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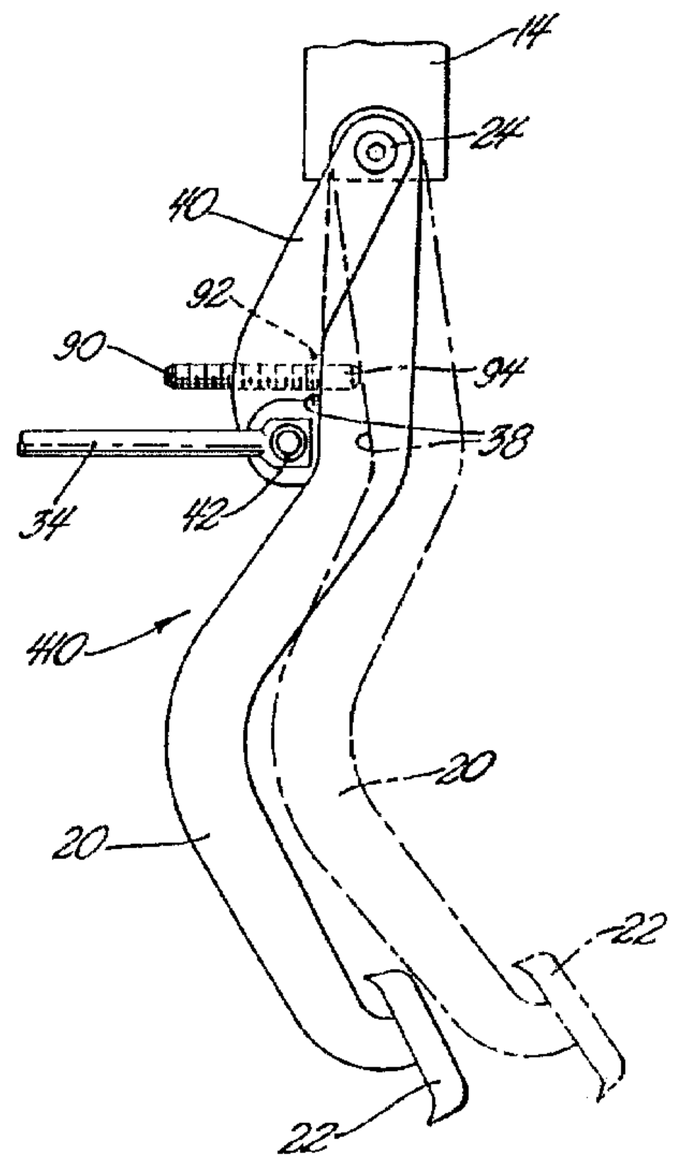

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An adjustment device (10) for an automobile control pedal (20) which is capable of pivotably adjusting the control pedal (20) relative to a datum point, such as the eyelet (36) of a cylinder pushrod (34). The adjustment device (10) allows the control pedal (20) to be optimally positioned to suit the needs of a particular driver. The control pedal (20) can be pivotally attached to a frame (14) in any conventional manner, such as with a pivot pin (24). The adjustment device (10) is mounted alongside the control pedal (20) and to the pushrod eyelet (36) without the need of additional support hardware other than a device for maintaining a predetermined distance between the pushrod eyelet (36) and the pivot pin (24) of the control pedal (20). Consequently the adjustment device can be readily adapted to fit conventional control pedal assemblies without significant modification. The adjustment device (10) includes a camming device (38) for causing pivotable movement of the pedal arm (20) relative to the datum point (36).

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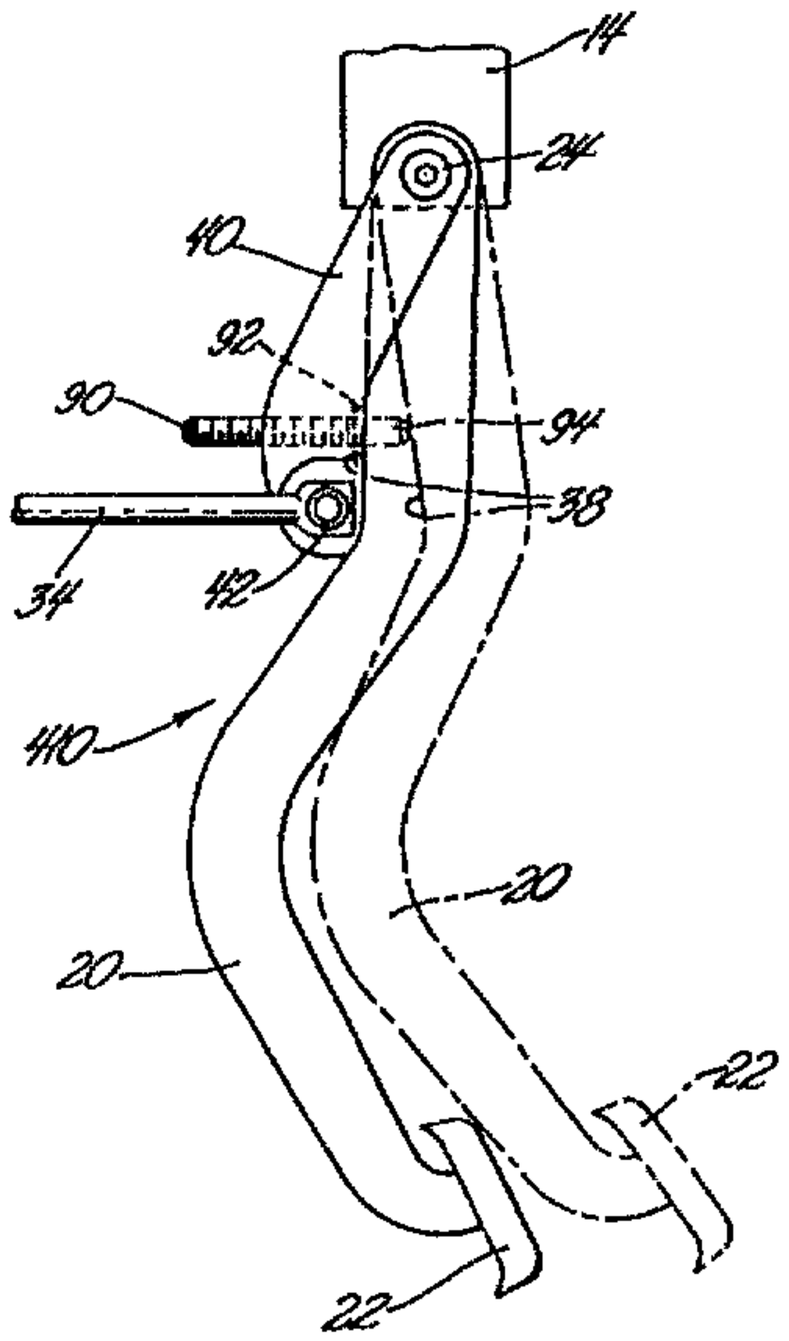

