embodiment in an assembled view ready for mounting.

FIG. 3 illustrates by exploded view a preferred embodiment of a pedal position sensor combined with a pedal force switch.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 1 illustrates the preferred embodiment of the electronic accelerator pedal assembly, by exploded view for clarity. The entire assembly 1 is supported by rigid pedal mounting bracket 10 that is affixed by bolt of other similar fastening structure to a suitable support such as bulkhead of an automobile (not illustrated). Rigid bracket 10 should be firmly supported so as to not move relative to the support. Rigid bracket 10 has coaxial openings 2 and 3 therein which receive shaft 13 therethrough. Between openings 2 and 3 and similarly supported upon shaft 13 is moving bracket 11. Moving bracket 11 has a U-shaped surface 7 interconnecting like surfaces of moving bracket 11. Formed into U-shaped surface 7 are two locating dimples 8 which serve to locate belleville spring washers 12. These belleville washers 12 are retained between U-shaped surface 7 and rigid bracket 10 at the slightly contoured or shaped region 9. To build the assembly 1, moving bracket 11 is positioned with torsion spring retention tabs 26 on the surface of shaped region 9 closest to coaxial openings 2 and 3. U-shaped surface 7 with dimples 8 and belleville spring washers 12 are then slid over the side of shaped region 9 so as to interact therewith on the surface of region 9 away from openings 2 and 3. Once assembled, a viewer looking from the angle of FIG. 1 will not be able to see U-shaped region 7, dimples 8 and belleville washers 12 due to shaped region 9 blocking the view.

Similarly supported upon shaft 13 is pedal arm 32, carrying therewith pedal pad 33. Not illustrated is the pivot pin and spring commonly associated with the pedal pad, allowing pedal pad 33 to pivot on arm 32, as these form no material part of the invention. Pedal arm 32 is carried upon shaft 13 through coaxial openings 35 and 36. Openings 35 and 36 are illustrated as generally rectangular in shape so as to engage flats 15 of shaft 13. Rotation of pedal arm 32 about shaft 13 therefore will also rotate shaft 13. The nature of the interconnections is not limiting, and may take any desirable form including but not limited to mating geometries, welded or brazed connections, or similar arrangements. This particular rectangular mating relationship between openings 35 and 36 and shaft 13 is preferred due to ease of manufacture and replacement.

Carried about shaft 13, but not generally engaged therewith, and also between openings 35 and 36 are the two torsion springs 30 and 31. A first end 37 of torsion spring 30 will press against tab 26 when spring 30 is installed, under slight compressive force. A second end 38 of spring 30 will press against the side of flat 34 not visible in FIG. 1, thereby forcing flat 34 of pedal arm 32 against stop 27. Torsion spring 31 is similarly installed. Duplication of function is achieved in the structure through the use of spring 31 with spring 30 and two spring washers 12. Failure of one of the pairs, or even one torsion spring and one spring washer will not disable the assembly. However, one or more springs could be used. Duplication is preferred.

Also carried on shaft 13 is the mechanical hysteresis mechanism 20 that produces the feel of the Bowden cable familiar to automobile drivers. Friction pad 21 mounts against bracket 10 and serves to provide a controlled friction with washer 22. Washer 22 is illustrated with a mating geometry similar to openings 35 and 36, so as to be rotated simultaneous with shaft 13. Rotary motion of shaft 13 is thereby retarded somewhat by the friction between washer 22 and pad 21, wherein pad 21 remains substantially anchored with bracket 10. Belleville spring washer 23, cap 24 and retaining ring 25 combine to maintain force through washer 22 and against pad 21. Flat 15 does not extend the full length of shaft 13, and at the termination nearest drive 14 allows shaft 13 to engage against the opening through bracket 11. This counterbalances the force applied on shaft 13 by belleville spring washer 23. Drive 14 engages with position sensor 17 to rotate drive arms 52 and 53 (shown in FIG. 3) upon rotation of shaft 13 relative to moving bracket 11. Position sensor 17 is retained to moving bracket 11 through bolts 18 and is therefore only actuated upon rotation of shaft 13 relative to moving bracket 11.

FIG. 2 shows assembly 1 ready for installation. Like elements are so numbered where visible. The completed assembly 1 as illustrated might be installed along the bulkhead dividing a passenger compartment from an engine area in an automotive or truck application, or might be installed upon a structure specifically built to provide rigid support for assembly 1.

FIG. 3 illustrates a preferred embodiment for the combined position sensor and switch assembly 17. As shown, the complete assembly 17 is generally surrounded by housing 57 and cover 50. Therein may also reside seal 51 to prevent the entry of foreign elements otherwise detrimental to the assembly, and rive arms 52 and 53. These drive arms are adapted to be pressed directly onto shaft 13 at drive 14, for direct mechanical engagement and rotation therewith. Alternatively, there may be additional structure as known in the prior art and not illustrated herein to provide for positive coupling therebetween. While there are two drive arms 52 and 53 illustrated, note that there may be any number from one or more, although two is preferred for duplication of function and yet low cost. The interconnections between drive arms 52 and 53 and shaft drive 14 are not illustrated in great detail and will be well known to one of ordinary skill. Exemplary patents, though not the only ones, are U.S. Pat. Nos. 4,355,293, 4,621,250 and 4,693,111 incorporated herein by reference. These drive arms 52 and 53 may be designed to mate one with the other and rest upon a rotary bearing surface at the base of housing 57. The mating features are not illustrated herein, through one or ordinary skill will recognize that mating concentric cylinders coaxial with the shaft 13 would provide one means of accomplishing the function. Drive arms 52 and 53 might be combined into one rigid structure and may have two contacts at the ends thereof. Other suitable structures are well known to those of ordinary skill in the art as noted above.

For the sake of illustration, flexible element 54 similar to that shown in U.S. Pat. No. 4,355,293 is retained in place by features not shown in housing 57 and pressure wedges 55 and 56. Attached on a side of housing 57 and forming the novel feature of assembly 17 is a switch 58 enclosed by actuator 59. Prior art switch and sensor combinations rely upon the same rotational shaft to actuate both the position sensor and the switch. In some instances the switch is even formed as a separate very short resistor element upon the same flexible film as the sensor. This type of assembly is inherently limited for several important reasons. Using the shaft to actuate both position and sensing functions forces the position sensor to travel a certain limited distance prior to switch actuation. This movement either is indicated as a change or non-zero position by the position sensor. Even where there is a large area of conductive patterned for the position sensor to slide upon during switch actuation, the conductive does have finite resistance and a change in resistance will be conveyed. Further, if the shaft should bind with the sensor, there is no way to verify whether there is intent to actuate the shaft. In some prior art applications, there has been an effort to separately package the switch and the sensor. This results in a more expensive package and spreads wiring over a greater distance—exposing the assembly to greater risk of damage or external interference.

Switch 58 is illustrated herein as a dome switch, but other types of switches and even electronic switching devices such as Hall effect sensors are contemplated. Similarly, other constructions of sensors are also contemplated and very much within the scope of this invention. The fact that switch actuator 59, radially disposed from shaft 13, is actuated without rotation of shaft 13 relative to assembly 17 is very important to this invention.

In operation of assembly 1, torsion springs 30 and 31 are under slight compressive force when no pressure is applied to pedal pad 33. Upon application of a small force upon pad 33, indicative of demand for throttle in the application of this invention to automobile accelerators, the force is transmitted through a second end 38 of torsion spring 30 to the first end 37 and into moving bracket 11. This causes moving bracket 11 to rotate on shaft 13 relative to rigid bracket 10, thereby compressing belleville washers 12 which have a lower compressive force than torsion springs 30 and 31. At this time, there is no compression of torsion springs 30 and 31. Dimples 8 are most preferably formed to be no larger than the thickness of the thinnest portion of spring washers 12, so to not interfere with the operation of the moving bracket 11 and belleville spring washers 12.

Compression or flattening of belleville spring washers 12 causes the entire moving bracket 11 and all parts supported thereon to rotate slightly relative to rigid bracket 10. This slight rotation is sensed by a switch 58 mounted on the side of sensor 17 and best illustrated in FIG. 3. The rotation causes housing 57 to move away from lip 4 of bracket 10. Actuator 59 normally is pressed tightly against lip 4 by the force of belleville spring washers 12. Movement of housing 57 away from lip 4 releases pressure from switch 58 to cause a switching action to occur. This switching action occurs regardless of whether the remainder of sensor 17 is operational, bound up, or otherwise non-functional, provided electrical connection exists. In this way, demand for throttle may be sensed independent of pedal position.

Since sensor 17 is retained to moving bracket 11 through bolts 18, no change in position relative to housing 57 occurs in position sensor drive arms 52 and 53 until shaft 13 rotates relative to moving bracket 11.

While the foregoing details what is felt to be the preferred embodiment of the invention, no material limitations to the scope of the claimed invention is intended. Further, features and design alternatives that would be obvious to one of ordinary skill in the art are considered to be incorporated herein. The scope of the invention is set forth and particularly described in the claims hereinbelow.

We claim:

1. A bracket assembly carrying an actuator means comprising:

a means for supporting a moving bracket means and locating a rotational axis, said moving bracket means occupying a first position relative to said supporting means when no force is applied to said actuator means;

a connecting means connecting said actuator means to said moving bracket means, said connecting means operative upon application of a first force to said actuator means to move said moving bracket means relative to said support to a second position without relative movement between said actuator and said moving bracket means, and upon application of a second force greater in magnitude than said first force to said actuator to rotate said moving bracket to said second position without relative movement between said actuator and said moving bracket means, and to subsequently move said actuator means relative to said moving bracket means;

said moving bracket means and said supporting means spaced from each other by a spring means.

2. The bracket assembly of claim 1 wherein said spring means comprises a belleville washer.

3. The bracket assembly of claim 1 wherein said connecting means comprises a resilient means.

4. The bracket assembly of claim 1 wherein said connecting means comprises a resilient means.

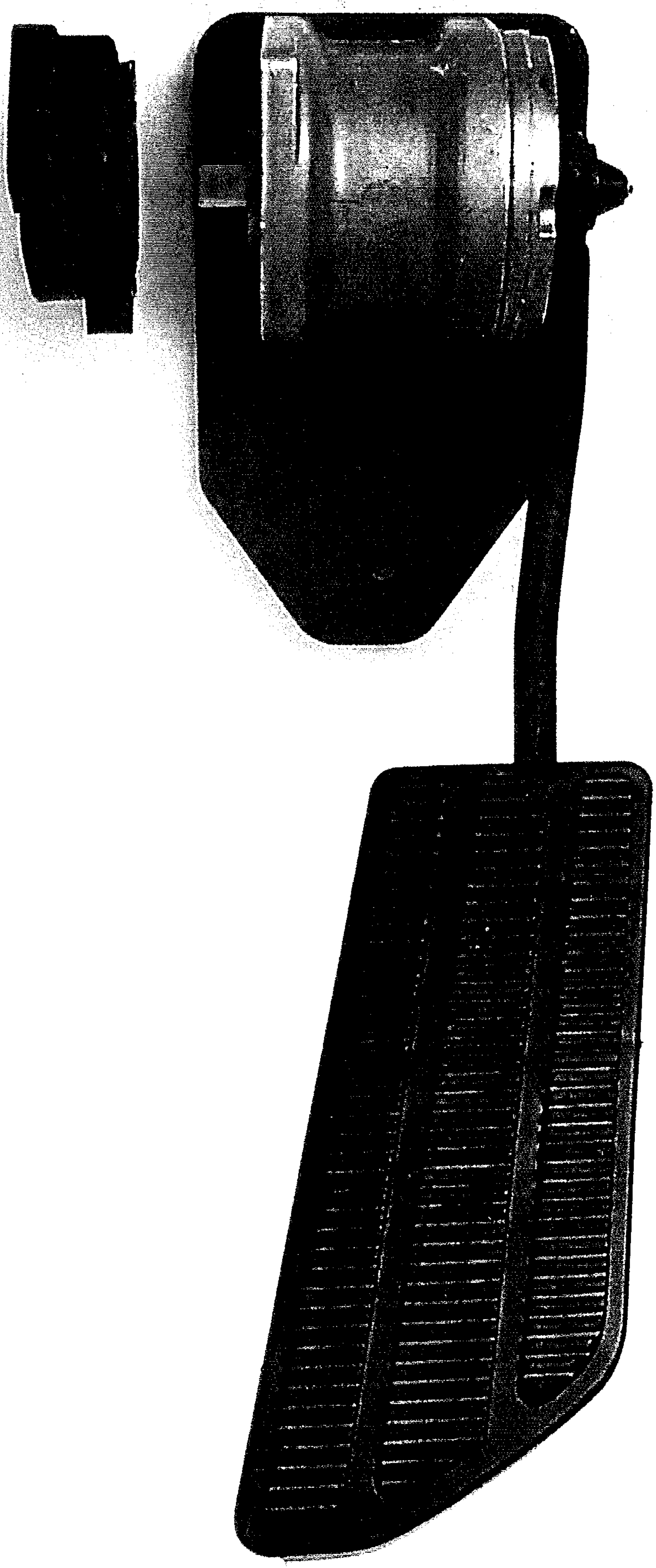
5. The bracket assembly of claim 4 wherein said resilient means requires more force to deform than said spring means.

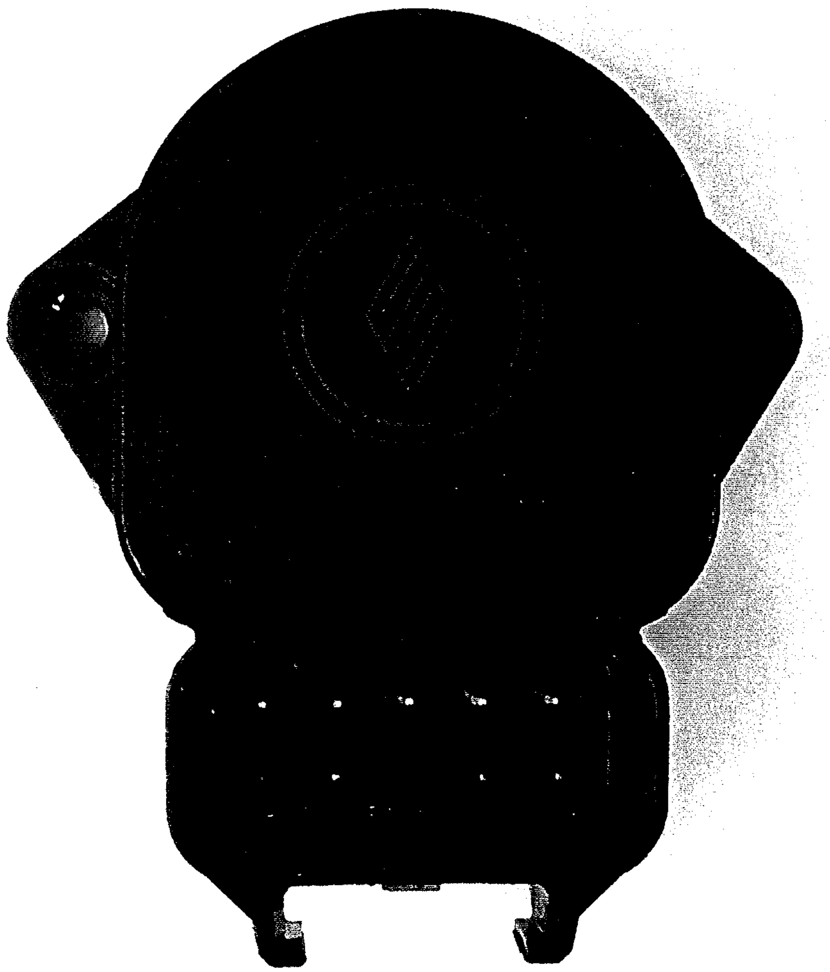
6. The bracket assembly of claim 1 wherein said spring means is spaced from said actuator means by said moving bracket means.

7. The bracket assembly of claim 1 wherein said actuator means comprises a pedal.

* * * * *

Exhibit 11





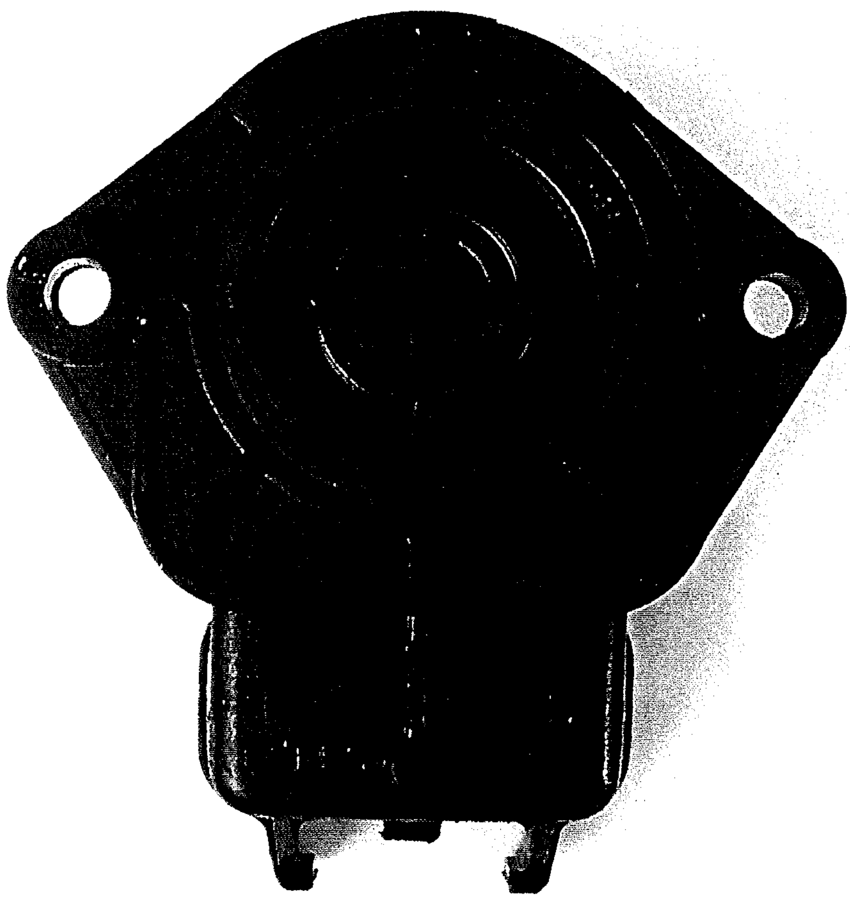


Exhibit 12

US005819593A

United States Patent [19]

Rixon et al.

[11] Patent Number: 5,819,593

[45] Date of Patent: *Oct. 13, 1998

[54] ELECTRONIC ADJUSTABLE PEDAL ASSEMBLY

[75] Inventors: Christopher J. Rixon, Tecumseh, Canada; Christopher Bortolon, Clawson, Mich.

[73] Assignee: Comcorp Technologies, Inc., Warren, Mich.

[*] Notice: The term of this patent shall not extend beyond the expiration date of Pat. No. 5,632,183.

[21] Appl. No.: 516,050

[22] Filed: Aug. 17, 1995

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 513,017, Aug. 9, 1995, Pat. No. 5,632,183.

[51] Int. Cl.^{6} G05G 1/14

[52] U.S. Cl. 74/514; 74/513

[58] Field of Search 74/514, 513, 512, 74/560

[56] References Cited

U.S. PATENT DOCUMENTS

3,643,524	2/1972	Herring	74/513 X
3,643,525	2/1972	Gibas	74/513 X
4,582,653	4/1986	Blanchard et al.	261/65
4,640,248	2/1987	Stoltman	423/399
4,869,220	9/1989	Imoehl	123/399
4,875,385	10/1989	Sitrin	74/512
4,905,544	3/1990	Ganoung	74/858
4,912,997	4/1990	Malcolm et al.	74/335
4,915,075	4/1990	Brown	123/399
4,944,269	7/1990	Imoehl	123/399
4,958,607	9/1990	Lundberg	123/399
4,976,166	12/1990	Davis et al.	74/512
4,989,474	2/1991	Cicotte et al.	74/512
5,045,035	9/1991	Ganoung	475/42
5,078,024	1/1992	Cicotte et al.	74/512
5,233,882	8/1993	Byram et al.	74/514
5,241,936	9/1993	Byler et al.	74/513 X
5,335,563	8/1994	Yamamoto et al.	74/512
5,408,899	4/1995	Stewart	74/513
5,460,061	10/1995	Redding et al.	74/513 X

FOREIGN PATENT DOCUMENTS

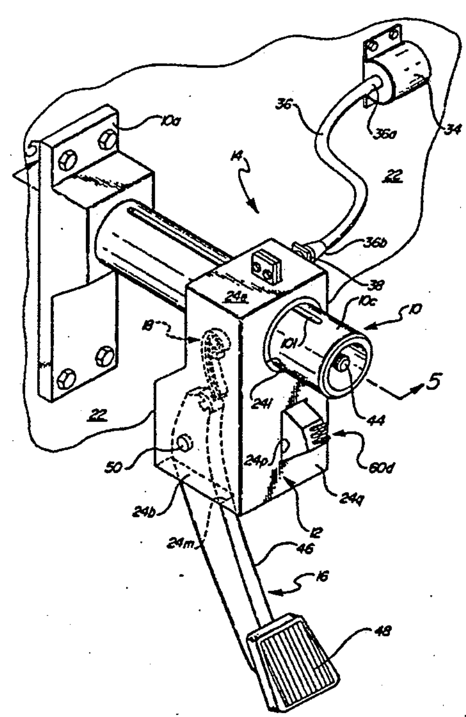
67315	3/1991	Japan	74/512
4128519	4/1992	Japan .	