Adjustable Automobile Pedal System

The present invention generally relates to automobile control pedals, such as brake, clutch and accelerator pedals. More specifically, this invention relates to an adjustable automobile control pedal system whose pedals can be selectively adjusted to allow optimal positioning of the pedals relative to the driver of the automobile.

Automobiles are conventionally provided with foot-operated control pedals, such as an accelerator, brake and clutch pedal, which are used to control the motion and speed of the automobile. Typically, these control pedals are permanently fixed to the vehicle chassis and rotate away from the driver when foot pressure is applied, and are not adjustable relative to the driver or their respective attachment points. Consequently, the control pedals must generally be attached so as to be positioned relative to the floor of the passenger compartment to afford operation which is adequately comfortable for the "average" driver. However, some adjustment of the driver relative to the control pedals is clearly desirable.

Though the driver's seat is usually mounted so as to be slidable in a fore and aft direction to accommodate drivers of different physiques, such an arrangement is only partially effective in positioning the driver relative to the control pedals. Seat adjustment allows the driver to position himself or herself relative to the automobile's steering wheel and the control pedals, to some degree improving the driver's comfort and facilitating the driver's ability to operate the vehicle's primary controls. However, it is nearly impossible for such a solution to accommodate all possible variations in the human frame. In particular, proportional differences between the lengths of a driver's arms, legs and feet in relation to the driver's overall

physique cannot be readily accommodated by merely adjusting the seat fore and aft with respect to the control pedals. Accordingly, it has been recognized that some form of control pedal adjustment is desirable to provide optimal comfort to the driver while also ensuring that the driver can fully operate the control pedals at all times.

Lever mechanisms, of course, are known in the prior art. The adjustment of one lever with respect to another concentrically mounted lever can also be found in wear or slack adjuster mechanisms. For example, Tack, U.S. Patent 2,550,731 and Tack et al, U.S. Patent 2,550,732, teach a manually operated screw mechanism threaded into one lever and operatively connected to associated hangers for adjusting the slack conditions in the brake rigging by adjusting with respect to the hangers and simultaneously modifying the position of the brake lever where it is connected to the associated brake rigging.

Many approaches to providing adjustable control pedals have been suggested in the prior art. One approach is to provide some form of ratchet device which allows the entire control pedal assembly to rotate about a primary pivot point. This approach rotates a frame to which the control pedals are each rotatably attached, thus providing rotation of the control pedals in unison relative to the driver. Examples of this approach are illustrated in U.S. Patent Nos. 3,282,125 to Dully; 3,400,607 to Smith; and 3,563,111 to Zeigler. A similar approach is to mount one or more control pedals to a frame which is slidable fore and aft as a unit relative to the driver, as illustrated in U.S. Patent Nos. 2,860,720 to Huff et al, 4,683,977 to Salmon, 5,010,782 to Asano et al, and British Patent No. 952,831 to Mussell. As taught by Asano et al, the entire frame and pedal assembly rotates about a single pivot point during actuation of the pedal. A disadvantage with pedal systems such as that of Asano et al is that a spring is required to return the pedal and frame assembly to its initial position, necessitating that the driver also overcome the force generated by the spring in order to actuate the pedal.

Yet another suggested approach is a variation on the two previously mentioned, employing a screw-actuated device to displace a frame to which one or more control pedals are rotatably mounted. The screw-actuated device can be used to either rotate the entire frame about a pivot point, as shown in U.S. Patent Nos. 3,151,499 to Roe, or the screw-actuated device can displace the frame fore and aft, as illustrated by U.S. Patent Nos. 3,301,088 to White; 3,643,525 to Gibas; 3,765,264 to Bruhn, Jr.; 4,870,871 to Ivan; 4,875,385 to Sitrin; and 4,989,474 as well as 5,078,024 to Cicotte et al. Typically, the screw-actuated device is disclosed to be driven by an eccentric motor which allows the control pedals to be selectively adjusted by the driver from an appropriate control switch mounted on the dashboard of the vehicle within the driver's reach.

As can be readily appreciated by those skilled in the art, the above examples all require substantial hardware and space beneath the automobile's instrument panel to accommodate the device providing the adjustment feature. Much of the necessary additional hardware can be attributed to the need to avoid effecting the operation of the brake and/or clutch pedals, during adjust, with their respective hydraulic cylinders. Specifically, the approach chosen must avoid causing the pushrods which actuate the respective cylinder pistons to be displaced relative to their cylinders so as to ensure non-engagement of the brakes and/or the clutch.

In addition, it is generally preferable that the approach chosen have no affect on the mechanical advantage of the control pedal as determined by the control pedal's orientation relative to the pushrod. Generally, the mechanical advantage of a control pedal can be described as the relative effort required to apply the control pedal as compared to the actual force required to actuate the device controlled by the control pedal. For instance, mechanical advantage can be improved by moving the contact point between the control pedal and the cylinder's pushrod toward the pivot point of the control pedal.

To avoid changing the mechanical advantage, the adjustable control pedal assemblies of the prior art generally teach a device in which the control pedals are independently adjusted so as to produce no adverse effect with respect to repositioning of the pedal pivot point relative to the pushrods of the respective operating cylinders, as can be seen with the teachings of Cicotte et al. Alternatively, the adjustment device must be provided with a mechanism which simultaneously adjusts the length of the pushrod to accommodate the displacement of the control pedal assembly, as seen with the teachings of Bruhn, Jr.

Though regarding an unrelated and non-analogous problem associated with optimizing the mechanical advantage of a control pedal, U.S. Patent No. 3,798,995 to Schroter teaches the use of a variable-ratio control pedal utilizing a camming contour for amplifying the mechanical advantage of the control pedal in the latter stages of the control pedal stroke. The intent with such a device is to maximize the driver's braking capability without the need for excessive forces applied to the control pedal. However, the teachings of Schroter are directed entirely toward achieving an optimal mechanical advantage and do not provide any adjustment of the control pedals with respect to the driver. Further, Schroter does not teach or suggest a solution to the problem of adjusting the positions of the control pedals, nor does Schroter even recognize the problem to which the above prior art is directed.

From the above discussion, it can be readily appreciated that the prior art does not disclose an automobile control pedal arrangement which can be adjusted to adapt to the particular physiological requirements of a driver, while simultaneously avoiding the requirement of mounting the entire control pedal assembly to a frame which is either pivotable or displaceable relative to the driver. Nor does the prior art teach or suggest an apparatus which entails minimal additional hardware to achieve suitable adjustment of one or more control or accelerator pedals to the effect that no repositioning of the prior art pivot point

locations is required and, therefore, no significant structural changes need be made to a conventional control pedal arrangement.

Accordingly, what is needed is a cost-efficient adjustment device for adjusting one or more automobile control and/or accelerator pedals, the adjustment device being capable of spatially adjusting the control pedals without repositioning the pivot attachment of the conventional control pedal arrangement to adapt to the physiological demands of a driver, while simultaneously requiring minimal structural reinforcements and modifications to achieve the desired results.

SUMMARY OF THE INVENTION

According to the present invention there is provided an adjustment device for one or more automobile control and/or accelerator pedals. The adjustment device is capable of causing pivotable adjustment, utilizing the conventional pivot point position of the control pedal to adjust one or more control pedals independently or in unison relative to a predetermined datum point. The datum point is preferably defined by a reaction member upon which the control pedal operates, such as the pivot eyelet of a master cylinder pushrod for a clutch or brake pedal, due to the need to leave the operation of the clutch and brake master cylinders unaltered during adjustment of the respective control pedals. For an accelerator pedal, the reaction member is typically a flexible cable by which the fuel system is operated. Because the accelerator pedal is typically pivotably mounted to the firewall for purposes of actuating the cable, the datum point may be any suitable reference point which allows conventional operation of the accelerator pedal with respect to the cable. Being adjustably pivotable in this manner, the control pedals can be optimally positioned to suit the needs of a particular driver.

Conventionally, each control pedal includes an arm which is pivotably attached to a frame member beneath the automobile's instrument panel by means of a pivot pin and bushing or the like. Where the control pedal is the brake or clutch pedal, the adjustment device of the present invention is mounted alongside

the conventional control pedal arm and pivotally attached at the eyelet of the cylinder pushrod, without the need of any additional support hardware other than a device for maintaining a predetermined distance between the pushrod eyelet and the pivot attachment of the control pedal arm. Consequently, the adjustment device can be readily adapted to fit conventional control pedal assemblies without significant modification.

In one embodiment, the adjustment device includes a camming device, such as a disc-shaped cam having a predetermined camming contour. The automobile pedal arm slidably abuts the camming device such that rotation of the camming device about its axis of rotation causes pivotable movement of the automobile pedal arm relative to the pushrod eyelet. By example, where the control pedal is the brake pedal, the brake pedal arm is displaced relative to the brake master cylinder's pushrod eyelet by the camming device.

The camming device preferably has its axis of rotation substantially parallel to the control pedal arm's axis of rotation about its corresponding pivot. Furthermore, its axis of rotation may be coincident with or spaced from the axis of the pushrod eyelet. The axis of rotation of the camming device is maintained a predetermined distance from the pivot of the control pedal arm by a spacing device, such as a link. By maintaining this predetermined distance, the axes of the camming device and the pushrod eyelet are properly maintained relative to the control pedal arm to maintain a preferred constant mechanical advantage for the control pedal arm.

The adjuster device also includes a cam driving device for rotating the camming device about its axis of rotation. When the driving device causes the camming device to rotate, the camming contour of the camming device produces a corresponding displacement of the control pedal arm relative to the pushrod eyelet. Thus, the control pedal arm is rotated about its pivot point, and thereby can be selectively adjusted relative to the driver of the automobile. As noted above, the link prevents any

change in the spatial positioning of the pushrod eyelet to the pivot point of the control pedal arm, preventing any change in the mechanical advantage of the control pedal. Further, there is no change in the position of the pushrod relative to the pushrod's corresponding cylinder to produce a partial application of the device which the control pedal operates.

According to a further embodiment of this invention, one end of the link is mounted directly to the eyelet of the pushrod, while the opposite end of the link is mounted to the control pedal arm's pivot point so as to be alongside the control pedal arm. In addition, the cam driving device and the camming device are mounted directly to the link or the control pedal arm. With this construction and arrangement, minimal additional hardware is necessary to implement the adjustment device of the present invention on conventional automobile control pedal assemblies. Consequently, little additional space is required to fit the hardware associated with the adjustment device in the conventional mounting space of the vehicle.