Primary Examiner—Charles A. Marmor
Assistant Examiner—MaryAnn Battista
Attorney, Agent, or Firm—Howard & Howard

[57] ABSTRACT

An electronic adjustable control pedal assembly for a motor vehicle including a carrier, a guide rod adapted to be secured to the dash panel of the vehicle and mounting the carrier for fore and aft movement along the guide rod, a power drive operative to move the carrier along the guide rod, and a pedal structure including a pedal arm pivotally mounted on the carrier and a potentiometer mounted on the carrier and operative to generate an output electrical signal proportioned to the extent of pivotal movement of the pedal arm.

4 Claims, 4 Drawing Sheets



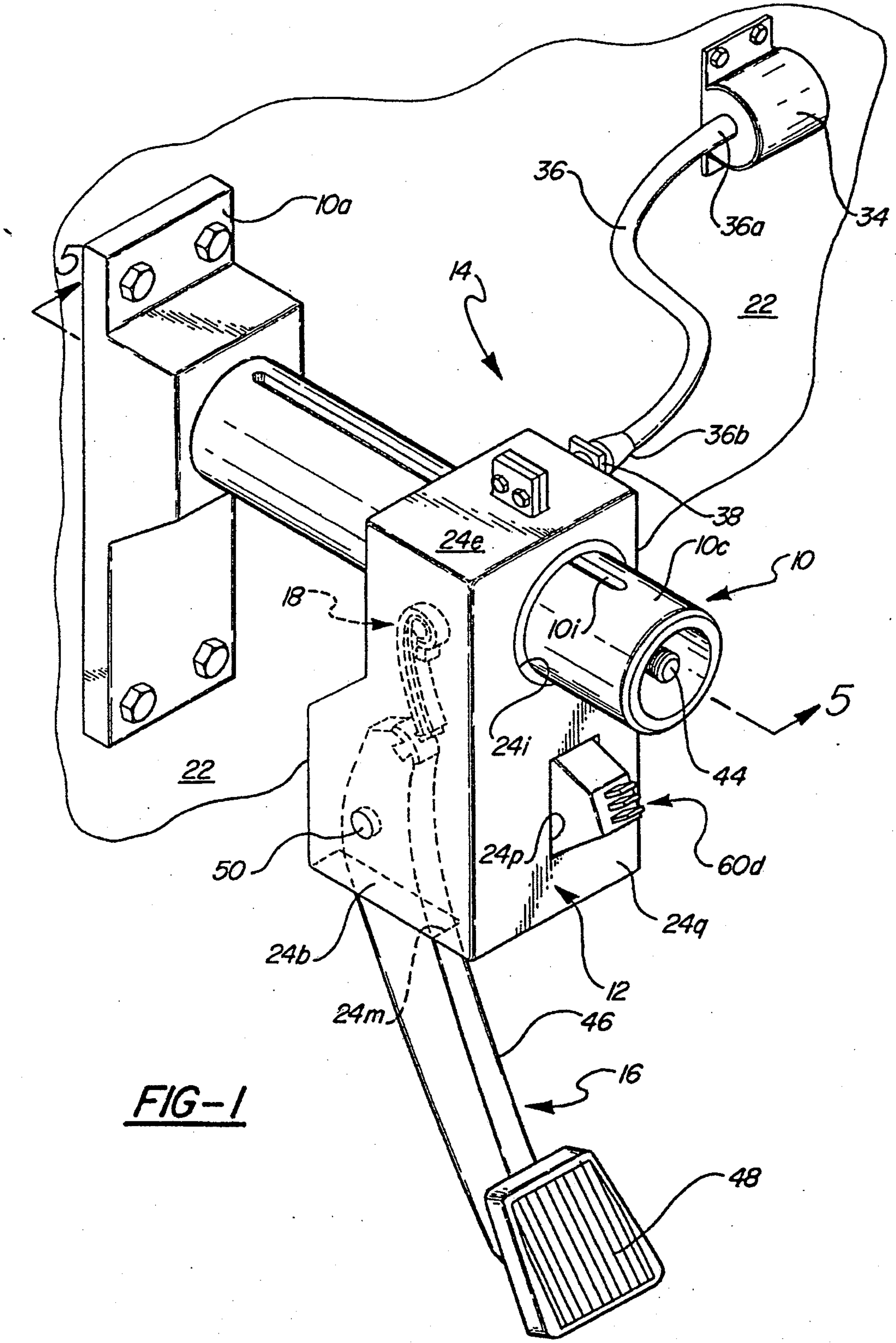

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FIG-1

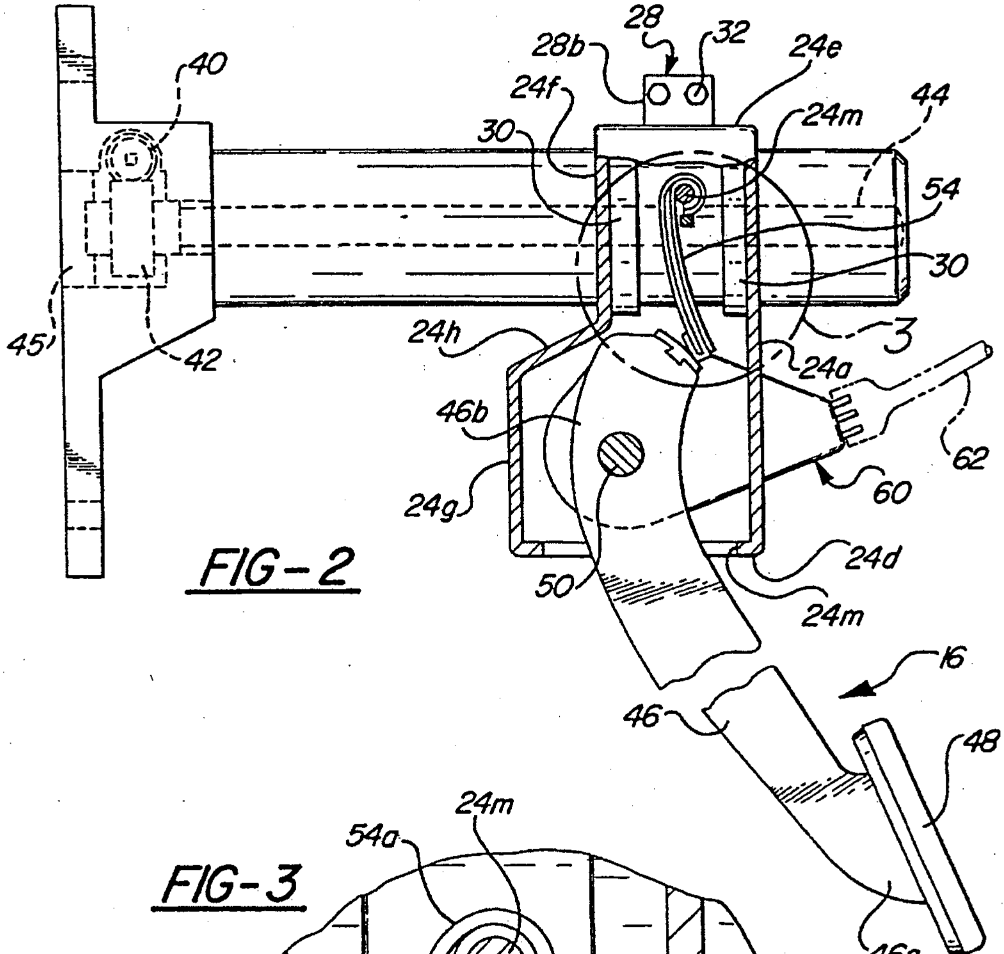
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FIG-2

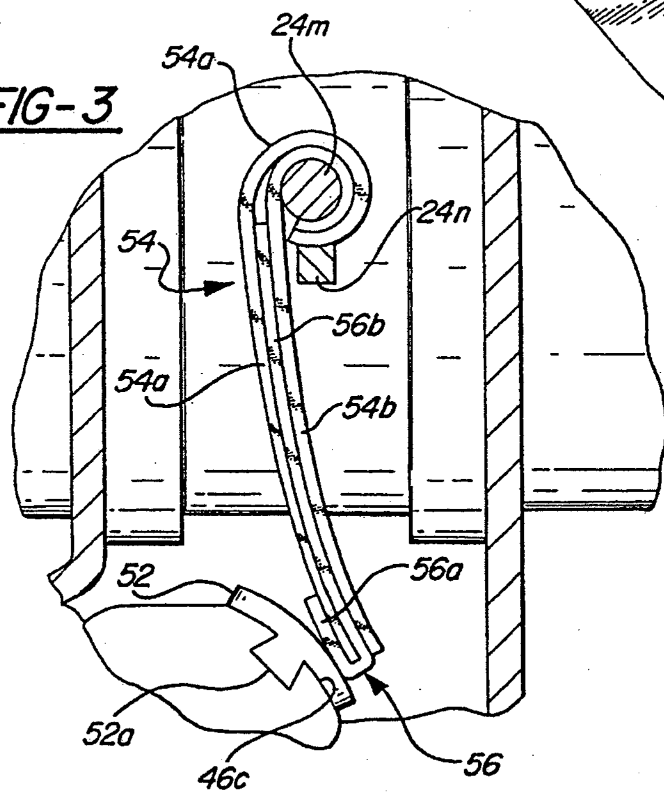
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FIG-3