In addition, no independent adjustment is necessary to maintain the position of the cylinder pushrod relative to its cylinder in that the adjustment device of the present invention provides control pedal adjustment with respect to the cylinder pushrod and does not require any relocation or cause any movement of the cylinder pushrod itself. The cylinder pushrod provides a stationary datum point throughout the adjustment of the control pedal, with mechanical contact between the camming device and the control pedal arm being maintained such that the control pedal is displaced with respect to the cylinder pushrod. Accordingly, the operation of the pushrod with its cylinder is not affected by the adjustment device of the present invention. Moreover, no change in the mechanical advantage of the control pedal arm results. Similarly, the operation of the accelerator cable is not affected by the adjustment device of the present invention, in that, the invention as disclosed displaces the pedal arm of the accelerator with respect to the attachment point of the accelerator cable.

In addition, a significant advantage of the present invention is that the cam driving device can be electrically driven by a suitable motor to allow control pedal positioning with one or more controls made accessible on the automobiles instrument pane. With suitable control circuitry, several positions can be placed into a memory device such that a driver can present an optimal control pedal position for his or her particular frame, allowing automatic recall of the memorized position.

In a further embodiment of the invention, the functions of the cam rotation device may be obtained by a power screw which can be rotated by a manual adjuster mechanism or electrical driven actuator in order to displace the control pedal arm with respect to the cylinder pushrod without any movement of the cylinder pushrod itself.

An adjustment device in accordance with the invention is capable of optimally positioning the control pedals and/or accelerator pedal relative to the driver, and it can provide pivotable adjustment of the automobile control or accelerator pedal relative to a predetermined fixed datum, such as the pushrod eyelet of the hydraulic cylinder operated by the control pedal or an accelerator cable operated by an accelerator pedal.

In one embodiment the adjustment device includes a camming device which pivotably rotates the control pedal relative to the predetermined datum to achieve the desired adjustement. The camming device can be positionally maintained relative to the control pedal arm during adjustment so as to maintain a preferred mechanical advantage.

It is possible for the camming device to be electrically driven so as to allow the control pedal to be adjusted from a control device which is readily accessible to the driver.

In yet another embodiment a power screw is utilized that may be rotated by a manual or electrically driven actuator mechanism in order

to displace the control pedal arm or accelerator pedal arm with respect to the cylinder pushrod or accelerator cable without any movement of either the cylinder pushrod and/or the accelerator cable.

The adjustment device generally requires minimal additional hardware so as to minimize the structural modifications required to adapt the adjustment device to a conventional automobile control pedal arm.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described in more detail, by way of example only, with reference to the accompanying drawings, in which:-

Figures 1A and 1B are side and frontal views, respectively, of an automobile control pedal unit provided an adjustment device in accordance with a first embodiment of this invention;

Figures 2A and 2B are side and frontal views, respectively, of an automobile control pedal unit provided with an adjustment device in accordance with a second embodiment of this invention;

Figures 3A and 3B are side and cross-sectional views, respectively of an automobile control pedal unit provided with an adjustment device in accordance with a third embodiment of this invention;

Figures 4A and 4B are side and frontal views, respectively, of an automobile control pedal unit provided with an adjustment device in accordance with a fourth embodiment of this invention;

Figures 5A and 5B are side and cross-sectional views, respectively, of an automobile accelerator pedal unit provided with an adjustment device in accordance with a fifth embodiment of this invention;

Figures 6A and 6B are side and cross-sectional views, respectively, of an automobile accelerator pedal unit provided

with an adjustment device in accordance with a sixth embodiment of this invention; Figures 7 and 8 are detailed cross-sectional views of the automobile control pedal units of Figures 1 and 4 and Figures 2 and 3, respectively, in accordance with this invention; and

Figures 9A and 9B are side and frontal views, respectively, of an automobile control pedal unit provided with an adjustment device in accordance with a seventh preferred embodiment of this invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

With reference to Figures 1A and 1B, there is shown an automobile control pedal assembly 10 in accordance with a first embodiment of this invention. As illustrated, the automobile control pedal assembly 10 represents a brake or clutch control pedal for actuating a master cylinder (not shown) located within the engine compartment of an automobile. The following descriptions pertaining to Figures 1A through 4B will each refer to the use of the present invention within the environment of a brake or clutch control pedal. Figures 5A through 6B illustrate the teachings of the present invention as adapted for use with an automobile's accelerator control pedal 60.

Conventionally, the control pedal assembly 10 illustrated in Figures 1A and 1B is suspended just above the compartment floor on the driver's side of the automobile. The control pedal assembly 10 is initially spaced a nominal distance from the driver's seat so as to be operable by a driver having an "average" physique. Typically, a driver's seat is adjustable fore and aft so as to bring the driver closer to the control pedal assembly 10, or to displace the driver further from the control pedal assembly 10, respectively, depending upon the driver's particular physique and preference. To supplement the adjustable feature of the driver's seat, an adjustment unit according to the present invention is secured to the control pedal assembly 10.

As illustrated in Figures 1A and 1B, the control pedal assembly 10 generally includes a pedal arm 20 and a pedal foot pad

22. The pedal arm 20 is typically attached to a frame member 14 located beneath the instrument panel (not shown) of the automobile such that the pedal arm 20 is rotatable in a direction away from the driver. The pedal arm 20 is secured to the frame member 14 by a pivot pin 24 which is shown as being retained by a cotter key 26 to prevent the pivot pin 24 from becoming loosened from the frame member 14. It may also be preferable to provide a pivot bushing (not shown) in conjunction with the pivot pin 24 to reduce friction between the pedal arm 20 and the frame member 14.