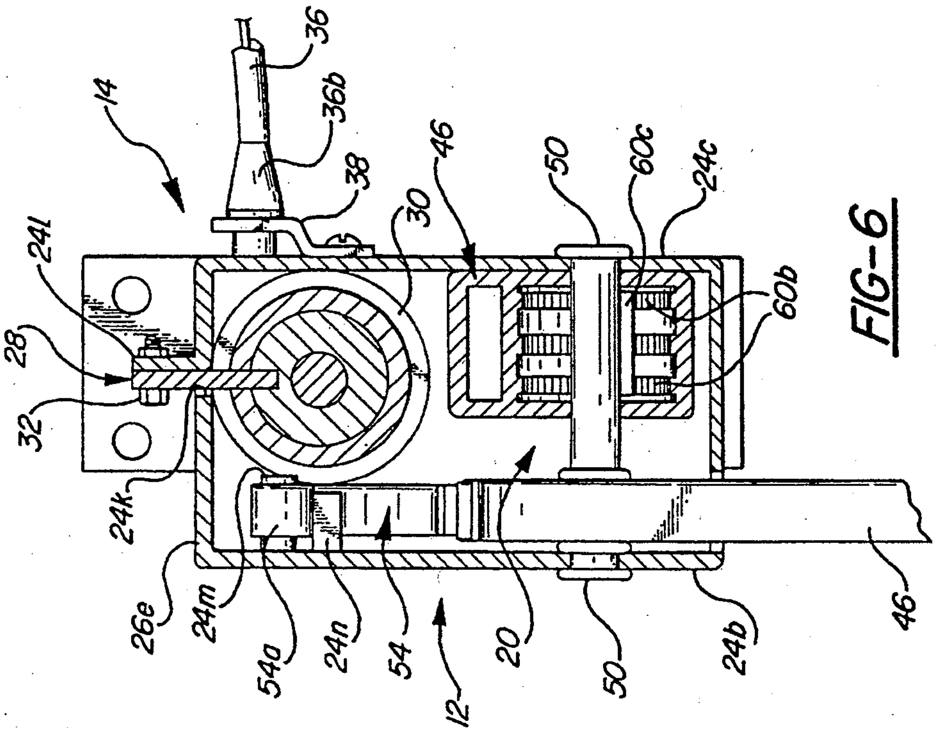
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FIG-6

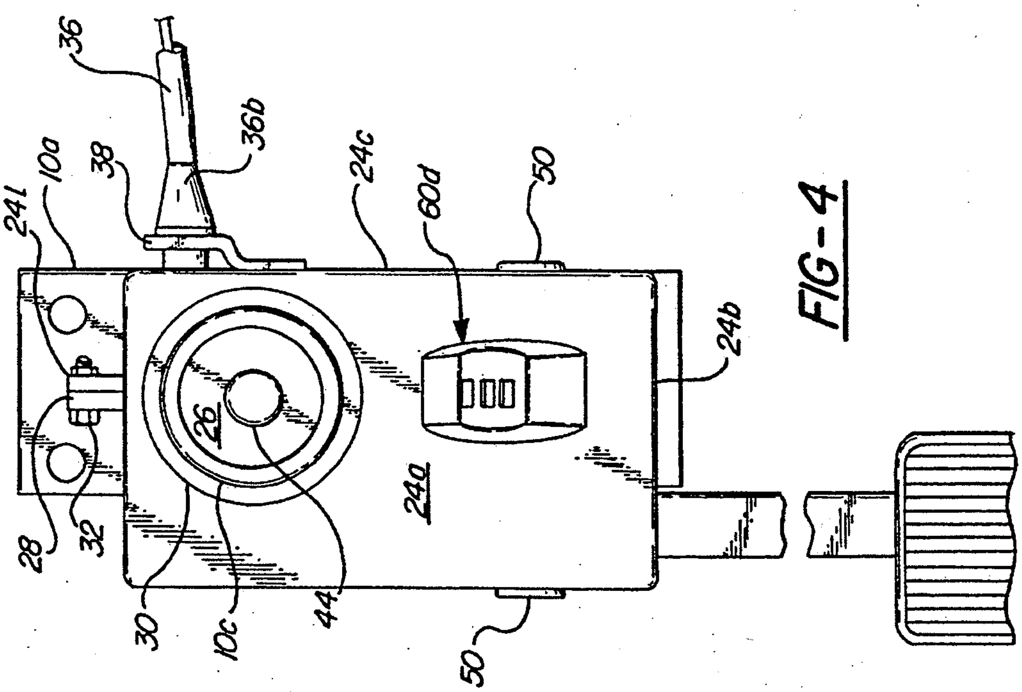
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FIG-4

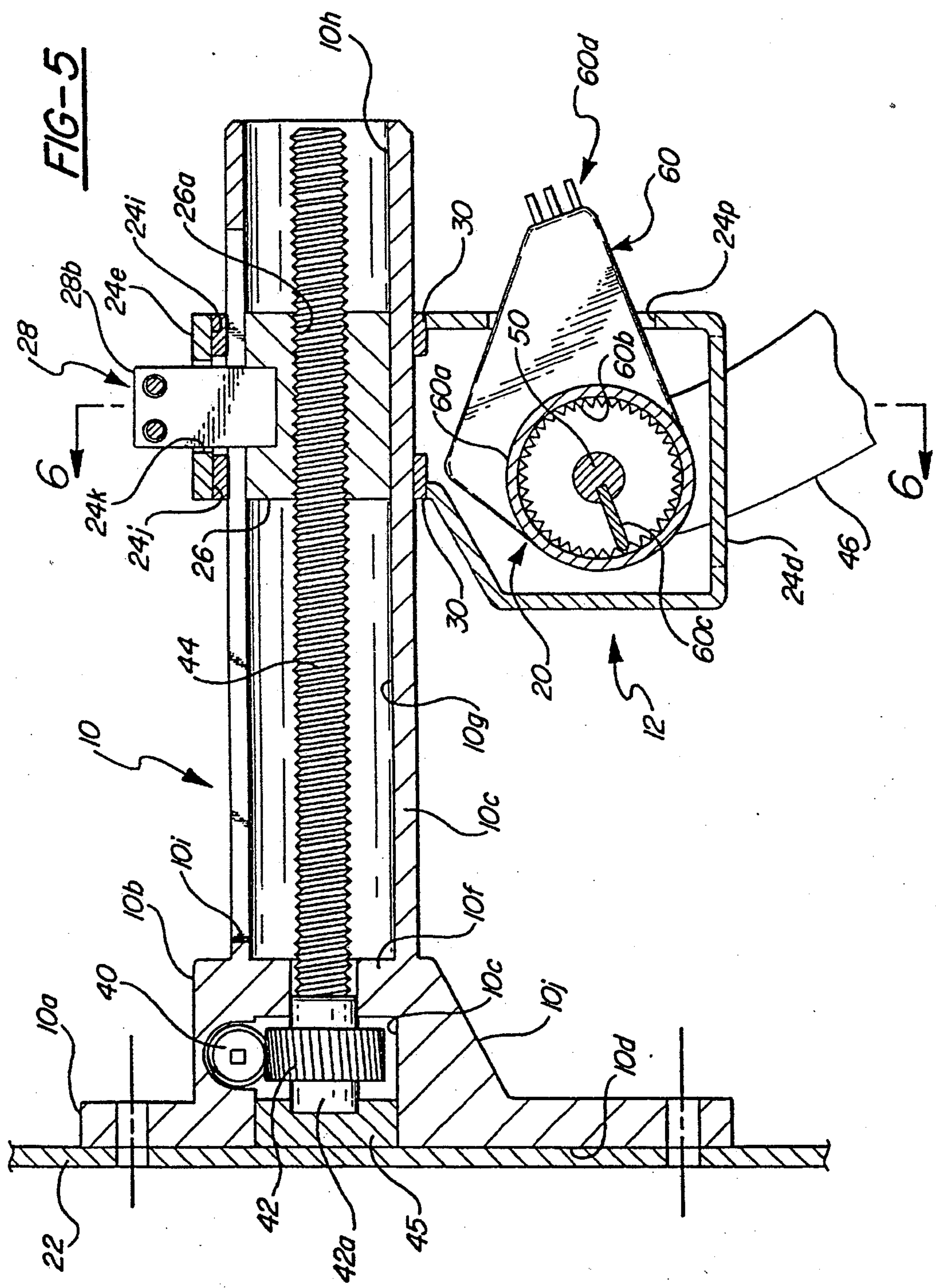
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FIG-5

ELECTRONIC ADJUSTABLE PEDAL ASSEMBLY

RELATED APPLICATION

This application is a continuation-in-part of U.S. patent application Ser. No. 08/513,017 filed on Aug. 9, 1995, now U.S. Pat. No. 5,632,183, and entitled Adjustable Pedal Assembly.

BACKGROUND OF THE INVENTION

This invention relates to control pedal apparatuses and more particularly to adjustment means for selectively adjusting the position of one or more of the control pedals of a motor vehicle.

In a conventional automotive vehicle pedals are provided for controlling brakes and engine throttle. If the vehicle has a manual transmission a clutch pedal is also provided. These pedals are foot operated by the driver. In order for the driver to maintain the most advantageous position for working these control pedals the vehicle front seat is usually slidably mounted on a seat track with means for securing the seat along the track in a plurality of adjustment positions.

The adjustment provided by moving the seat along the seat track does not accommodate all vehicle operators due to differences in anatomical dimensions. Further, there is growing concern that the use of seat tracks, and especially long seat tracks, constitutes a safety hazard in that the seat may pull loose from the track during an accident with resultant injuries to the driver and/or passengers. Further, the use of seat tracks to adjust the seat position has the effect of positioning shorter operators extremely close to the steering wheel where they are susceptible in an accident to injury from the steering wheel or from an exploding air bag. It is therefore desirable to either eliminate the seat track entirely or shorten the seat track to an extent that it will be strong enough to retain the seat during an impact. Shortening or eliminating the seat track requires that means be provided to selectively move the various control pedals to accommodate various size drivers.

Various proposals were made over a period of many years to provide selective adjustment of the pedal positions to accommodate various size drivers but none of these proposals met with any significant commercial acceptance since the proposed mechanisms were unduly complex and expensive and/or were extremely difficult to operate and/or accomplished the required pedal adjustment only at the expense of altering other critical dimensional relationships as between the driver and the various pedals. Recently a control pedal mechanism has been developed which is simple and inexpensive and easy to operate and that accomplishes the required pedal adjustment without altering further critical dimensional relationships as between the driver and the various pedals. This control pedal mechanism is disclosed in U.S. Pat. Nos. 4,875,385; 4,989,474 and 5,078,024 all assigned to the assignee of the present application. The present invention represents further improvements in adjustable control pedal design and specifically relates to an adjustable control pedal apparatus which is compatible with, and incorporates, a drive-by-wire arrangement in which the link between the pedal and the associated controlled device of the motor vehicle comprises an electronic signal rather than a mechanical linkage.

SUMMARY OF THE INVENTION

This invention is directed to the provision of a simple, inexpensive and effective apparatus for adjusting the control pedals of a motor vehicle.

More specifically, this invention is directed to the provision of an adjustable control pedal apparatus that is especially suitable for use in conjunction with a drive-by-wire throttle control.

The invention apparatus is adapted to be mounted on the body structure of the motor vehicle and includes a carrier, guide means mounting the carrier for fore and aft movement relative to the body structure, and drive means operative to move the carrier along the guide means. According to the invention, the pedal assembly further includes a pedal structure mounted on the carrier for movement relative to the carrier and means operative in response to movement of the pedal structure on the carrier to generate an electrical signal proportioned to the extent of movement of the pedal structure on the carrier. This arrangement provides a simple and effective means of generating an electronic control signal on an adjustable pedal assembly and ensures that the ergonomics of the control pedal will not vary irrespective of the position of adjustment of the pedal structure.

According to a further feature of the invention, the pedal structure is pivotally mounted on the carrier and the electric signal is generated in response to pivotal movement of the pedal structure on the carrier. This specific arrangement retains the customary pivotal movement of the control pedal and also maintains the constant ergometric operation of the control pedal assembly.

According to a further feature of the invention, the generator means includes a potentiometer mounted on the carrier whose setting is varied in response to pivotal movement of the pedal structure on the carrier. This specific arrangement provides a simple and effective means of generating the required electronic signal to provide drive-by-wire operation.

According to a further feature of the invention, the pedal structure includes a pedal arm and a pedal mounted on a lower end of the pedal arm; the pedal assembly further includes a feedback apparatus; and the feedback apparatus includes a spring mounted on the carrier and arranged to exert a spring force against the pedal arm that varies in response to pivotal movement of the pedal arm, a first friction surface defined on the pedal arm, and a second friction surface defined on the spring and arranged for wiping coaction with the first friction surface in response to pivotal movement of the pedal arm. This specific arrangement provides a simple and effective means of providing the desired feel or feedback to the operator upon movement of the pedal and further provides the desired hysteresis effect.

According to a further feature of the invention the first friction surface is defined by a cam surface on the pedal arm; the spring comprises a leaf spring fixedly secured at one end thereof to the carrier and defining a free end; and the second friction surface is defined on the free end of the leaf spring. With this arrangement, pivotal movement of the pedal arm generates wiping action between the cam surface and the free end of the spring and varies the extent of flexing of the spring about its fixed end.

According to a further feature of the invention, the feedback apparatus means further includes a first resistance plate mounted on the upper region of the pedal arm and a second resistance plate mounted on the free end of the leaf spring and biased against the first resistance plate. This arrangement allows the resistance offered to the pivoting pedal to be varied either by varying the spring characteristics of the spring or by varying the resistance characteristics of the resistance plates.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a perspective view of an electronic adjustable pedal assembly according to the invention;

FIG. 2 is a fragmentary side view of the pedal assembly;

FIG. 3 is a detail view taken within the closed line 3 of FIG. 2;

FIG. 4 is an end view of the pedal assembly;

FIG. 5 is a cross-sectional view taken on line 5—5 of FIG. 1; and

FIG. 6 is a cross-sectional view taken on line 6—6 of FIG. 5.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The invention control pedal assembly, broadly considered, is intended to allow efficient fore and aft movement of the pedal assembly to accommodate operators of varying anatomical dimension and is operative to generate an electronic or drive-by-wire signal in response to pivotal movement of the pedal assembly while retaining the same ergometric operation of the pedal irrespective of the position of adjustment of the pedal.

The pedal assembly includes a support structure 10, a carrier assembly 12, a drive assembly 14, a pedal assembly 16, a resistance or feedback assembly 18, and a generator means 20.

Support structure 10 may be formed as two or more parts which are suitably joined together or may, as shown, be formed as a single integral unitary member in a casting or forging operation. Structure 10 includes a bracket portion 10*a*, a transmission housing portion 10*b*, and a guide rod portion 10*c*.

Bracket portion 10*a* is adapted to be suitably secured to the dash panel 22 of the associated motor vehicle utilizing suitable fastener means in known manner.

Transmission housing portion 10*b* extends rearwardly from bracket portion 10*a* and has a generally cubicle configuration defining a hollow 10*c* opening at the front face 10*d* of bracket 10*a* and further defining a central bore 10*e* in a rear wall 10*f* of the housing portion.

Guide rod portion 10*c* extends rigidly rearwardly from the rear wall 10*f* of the transmission housing portion, is hollow so as to provide a tubular configuration defining a central circular bore 10*g* concentric with bore 10*e*, is open at its rear end 10*h*, and includes an upper axial slot 10*i* extending from a location proximate the transmission housing wall 10*f* to a location proximate guide rod rear end 10*h*.

Carrier assembly 12 includes a housing 24, a nut 26, and a key 28.

Housing 24 may be formed as a casting, forging or stamping, and is designed to move slidably along the guide rod portion 10*c* of support structure 10. Housing 24 includes a rear wall 24*a*, side walls 24*b* and 24*c*, a bottom wall 24*d*, a top wall 24*e*, and a front wall including an upper portion 24*f*, a lower portion 24*g*, and an angled intermediate connector portion 24*h*. A circular opening 24*i* is provided in rear wall 24*a* proximate top wall 24*e* and a circular opening 24*j* is provided in front wall upper portion 24*f* proximate top wall 24*e* in axial alignment with opening 24*i*. Housing 24 is mounted on the guide rod portion 10*c* of support structure 10 with guide rod portion 10*c* passing through apertures 24*i* and 24*j* and bushings 30 positioned in apertures 24*i* and 24*j* in sliding engagement with the outer periphery of guide rod portion 10*c* so as to mount the housing for sliding movement along the guide rod. Angled front wall 24*h* is complementary to the angled lower surface 10*j* of the transmission housing portion 10*b* of support structure 10 so that the housing 24 may move into nesting relation with respect to the support structure with the housing in its extreme forward position.

Nut 26 is circular, is mounted for sliding movement in circular bore 10*g* of support structure 10, and defines a central threaded bore 26*a*.

Key 28 is seated at its lower end 28*a* in a notch 26*b* in the upper periphery of nut 26 and passes upwardly through slot 10*i* and through an opening 24*k* in top housing wall 24*e* for securement at its upper end 28*b*, by fasteners 32, to a flange 241 upstanding from housing top wall 24*e*. Key 28 thus lockingly interconnects nut 26 and housing 24 so that movement of nut 26 in bore 10*g* is imparted to housing 24 so as to move housing 24 axially along guide rod portion 10*c*.

Drive assembly 14 includes a motor 34, a cable 36, a bracket 38, a worm 40, a worm gear 42, and a screw shaft 44.

Motor 34 comprises a suitable electric motor, with position memory if required, and is suitably secured to dash panel 22 proximate the bracket portion 10*a* of the support structure.

Cable 36 comprises a well-known bowden cable and is drivingly secured at one end 36*a* to the output shaft of motor 34. Bracket 38 is secured to an outer face of transmission housing 10*b* and mounts the other end 36*b* of cable 36.

Worm 40 is suitably journalled in transmission housing 10*b* in overlying relation to cavity 10*c* and is drivingly connected to cable end 36*b*.

Worm gear 42 is journalled in cavity 10*c* in meshing engagement with worm 40 and includes a front trunion 42*a* journalled in a bearing 45 positioned in the open front end of cavity 10*c* and a rear trunion 42*b* journalled in a counterbore 10*k* in transmission rear wall 10*f*.

Screw shaft 44 extends rearwardly from worm gear 42 centrally within support structure bore 10*g* and passes threadably through the threaded central bore 26*a* of nut 26.

It will be seen that actuation of motor 34 has the effect of rotating screw shaft 44 to thereby move nut 26 and housing 24 fore and aft along guide rod 10*c* with the extent of forward and rearward movement defined and limited by engagement of key 28 with the front and rear ends of slot 10*i*.

Pedal assembly 16 includes a pedal arm 46 and a pedal 48 secured to the lower end 46*a* of the pedal arm. Pedal arm 46 passes upwardly through a slot 24*m* in the lower housing wall 24*d* for pivotal mounting at its upper end 46*b* to housing side walls 24*b* and 24*c* via a pivot shaft 50.

Resistance assembly 18 includes a pedal arm friction cam plate 52, a leaf spring 54, and a spring friction cam plate 56. Resistance assembly 18 is intended to provide feedback or "feel" to the operator to replace the feedback normally provided by the mechanical linkage interconnecting the pedal and the controlled device such as the fuel throttle. With a mechanical linkage, the pedal pressure required when advancing the accelerator pedal is greater than that required to maintain a fixed position. This difference is often referred to as due to the hysteresis effect. This effect is important in maintaining the accelerator pedal in position while driving at a relatively constant speed and it must also be considered in achieving a desired deceleration time. The pressure which must be applied in accelerating is easily borne but if the back pressure of an accelerator spring produced the same effect during the time it was required to retain or maintain speed it would soon become uncomfortable for the operator to maintain a relatively constant speed. The hysteresis effect provides relief. It lessens the load required to maintain a setting of the accelerator yet there is still force to cause reverse pedal action when the foot applied pressure is removed. Resistance assembly 18 provides the "feel" of a mechanical linkage including the desired hysteresis effect to relieve operator fatigue.

Pedal arm friction cam plate 52 may be formed, for example, of a plastic material such as Delrin® and is secured to an upper cam edge 46*c* of the pedal arm via a dovetail connection 52*a*.

Spring 54 comprises a laminated leaf spring and includes a curl 54*a* at its upper end wrapped around a pin 24*m* projecting inwardly from housing side wall 24*b*. A nub 24*n* projects inwardly from housing side wall 24*b* below pin 24*m* and coacts with pin 24*m* to trap the end tip 54*b* of curl 54*a* to fixedly secure the upper end of the spring to housing side wall 24*b*.

Spring friction cam plate 56 may be formed, for example, of a glass filled nylon material and includes a working portion 56*a* suitably secured to the lower end 54*b* of leaf spring 54 and a tail portion 56*b* passing upwardly between the leaves 54*a*, 54*b* of leaf spring 54. The parts are configured such that with the pedal 48 in its upper or rest position, as seen in FIG. 1, friction plate working portion 56*a* is urged against friction plate 52 by spring 54 so as to resist pivotal movement of the pedal assembly to an operative position with the resistance being constituted both by the increasing resistance force of the spring 54 and by the frictional resistance force between plates 52 and 56*a* generated by the wiping or camming action of plate 52 against plate 56*a* as the pedal arm pivots about the axis of pivot shaft 50. Upon release of pressure on the pedal, the frictional resistance force between plates 52 and 56*a* become subtractive rather than additive with respect to the force of spring 54, thereby creating the desired hysteresis effect. The materials of cam plates 52 and 56*a* may be selectively varied to selectively vary the friction levels and hence the damping or hysteresis effect provided by the rubbing plates.