The pedal arm 20 is typically maintained in a forward position by the biasing effect of a master cylinder pushrod 34 which is conventionally biased toward the automobile's passenger compartment by a spring (not shown) within the master cylinder. The pedal arm 20 may also be biased toward the master cylinder pushrod 34 by a suitable helical spring (not shown) so as to maintain positive engagement between the pedal arm 20 and the master cylinder pushrod 34. The master cylinder pushrod 34 reciprocates in its axial direction to actuate a piston (not shown) within the master cylinder for purposes of selectively engaging or disengaging the automobile's brakes or clutch, respectively. Conventionally, the master cylinder pushrod 34 would be rotatably attached directly to the pedal arm 20 with a pivot pin which passes through both the pedal arm 20 and an eyelet 36 located on the end of the master cylinder pushrod 34.

However, as can be seen in Figures 1A and 1B, which illustrate the first embodiment of this invention, the pedal arm 20 of the present invention is indirectly actuated by the master cylinder pushrod 34 through a cam 28. The cam 28 is pivotably attached to a pivot link 40 which rotatably interconnects the eyelet 36 of the master cylinder pushrod 34 with the pivot pin 24 of the pedal arm 20. The cam 28 is preferably disc-shaped with a cam contour 30 disposed on an outer surface spaced radially outward from the cam's axis of rotation. As shown in Figure 1A, the cam contour 30 may constitute essentially the entire perimeter of the cam 28, such that the cam 28 can be rotated as much as 360

degrees while still operating within the range of the cam contour 30. The cam contour 30 is slidably disposed against a camming surface 38 provided on the forward surface of the pedal arm 20. As a result, rotation of the cam 28 causes fore or aft pivoting of the pedal arm 20, depending upon the cam's direction of rotation.

The rate of rotation of the pedal arm 20 is determined in part by the cam contour 30. Depending upon the preferred control parameters with which the pedal arm 20 is to be adjusted relative to the driver's seat, the cam contour 30 can be radially spaced from the cam's axis of rotation so as to cause a constant rate of rotation of the pedal arm 20 given a constant rate of rotation of the cam 28. Alternatively, the cam contour 30 can be shaped to provide a rate of rotation which varies as the pedal arm 20 rotates, providing finer adjustment of the pedal arm 20 where the pedal arm's rate of rotation is lowest.

As noted above, the position of the cam 28 relative to the pedal arm 20 is maintained by being rotatably mounted to the pivot link 40. Preferably, the pivot link 40 is pivotably attached at its upper end to the frame member 14 with the pivot pin 24 so as to extend alongside the pedal arm 20. The lower end of the pivot link 40 is secured to the eyelet 36 of the master cylinder pushrod 34 with a pin 42. As such, the pivot link 40 ensures that the cam 28 will remain positioned to cam against the camming surface 38 of the pedal arm 20. With the biasing effect of the master cylinder pushrod 34, positive contact can be maintained at all times between the cam surface 30 of the cam 28 and the camming surface 38 of the pedal arm 20 to ensure positive mechanical action therebetween. As previously noted, a helical spring (not shown) can also be provided to either act upon the pedal arm 20 to bias the pedal arm 20 against the cam 28, or act through the pivot link 40 to bias the cam 28 against the pedal arm 20. In addition, the pivot link 40 prevents the rotation of the cam 28 from altering the position of the pushrod eyelet 36, and thereby the master cylinder pushrod 34, relative to the master cylinder. Accordingly, any articulation of the pushrod 34 is

avoided during the adjustment made to the pedal arm 20 by the cam 28.

The rotation of the cam 28 is preferably achieved with a drive motor 44 which rotates the cam 28 through a gear box 48 and shaft 46 assembly. Though any suitable type of drive motor 44 can be used, it is preferable in the environment of an automobile's passenger compartment to use an electric drive motor which generates minimal noise. A suitable output speed for the drive motor 44 through the gear box 48 is on the order of about 10 to 12 rpms, though it is foreseeable that different motors could be matched with different gear boxes to produce higher or lower output speeds. As illustrated in Figure 1A, the drive motor 44 and gear box 48 are attached directly to the pivot link 40 by a pair of threaded fasteners 50. The shaft 46 extends from the gear box 48 through an aperture 32 in the pivot link 40 to the cam 28. A detailed view of this arrangement is illustrated in Figure 7, which more clearly illustrates the manner in which the cam 28 is pivotably mounted to the link 40, and secured with a clip 54. Consequently, when the shaft 46 is rotated by the drive motor 44, the cam 28 is also rotated about its axis of rotation, causing a corresponding movement of the pedal arm 20 relative to the cam's axis of rotation and the pushrod eyelet 36.

Figures 1A and 2B illustrate a control pedal assembly 110 in accordance with a second embodiment of this invention, with the same reference numerals representing identical or similar components of Figures 1A and 1B, but interconnected in a different manner. Primarily, the embodiment of Figures 2A and 2B differs from that of Figures 1A and 1B, in that the axis of rotation of the cam 28 coincides with the eyelet 36 of the master cylinder pushrod 34, and the drive motor 44 rotates the cam 28 through a gear 58 mounted to the shaft 46 and in mesh with a gear tooth form 56 provided on the cam 28. A detailed view of this arrangement is illustrated in Figure 8. Otherwise, the basic characteristics of the control pedal assembly 10 of Figures 1A and 1B still apply, with rotation of the cam 28 causing the pedal arm 20 to be rotated

toward or away from the eyelet 36 of the master cylinder pushrod 34.

Figures 3A and 3B illustrate a control pedal assembly 210 in accordance with a third embodiment of this invention, again with the same reference numerals representing the identical or similar components of Figures 1A through 2B, but interconnected in a different manner. Primarily, the embodiment of Figures 3A and 3B differs from that of Figures 1A and 1B, in that both the cam 28 and the drive motor 44 are mounted to the pedal arm 20, instead of the pivot link 40, with the cam 28 being supported on a pivot pin 52. Also, in a manner essentially identical to that of Figures 2A and 2B, the drive motor 44 rotates the cam 28 through the gear 58 mounted to the shaft 46, as represented by Figure 8.

A further variation of the control pedal assembly of Figures 1A and 1B is illustrated in Figures 4A and 4B, representing a control pedal assembly 310 in accordance with a fourth embodiment of this invention. Again, the same reference numerals are used to represent identical or similar components, which are interconnected in a different manner. This embodiment differs from that of Figures 1A and 1B by the shape of the pivot link 40, and the position of the drive motor 44 and the cam 28 on the pivot link 40. Shifting the position of the drive motor 44 toward the center of the pivot link 40 allows the pivot link 40 to be aligned substantially parallel with the pedal arm 20, as can be seen in Figure 4A, such that the control pedal assembly 310 is more compact. In a manner essentially identical to that of Figures 1A and 1B, the cam 28 is secured to the shaft 46 as shown in Figure 7.

With reference to Figures 5A through 6B, there is shown an automobile accelerator pedal assembly 60 in accordance with fifth and sixth embodiments of this invention. As illustrated, the accelerator pedal assembly 60 is conventional to the extent that it serves to actuate a cable 84 connected to the fuel metering system of an automobile. Similar to the pedal systems of Figures 1A through 4B, the accelerator pedal assembly 60 is

suspended just above the compartment floor on the driver's side of the automobile. However, an adjustment unit according to the present invention is secured to the accelerator pedal assembly 60 to supplement the adjustable feature of the driver's seat.

As illustrated in Figure 5A, the accelerator pedal assembly 60 generally includes a pedal arm 70 and a foot pad 72. The pedal arm 70 is pivotably attached with a pin 74 to the upper end of a link 62, to which the accelerator cable 84 is directly attached. The link 62 has a U-shaped cross section, as shown in Figure 5B, such that the pedal arm 70 can nest within the link 62. The pedal arm 70 also has a U-shaped cross section for added stiffness and strength. The lower end of the link 62 is pivotably attached with a pin 66 to a frame member 68 located beneath the instrument panel of the automobile, such that the link 62 can be pivoted about the pin 66 in order to pull the accelerator cable 84 in a direction toward the driver. As shown in Figure 5A, the pedal arm 70 is maintained in forward position with a cam 78 pivotably mounted within the link 62 on the pin 66. Bushings 76 allow the pin 66 to rotate relative to the link 62. The pin 66 is press fit onto the cam 78, such that the cam 78 can be rotated by a drive motor, such as that illustrated in Figures 1A through 4B, through a coupling 86. Consequently, the accelerator pedal system 60 can be operated off a drive motor which is simultaneously used to adjust the brake and/or clutch pedals. As before, the cam 78 is preferably disc-shaped with a cam contour 80 disposed on an outer surface spaced radially outward from the cam's axis of rotation. The cam contour 80 may constitute essentially the entire perimeter of the cam 78, such that the cam 78 can be rotated as much as 360 degrees while still operating within the range of the cam contour 80. The cam contour 80 is slidably disposed against a camming surface 88 provided on the forward surface of the pedal arm 70, which is biased against the camming contour 80 by any suitable spring or the like (not shown). As a result, rotation of the cam 78 causes fore or aft rotation of the pedal arm 70 about the pin 74, depending upon the cam's direction of rotation.

As a result of the above, the cam 78 also serves as a fulcrum, such that the act of the driver depressing the pedal arm 70 causes the pedal arm 70 and the link 62 to rotate together about the pin 66. As noted before, rotation of the link 62 serves to pull the accelerator cable 84 for the purpose of actuating the automobile's fuel metering system. However, as can be seen in Figures 5A and 5B, the position of the pedal arm 70 can be altered by rotating the cam 78 about the pin 74 in a manner similar to that described in the previous embodiments of this invention.

A final version of the accelerator pedal assembly 60 of this invention is illustrated in Figures 6A and 6B. The same reference numerals are used to represent identical or similar components which are interconnected in a different manner. This embodiment differs from that of Figures 5A and 5B by the shape of the link 62 and the position of the cam 78 on the link 62. As shown, in lieu of using the same pin 66 on which the cam 78 is supported, a second pin 82 is used to rotatably secure the lower end of the link 62 to the frame member 68. As a result, the forces imposed on the pin 66 are significantly reduced. In addition, the link 62 is modified to more fully enclose the cam 78.

Figures 9A and 9B represent a control pedal assembly 410 in accordance with a further preferred embodiment of this invention, again with the same reference numerals representing the identical or similar components of Figures 1A through 4B. However, in this embodiment, the function of the cams 28 and shafts 46 of Figures 1A through 4B are performed by a power screw 90. As shown, the power screw 90 is threadably received in an internally threaded boss 92 formed on or secured to the pivot link 40. One end 94 of the power screw abuts the camming surface 38 provided on the forward surface of the pedal arm 20. As a result, rotation of the power screw 90 causes fore or aft pivoting of the pedal arm 20, depending upon the power screw's direction of rotation. The power screw 90 can be driven in any suitable manner, such as a drive motor (not shown) connected to the end of

the power screw 90 through a coupling (not shown) or a manually actuated cable. A gear driver reduction insert is also contemplated. As is apparent from the above description, an advantage of the embodiment shown in Figures 9A and 9B is the simplification of the mechanism which pivots the pedal arm 20.