Generator means 20 comprises a potentiometer 60 positioned within the hollow of housing 24 and suitably secured to housing side wall 24*c*. Potentiometer 60 includes a central shaft, constituted by the pivot shaft 50, a housing 60*a* concentric with shaft 50, a plurality of resistance elements 60*b* mounted circumferentially around the inner periphery of housing 60*a* in side-by-side relation, a wiper arm 60*c* mounted on shaft 50 and operative to electrically slidably engage the resistance elements 60*b* in response to pivotal movement of shaft 50, and an outlet 60*d* projecting rearwardly through opening 24*p* in housing rear wall 24*a* and electrically connected to wiper 60*c* and resistance elements 60*b* in a manner such that the electrical signal appearing at the outlet 60*d* varies in proportion to the extent of pivotal movement of the pivot shaft 50. It will be seen that pivotal movement of pedal 48 has the effect of rotating pivot shaft 50 and thereby varying the electrical signal appearing at the potentiometer outlet 60*d* so that the signal appearing at outlet 60*d* is at all times proportioned to and indicative of the pivotal position of the pedal. It will be understood that electric power is suitably supplied to potentiometer 60 and an electrical conduit 62 is suitably connected to potentiometer outlet 60*d* and extends to the vehicle function or accessory, such as the vehicle throttle, that is being electrically controlled by the pedal assembly.

In operation, the position of the pedal 48 relative to the operator is selectively adjusted by selectively energizing motor 34 to selectively move nut 26 forwardly and rearwardly within guide rod bore 10*g* and thereby, via key 28, move the pedal assembly selectively forwardly and rearwardly along guide rod 10*c* with the limits of forward and rearward movement determined by engagement of the key with the respective forward and rearward ends of the slot 10*i*. In any position of adjustment of the pedal, actuation of the pedal or release of the pedal results, in the manner previously described, in the generation of an output signal at the outlet 60*d* proportioned to the extent of pivotal movement. Since the pivotal movement of the pedal arm is precisely the same in any position of adjustment of the pedal structure, the ergometrics of the assembly do not vary irrespective of the position of adjustment of the pedal assembly and irrespective of the anatomical stature of the operator.

As the pedal is moved downwardly, a "feel" is imparted to the pedal, simulating the feel of a mechanical linkage between the pedal and the controlled vehicle system, by the combined effect of flexing of the leaf spring 54 and frictional sliding or wiping engagement between the friction plates 52 and 56*a*. Further, as the pedal is released or allowed to return, the frictional force becomes subtractive rather than additive with respect to the spring force, thereby creating the desired hysteresis effect. The amount of feel imparted to the pedal can thus be precisely adjusted by adjusting the spring rate or other parameters of leaf spring 54, and/or by adjusting the materials or other parameters of friction plates 52 and 56*a*, and/or by adjusting the rise of cam edge 46*c*, thereby rendering it relatively easy to fine tune the system to achieve any desired feel and any desired hysteresis effect.

The invention will be seen to provide an electronic adjustable pedal assembly for a motor vehicle in which the assembly may be readily adjusted to accommodate operators of varying anatomical dimensions and in which the ergometrics of the system remain constant irrespective of the position of adjustment of the pedal structure.

Whereas a preferred embodiment of the invention has been illustrated and described in detail, it will be apparent that various changes may be made in the disclosed embodiment without departing from the scope or spirit of the invention. For example, although the invention pedal assembly has been indicated for use in controlling the throttle of the associated vehicle, the invention pedal assembly may be used to electrically control a wide variety of vehicle functions or accessories. Further, although the resistance assembly 18 has been illustrated as providing the damping for an adjustable pedal assembly, it will be apparent that this resistance assembly can also be utilized to provide damping for a non-adjustable pedal assembly.

What is claimed is:

1. An adjustable pedal assembly for a motor vehicle adapted to be mounted on a body structure of the vehicle and operative to generate a control signal for controlling an associated device of the motor vehicle, said assembly comprising:

a carrier;

guide means mounting the carrier for fore and aft movement relative to the vehicle body structure;

drive means for moving the carrier along the guide means;

a pedal structure mounted on the carrier for movement relative to the carrier; and

generator means operative in response to movement of the pedal structure relative to the carrier to generate an electric control signal proportioned to the extent of movement of the pedal structure relative to the carrier;

the carrier defining a smooth bore and a threaded bore;

the guide means including a guide rod slidably received in the smooth bore; and the drive means including a screw shaft threadably received in the threaded bore.

2. An adjustable pedal assembly for a motor vehicle adapted to be mounted on a body structure of the vehicle and operative to generate a control signal for controlling an associated device of the motor vehicle, said assembly comprising:

a carrier;

guide means mounting the carrier for fore and aft movement relative to the vehicle body structure;

drive means for moving the carrier along the guide means;

a pedal structure including an upper end pivotally mounted on the carrier; and

generator means operative in response to pivotal movement of the pedal structure on the carrier to generate an electric control signal proportioned to the extent of pivotal movement of the pedal structure;

the carrier defining a smooth bore and a threaded bore;

the guide means including a guide rod slidably received in the smooth bore; and

the drive means including a screw shaft threadably received in the threaded bore.

3. An adjustable pedal assembly for a motor vehicle adapted to be mounted on a body structure of the vehicle and operative to generate a control signal for controlling an associated device of the motor vehicle, said assembly comprising:

a carrier;

guide means mounting the carrier for fore and aft movement relative to the vehicle body structure;

drive means for moving the carrier along the guide means;

a pedal structure including an upper end pivotally mounted on the carrier;

generator means operative in response to pivotal movement of the pedal structure on the carrier to generate an electric control signal proportioned to the extent of pivotal movement of the pedal structure;

resistance means operative to resist pivotal movement of the pedal structure;

the pedal structure including a pedal arm and a pedal mounted on a lower end of the pedal arm;

the resistance means including a leaf spring fixedly mounted at one end thereof on the carrier and having a free end biased against an upper region of the pedal arm;

the resistance means further including a first resistance plate mounted on the upper region of the pedal arm and a second resistance plate mounted on the free end of the leaf spring and biased against the first resistance plate.

4. An adjustable pedal assembly for a motor vehicle adapted to be mounted on a body structure of the vehicle and including a carrier, guide means mounting the carrier for fore and aft movement relative to the body structure, and drive means operative to move the carrier along the guide means, characterized in that:

the pedal assembly further includes a pedal structure mounted on the carrier for movement relative to the carrier and generator means operative in response to movement of the pedal structure on the carrier to generate an electrical signal proportioned to the extent of movement of the pedal structure on the carrier;

the guide means comprises a guide rod;

the carrier includes an upper portion mounted on the guide rod for sliding fore and aft movement along the guide rod;

the pedal structure includes a pedal arm having an upper end mounted on a lower portion of the carrier;

the pedal arm is pivotally mounted on the lower carrier portion;

the generator means includes a potentiometer mounted on the lower portion of the carrier and means operative in response to pivotal movement of the pedal arm to vary the setting of the potentiometer;

the guide rod comprises a hollow rod;

the carrier further includes a nut slidably positioned within the hollow of the guide rod and means connecting the nut to the upper portion of the carrier so that sliding movement of the nut within the guide rod moves the carrier fore and aft along the guide rod;

the drive means includes a screw shaft threadably received in the nut and means operative to rotate the screw shaft.

* * * * *

Exhibit 13

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2,860,720

ADJUSTABLE TOEBOARD FOR AN AUTOMOBILE

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6 Claims. (Cl. 180—90.6)

This invention relates to a toeboard, and more particularly to an adjustable toeboard for a vehicle.

One feature of the invention is that it provides an improved toeboard; another feature of the invention is that it provides a movable toeboard for changing the distance between the fuel and brake pedals and the seat; a further feature of the invention is that the toeboard is swingably mounted and means are provided for adjusting the angular position of the toeboard to swing it toward or away from the seat; still another feature of the invention is that the toeboard movably mounts brake and fuel pedals, the distance of these pedals from the seat varying with the angular position of the toeboard; and yet a further feature of the invention is that power operated actuating means in the engine compartment of the vehicle are connected to the toeboard adjacent the lower side thereof for controlling the angular position of the toeboard.

Other features and advantages of the invention will be apparent from the following description and from the drawings, in which:

Fig. 1 is a fragmentary perspective view of the inside of the passenger compartment of a vehicle having the improved toeboard therein, the toeboard being shown in its most forward position in full lines and in its rearmost position in broken lines;

Fig. 2 is a fragmentary longitudinal vertical section through a portion of the engine and passenger compartments of the automobile, the movable toeboard being shown in its most forward position in full lines and in its rearmost position in broken lines;

Fig. 3 is a vertical transverse section taken along the line 3—3 of Fig. 2, parts being broken away to show underlying structure; and

Fig. 4 is an enlarged fragmentary section taken along the line 4—4 of Fig. 2 showing the power operated actuating means, parts being shown in one position in solid lines and in another position in broken lines.

In most automobiles the seats, and particularly the driver's seat, are adjustable longitudinally of the car to change the distance between the seat cushion and the foot control pedals. The adjustable seat requires more space than it would if it were not longitudinally movable and the longitudinal adjusting apparatus also utilizes space in the passenger compartment. Often the drive shaft tunnel interferes with the location of the transverse rods which are part of the seat adjuster, making it necessary to raise the seat to an undesirable height. This may be of particular importance in a low-roofed automobile, as in a sport car. This invention provides an improvement over a longitudinally adjustable seat by providing a movable toeboard upon which the foot control pedals are mounted. By moving the toeboard toward or away from the seat, the distance between the seat and the pedals may be varied without moving the seat longitudinally. This conserves space in the passenger compartment since the seat may be fixedly mounted or

mounted for vertical movement only without the necessity of using a bulky horizontal seat adjuster. Furthermore, the space through which the toeboard is movable normally is not used for any other purpose so that useable space in the passenger compartment is conserved. In the preferred embodiment which is illustrated in the drawings, the toeboard in front of the driver's seat is swingably mounted, being pivoted adjacent its upper end and being connected adjacent its lower end to power operated actuating means in the engine compartment for adjusting its angular position. If desired, the toeboard in front of the passenger's seat can also be made adjustable.

Referring now more particularly to the drawings, an automobile designated generally as **10** in Figs. 1 and 2 has a passenger compartment **12** and an engine compartment **14** separated by a fire wall **16**. The engine compartment is at the front of the automobile below the hood **18** and the passenger compartment is provided with a forwardly facing windshield **20** in conventional manner. Within the passenger compartment **12** there is a driver's seat **22** and a passenger's seat **24**, which seats preferably are vertically adjustable as shown in broken lines in Figs. 1 and 2. These seats are illustrated only fragmentarily since they may be of conventional construction, including a cushion and a generally vertical back. Forwardly of the driver's seat there is a steering control **26** mounted on a column **27** which extends through the automobile dashboard **28**. The steering column is swivelly connected to a rod **30** which extends into the engine compartment **14** through an opening in the fire wall **16**.