From the above, it can be seen that a significant advantage of the adjustment devices of this invention is that by selectively energizing a drive motor, a cam can be used to select an optimal fore or aft position of one or more automobile control pedal arms relative to the needs of the driver. Consequently, not only can the driver adjust the driver's seat to position himself or herself relative to the automobile's control pedals, but the driver can also adjust the position of the control pedals such that they are positioned to provide optimal comfort to the driver. The use of this invention may result in significant simplification of the seat adjuster mechanisms or telescoping steering wheel mechanism since the function of providing adjustment of the seat to enable reaching of the pedals need no longer be considered.

In addition, where all of the automobile's control pedals - namely, the brake, clutch and accelerator pedals – are provided with the adjustment device of the present invention, each control pedal can be adjusted individually or collectively so as to provide optimal positioning of the control pedals for the particular physique of the driver. The control pedals can be independently adjusted with individual drive motors, or a single drive motor can be coupled with each pedal, such that all of the pedals are simultaneously adjusted according to a single command initiated by the driver. With either approach, the controls for the drive motor, and thus the adjustment of each control pedal assembly, can be located to be accessible to the driver, such as on the automobile's instrument panel.

Another advantage is that the adjustment devices of this invention require minimal additional hardware and can be readily adapted to a conventional control pedal without the need to relocate the brake cylinder pushrod or accelerator cable from its

current position. Accordingly, excessive space beneath the instrument panel is not required to accommodate the adjustment devices, nor is there a significant penalty in terms of added weight.

While the invention has been described in terms of certain preferred embodiments, it is apparent that other forms could be adopted by one skilled in the art. For example, other means for rotating the cams 28 and 78 could be readily adopted by those skilled in the art to achieve the adjustment of the control pedals as described, and various other components or structures could be employed in lieu of the links 40 and 62. Accordingly, the scope of the invention is to be limited only by the following claims.

What is claimed is:

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. An adjustment device for adjusting a pedal arm with respect to a predetermined datum position on a reaction member, the pedal arm being rotatable about an axis of arm rotation, the adjustment device comprising:

means rotatably-mounted juxtaposed said pedal arm for rotating said pedal arm about said axis of arm rotation, said rotating means having one end abutted against said pedal arm such that rotation of said rotating means causes said pedal arm to rotate about said axis of arm rotation, and said rotating means having an axis of rotation located between said axis of arm rotation and said predetermined datum point;

means for locating said axis of rotation a predetermined distance from said axis of arm rotation, said locating means having a first end and an oppositely-disposed second end, at least one of said first and second ends being pivotably mounted substantially concentric with said axis of arm rotation, said locating means being adapted to coact with said rotating means to rotate said pedal arm about said axis of arm rotation; and

drive means interconnected with said rotating means for driving said rotating means about said axis of rotation.

2. The adjustment device of claim 1, wherein said locating means comprises a link.

3. The adjustment device of claim 1 or 2, further comprising a frame member, and wherein said one of said at least first and second ends of said locating means is pivotably attached to said frame member and pivotably mounted substantially concentric with said axis of arm rotation, and wherein the other of said at least first and

second ends of said locating means is pivotably attached to said reaction member so as to define a pivot axis.

4. The adjustment device of claim 3, wherein said axis of rotation is spaced a predetermined distance from said pivot axis defined by said reaction member and said second end of said locating means.

5. The adjustment device of any one of claims 1 to 4, wherein said rotating means is a power screw rotatably mounted to said locating means.

6. The adjustment device as claimed in any one of claims 1 to 5, wherein said reaction member has one end secured to said locating means, and wherein said means for locating further comprises:

a link member having one end pivotably connected to said pedal arm at said axis of arm rotation and a peripheral portion connected to said reaction member; and

means for securing said reaction member to said link member.

7. The adjustment device as claimed in claim 6, further comprising:

a cam surface juxtaposed said pedal arm; and

means for mounting said camming member to said link member; and

wherein said drive means is mounted to said link member, said drive means further comprising:

a drive housing mounted to said link member;

a drive motor located in said drive housing; and

gear drive means mounted in said drive housing complementary with said drive motor, said gear drive means having a projecting portion extending in a direction towards said camming member and

engaging said camming member to establish a driving relationship therewith, said gear drive means rotating said camming member in one direction when said drive motor is driven in a first direction and further rotating said camming member in a second opposite direction when said drive motor is driven in a second opposite direction, such that as said camming member rotates said pedal arm is pivoted about said axis of arm rotation.

8. The adjustment device as claimed in claim 6 or 7, wherein said peripheral portion of said link member comprises an opposite end of said link member having an aperture defining a pivot axis centrally disposed with said aperture, said pivot axis of said opposite end of said link member being coaxial with said axis of cam rotation.

9. The adjustment device as claimed in claim 7, wherein said peripheral portion of said link member comprises an opposite end of said link member having an aperture defining a pivot axis centrally disposed with said aperture, and further wherein said axis of cam rotation is located between said pivot axis and said axis of arm rotation.

10. The adjustment device of claim 1, wherein said means rotatably mounted juxtaposed said pedal arm comprises a camming member rotatably mounted juxtaposed said pedal arm for rotating said pedal arm about said axis of arm rotation, said camming member having an axis of cam rotation; wherein said means for locating said axis of rotation a predetermined distance from said axis of arm rotation comprises a link member having one end pivotally-mounted substantially concentric with said axis of arm rotation and another end defining a pivot axis, whereby said link member coacts with said camming member to rotate said

pedal arm about said axis of arm rotation; and further wherein said drive means is interconnected with said camming member for driving said camming member about said axis of cam rotation.

11. The adjustment device of claim 10, wherein:

said camming member is rotatably-mounted to said link member such that said camming member cams against said pedal arm to rotate said pedal arm about said axis of arm rotation; and

said drive means is mounted to said link member so as to rotate said camming means about said axis of cam rotation.