Below the lower edge of the windshield **20** there is a transverse structural body support member **32** to which is secured a casting **34**. The steering column **27** is bolted at **36** to flanges on the lower side of the casting **34**, and at the forward side spaced hinge supports **38** project from the casting. The toeboard in front of the driver's seat, which is designated by the reference character **40**, is bolted to a toeboard support casting **42** which, at its upper end, has spaced arms **44** terminating in apertured yokes **46**. The lugs **38** which project from the support casting **34** are received in the yokes **46** and bolts or pintles **48** swingably mount the toeboard casting **42** on the support casting **34**. As seen best in Fig. 2, the toeboard **40** and its support casting **42** are formed as a dog leg or L when viewed in vertical section, having an upper portion which extends downwardly and forwardly from the pintles **48** and having a lower portion which is the toeboard proper and which extends downwardly and rearwardly, terminating adjacent a carpet **50** which covers the vehicle floor **52**.

Adjacent its center the toeboard is formed with a truncated housing portion **54** having an opening **56**. Behind this housing there is a pedal support bracket **58** secured to the support casting **42** and a brake pedal **60** and a fuel pedal **62** are pivotally mounted on the support bracket **58**, the pivotal mounting for the brake pedal **60** being shown at **64** in Fig. 2. The forward end of the brake pedal is connected to an actuating rod **66** and the forward end of the fuel pedal **62** may be similarly connected to a rod, these rods extending through the fire wall **16** into the engine compartment and being connected to the proper control means therein.

As seen best in Fig. 2, the toeboard may be swung between a forward position shown in solid lines and a rearward position shown in broken lines and the distance of the pedals **60** and **62** from the driver's seat **22** depends upon the angular position of the toeboard. In order to control this angular position, there are power operated actuating means in the engine compartment **14** connected to the toeboard adjacent the lower side thereof. The support casting 42 has adjacent its lower end forwardly projecting lugs 68 and 70 which extend through the fire wall and between which a slide bar 72 is mounted. Connecting brackets 74 and 76 are mounted on the rod 72, at least the bracket 74 being freely slidable thercon.

A reversible electric motor 78 is connected through a gear box 80 to a screw device 82, which, at one end, mounts a rotatable bearing 84 which does not travel longitudinally along the screw, and at the other end mounts a traveling nut 86 threaded on the screw. A pair of scissors links 88 and 90 are connected between the screw jack device and the rod 72 on the bracket 42. One end of link 88 is pivotally connected to the bearing 84 and the other end is pivotally connected to the bracket 74 on the rod 72, said bracket being slidable on the rod 72. One end of link 90 is pivotally connected to the traveling nut 86 and the other end is pivotally connected to the bracket 76 on the rod 72. The scissors links are pivotally connected together adjacent their centers at 92. When the motor 78 is operated, the traveling nut 86 is driven along the screw jack 82 to any desired position between the extreme positions shown in Fig. 4. Movement of the nut 86 along the screw jack operates through the scissors links to swing the bracket 42 and the toeboard 40 between the extreme positions shown in Figs. 4 and 2 so that the distance of the brake pedal 60 and the fuel pedal 62 from the driver's seat 22 may be adjusted. Any conventional switch means, preferably operated from the passenger compartment, may be used to operate the motor 78 in either direction. The motor, of course, may be connected to the automobile electric power source in conventional manner.

Since the toeboard swings from a pivotal connection at its upper end, the adjustment may be made without using any space which normally is used in the passenger compartment. Because the toeboard is adjustable, drivers of different size may be accommodated without making the seat movable longitudinally and no useable space in the passenger compartment need be occupied by a bulky seat adjuster. Also, since the seat does not move longitudinally, there is no necessity for reserving several inches of otherwise useable space to accommodate fore and aft seat movement.

While we have shown and described one embodiment of our invention, it is capable of many modifications. Changes, therefore, in the construction and arrangement may be made without departing from the spirit and scope of the invention as set forth in the appended claims.

We claim:

1. In combination in a vehicle having a passenger compartment and an engine compartment forwardly of the passenger compartment and separated therefrom by a generally vertical fire wall, a fixed support member in the passenger compartment, a toeboard panel extending in generally parallel relationship to said fire wall, means hingedly mounting said toeboard adjacent its upper end on said support member for swinging movement toward and away from said fire wall, operating means in the engine compartment for swinging said toeboard toward and away from said fire wall, means connecting said operating means to the toeboard at a location spaced from the hinge mounting thereof, and at least one control pedal movably mounted on said toeboard.

2. In combination in a vehicle having a passenger compartment and an engine compartment forwardly of the passenger compartment and separated therefrom by a generally vertical fire wall, a fixed support member in the passenger compartment, a toeboard panel extending in generally parallel relationship to said fire wall, means hingedly mounting said toeboard adjacent its upper end on said support member for swinging movement toward and away from said fire wall, power actuated operating means in the engine compartment for swinging said toeboard toward and away from said fire wall, means connecting said operating means to the toeboard near the lower end thereof, and at least one control pedal movably mounted on said toeboard.

3. In combination in a vehicle having a passenger compartment and an engine compartment forwardly of the passenger compartment separated therefrom by a generally vertical fire wall, a fixed support member in the passenger compartment, a toeboard panel extending in generally parallel relationship to said fire wall, means hingedly mounting said toeboard adjacent its upper end on said support member for swinging movement toward and away from said fire wall, a seat mounted in said passenger compartment rearwardly of the toeboard, operating means in the engine compartment for swinging said toeboard toward and away from said fire wall independently of said seat, means connecting said operating means to the toeboard at a location spaced from the hinge mounting thereof, and at least one control pedal movably mounted on said toeboard.

4. In combination in a vehicle having a passenger compartment and an engine compartment forwardly of the passenger compartment and separated therefrom by a generally vertical fire wall, a fixed support member in the passenger compartment, a toeboard panel extending in generally parallel relationship to said fire wall, means hingedly mounting said toeboard adjacent its upper end on said support member for swinging movement toward and away from said fire wall, a seat mounted in the passenger compartment rearwardly of said toeboard, power actuated operating means in the engine compartment for swinging said toeboard toward and away from said fire wall independently of said seat, means extending through the fire wall and connecting said operating means to the toeboard near the lower end thereof, and a brake pedal and a fuel pedal movably mounted on said toeboard.

5. In combination in a vehicle: a seat; a unitary toeboard assembly located forwardly of said seat and including a toeboard portion and a support portion; at least one control pedal movably mounted on said toeboard assembly; means for hingedly mounting said toeboard assembly adjacent its upper end for swinging movement toward and away from said seat to change the distance between said pedal and seat, said support portion having mounting extensions adjacent its upper end; and power-operated actuating means connected to said toeboard assembly and being independent of said seat for controlling the angular position of the toeboard assembly and the distance between said pedal and seat.

6. In a vehicle having a passenger compartment and an engine compartment with a fire wall therebetween, apparatus of the character described, including: a seat mounted in the passenger compartment; a unitary toeboard assembly in the passenger compartment adjacent the fire wall, said assembly including a toeboard portion and a support portion; at least one control pedal movably mounted on said toeboard assembly; means for hingedly mounting said toeboard assembly at its upper end for swinging movement to change the distance between said pedal and seat, said support portion having a pair of mounting arms at its upper end; and actuating means in the engine compartment connected through said fire wall to said toeboard assembly adjacent the lower side thereof to control the angular position of said toeboard assembly independently of said seat and thereby change the distance between said pedal and seat.

References Cited in the file of this patent

UNITED STATES PATENTS

2,620,042	Vincent	Dec. 2, 1952

FOREIGN PATENTS

734,938	Germany	May 3, 1943
613,199	Great Britain	Nov. 23, 1948

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ADJUSTABLE TOEBOARD FOR AN AUTOMOBILE

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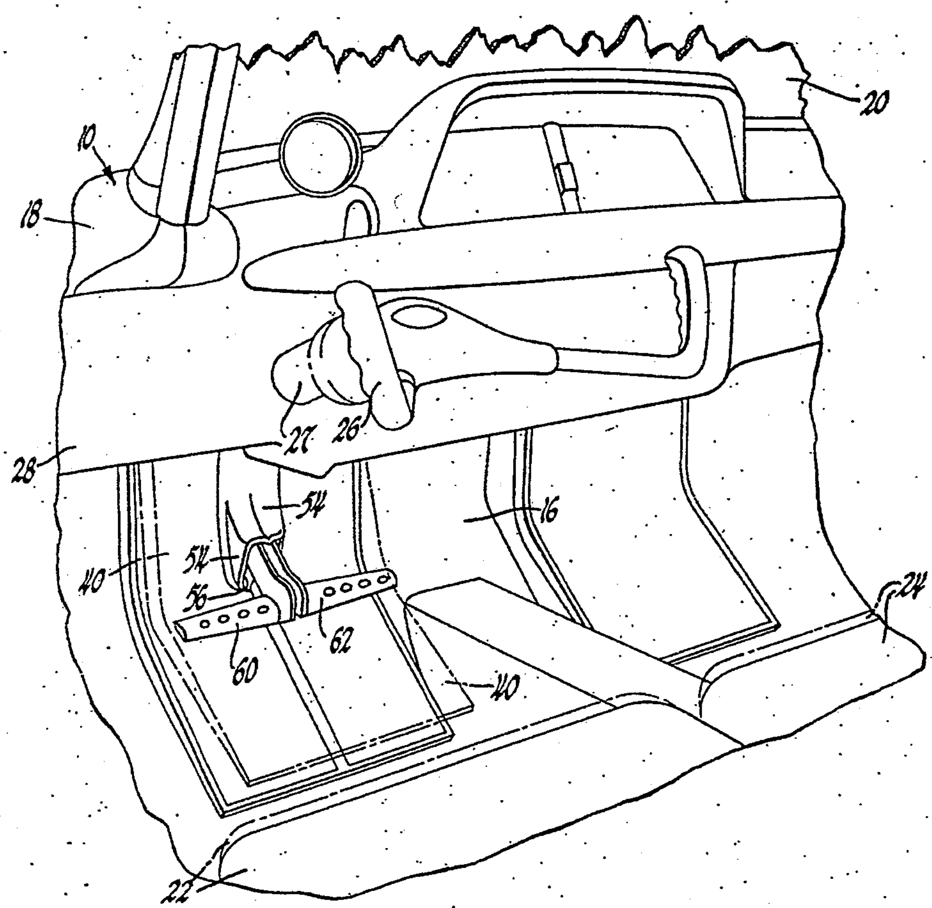

Fig. 1

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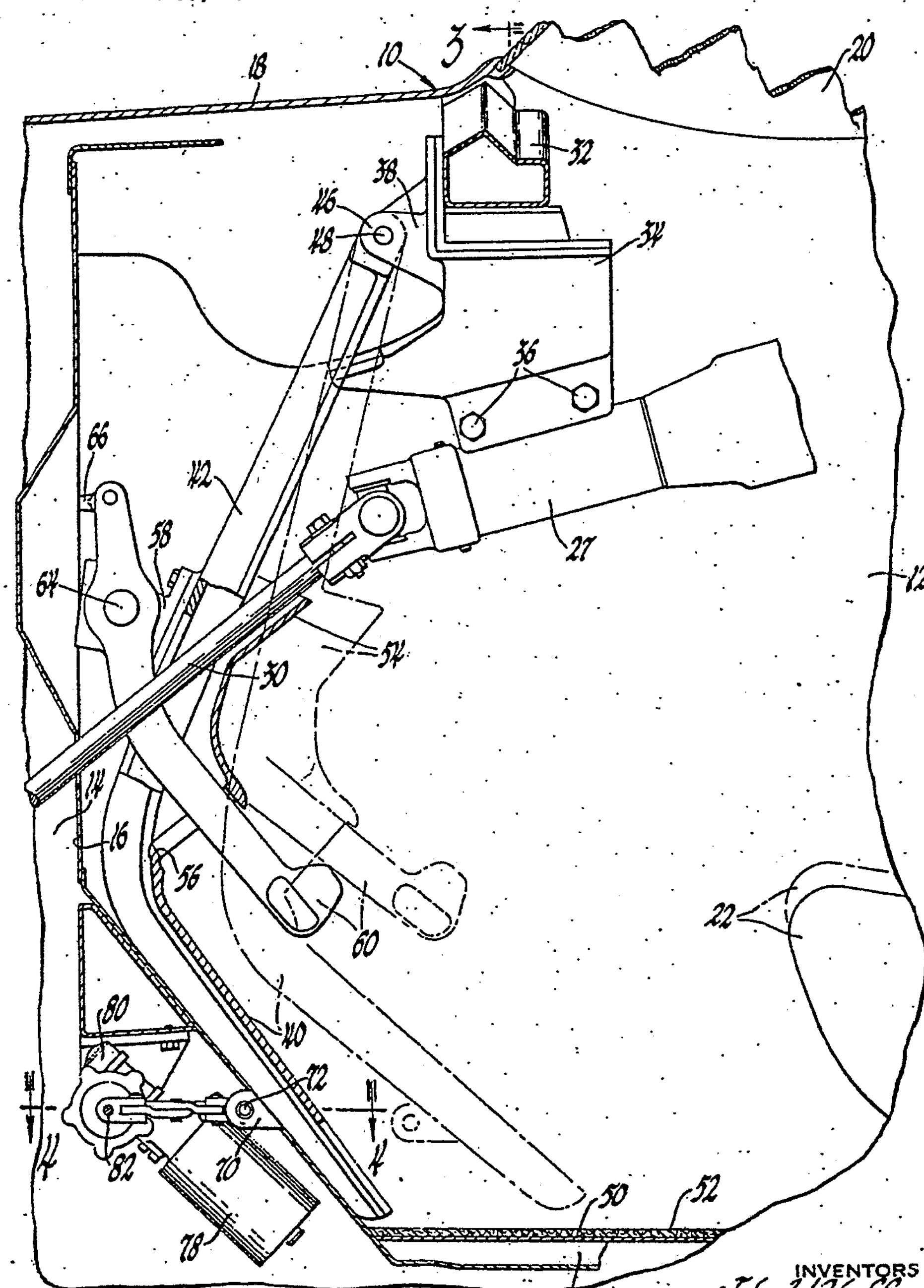

Fig. 2

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ADJUSTABLE TOEBOARD FOR AN AUTOMOBILE

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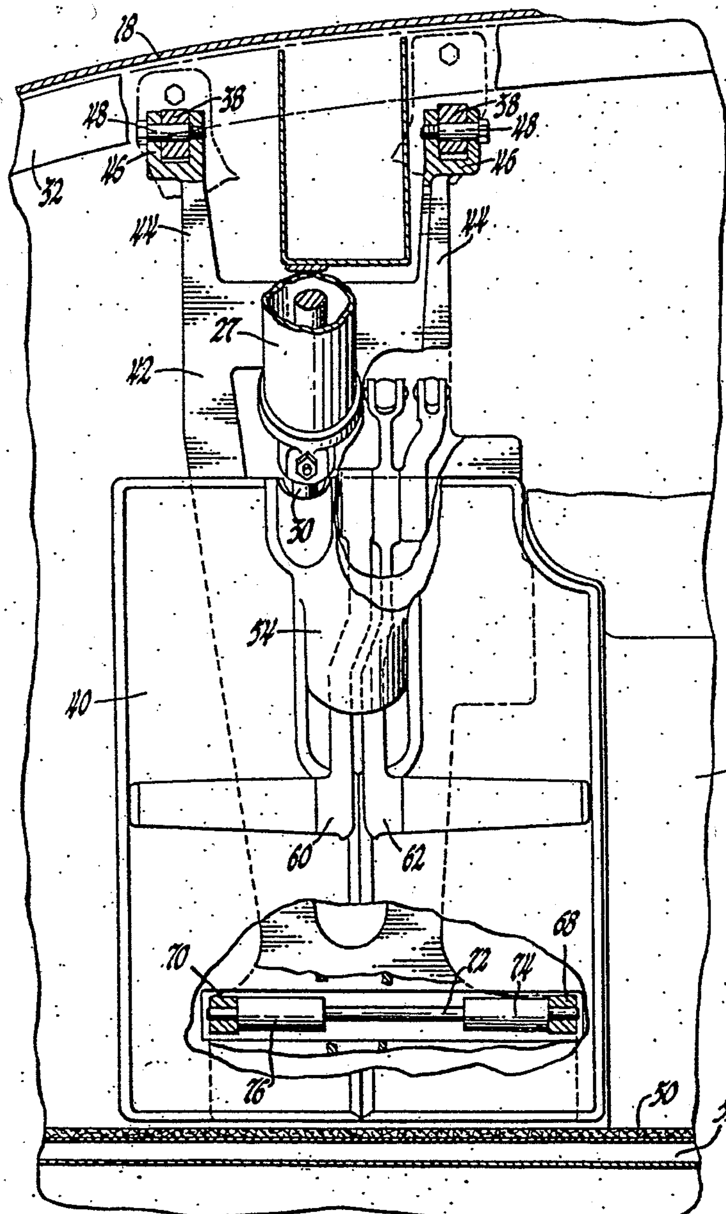

Fig. 3

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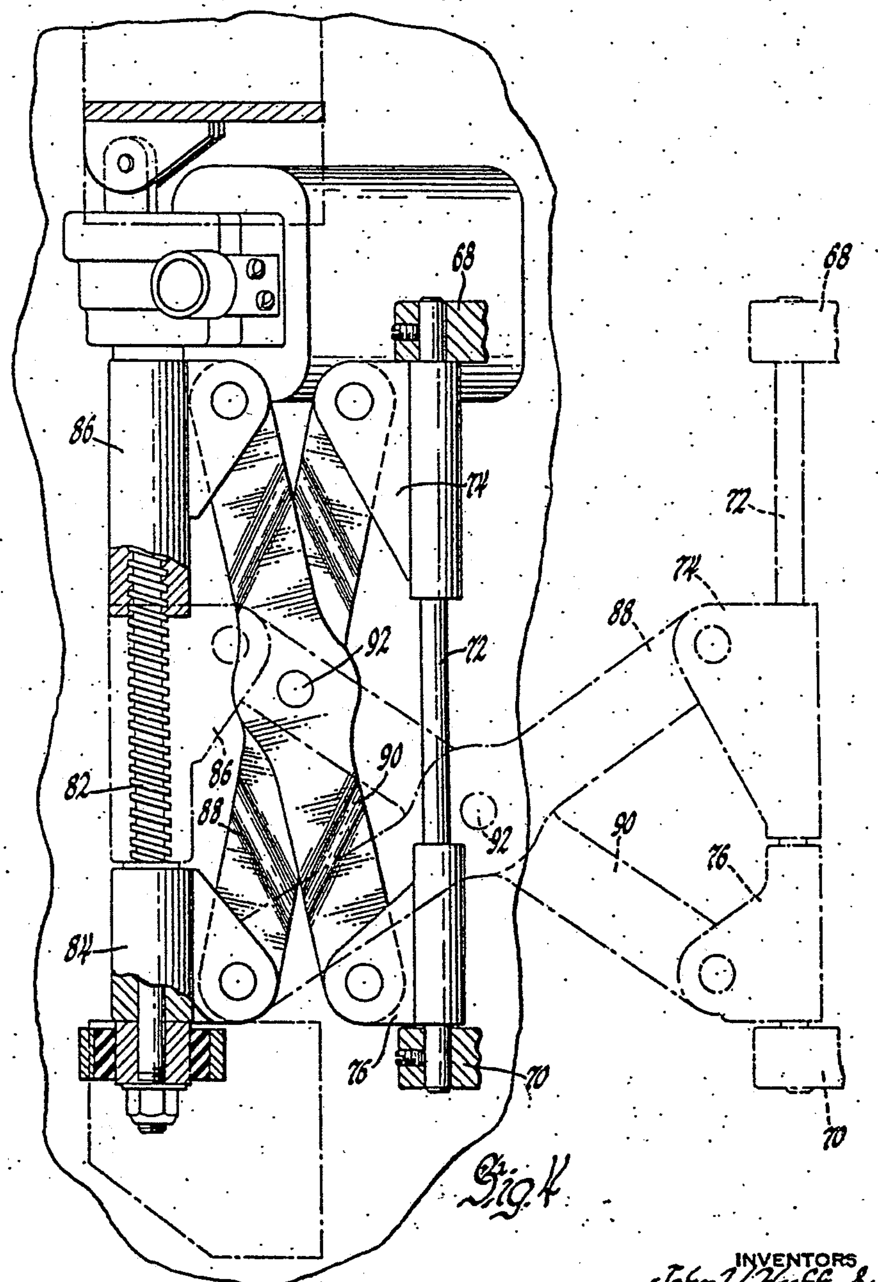

Fig. 4

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