12. The adjustment device of claim 11, wherein the other end of said link member defines a pivot axis, said reaction member being concentrically attached to said other end about said pivot axis for pivoting movement relative thereto, and further wherein said axis of cam rotation is located a predetermined distance from said pivot axis defined by said reaction member.

13. The adjustment device of claim 12, wherein said axis of cam rotation coincides with said pivot axis defined by said other end of said link member.

14. The adjustment device of claim 10, wherein:

said camming member is rotatably mounted to said pedal arm such that said camming member cams against said link member to rotate said pedal arm about said axis of arm rotation; and

said drive means is mounted to said pedal arm and is interconnected with said camming member so as to rotate said camming member about said axis of cam rotation.

15. The adjustment device of claim 10, wherein:

said camming member is rotatably mounted to said link member such that said camming member cams against said pedal arm to rotate said pedal arm about said axis of arm rotation; and

said drive means is mounted remote from said link member and is interconnected with said camming member so as to rotate said camming member about said axis of cam rotation.

16. The adjustment device of claim 10, wherein said drive means further comprises an extended drive shaft interconnecting said drive means with said camming member for rotating said camming member about said axis of cam rotation.

17. The adjustment device of claim 16, wherein said drive means further comprises a drive motor and a gear drive device interconnecting said drive motor with said extended drive shaft of said drive means.

18. The adjustment device of claim 13, wherein said drive means further comprises a drive member and an extended drive shaft interconnecting said drive member with said camming means for rotating said camming member about said axis of cam rotation.

19. The adjustment device of claim 17, wherein said extended drive shaft of said drive means further comprises a pinion gear secured to said extended drive shaft and wherein said camming member comprises a gear tooth form in mesh with said pinion gear for rotating said camming member about said axis of cam rotation.

20. The adjustment device of claim 18, wherein said drive means further comprises a drive motor and a gear drive device

interconnecting said drive motor with said extended drive shaft of said drive means.

21. The adjustment device of claim 14, wherein said drive means further comprises an extended drive shaft interconnecting said drive means with said camming member for rotating said camming member about said axis of cam rotation.

22. The adjustment device of claim 21, wherein said extended drive shaft of said drive means further comprises a pinion gear secured to said extended drive shaft and wherein said camming member comprises a gear tooth form in mesh with said pinion gear for rotating said camming member about said axis of cam rotation.

23. The adjustment device of claim 21, wherein said drive means further comprises a drive motor and a gear drive device interconnecting said drive motor with said extended drive shaft of said drive means.

24. The adjustment device of claim 10, wherein said reaction member is secured to said link member intermediate said one end and other end.

25. The adjustment device of claim 24, wherein said axis of cam rotation coincides with said axis of link rotation.

26. The adjustment device of claim 24, wherein said axis of cam rotation is spaced a predetermined distance from said axis of link rotation.

27. The adjustment device of claim 24, 25 or 26, wherein said drive means is mounted remote from said camming member and wherein said camming member comprises a coupling for interconnecting said camming member with said drive means.

28. The adjustment device of claim 10, wherein said axis of cam rotation is substantially parallel to said axis of arm rotation.

29. The adjustment device of claim 10, wherein said camming member is a disc having a camming surface radially spaced from said axis of cam rotation, and said camming surface slidably contacts said pedal arm.

30. The adjustment device as claimed in claim 10, wherein said reaction member has one end secured to said link member, and wherein said link member further comprises a peripheral portion connected to said reaction member and means for securing said reaction member to said link member.

31. The adjustment device as claimed in claim 11, wherein said camming member mounted to said link member further comprises:

a cam surface juxtaposed said pedal arm; and

means for mounting said cam member to said link member; and

wherein said drive means mounted to said link member further comprises:

a drive housing mounted to said link member;

a drive motor located in said drive housing; and

gear drive means mounted in said drive housing complementary with said drive motor, said gear drive means having a projecting portion extending in a direction towards said cam member and engaging said cam member to establish a driving relationship

therewith, said gear drive means rotating said cam member in one direction when said drive motor is driven in a first direction and further rotating said cam member in a second opposite direction when said motor is driven in a second opposite direction such that as said cam member rotates said pedal arm is pivoted about said axis of arm rotation.

32. The adjustment device as claimed in claim 31, wherein said other end of said link member comprises an opposite end of said link member having an aperture defining a pivot axis centrally disposed with said aperture, said pivot axis of said opposite end of said link member being co-axial with said axis of cam rotation.

33. The adjustment device as claimed in claim 31, wherein said other end of said link member comprises an opposite end of said link member having an aperture defining a pivot axis centrally disposed with said aperture, and further wherein said axis of cam rotation is located between said pivot axis and said axis of arm rotation.

34. The adjustment device as claimed in claim 14, wherein said camming member further comprises a cam surface juxtaposed said link member, wherein said locating means comprises means for mounting said camming member to said pedal arm, and wherein said drive means further comprises:

a drive housing mounted to said pedal arm;

a drive motor located in said drive housing;

gear drive means mounted in said drive housing complementary with said drive motor, said gear drive means having a projecting portion extending in a direction towards said camming member and engaging said cam member to establish a driving relationship therewith, said gear drive means rotating said camming member in

one direction when said drive motor is driven in a first direction and further rotating said camming member in a second opposite direction when said drive motor is driven in a second opposite direction such that as said camming member rotates said pedal arm is pivoted about said axis of arm rotation; and

means for mounting said drive means to said pedal arm.

35. The adjustment device as claimed in claim 14, wherein said camming member further comprises a cam surface juxtaposed said reaction member, wherein said locating means comprises means for mounting said camming member to said pedal arm, and further wherein said drive means comprises:

a drive housing mounted to said pedal arm;

a drive motor located in said drive housing;

gear drive means mounted in said drive housing complementary with said drive motor, said gear drive means having a projecting portion extending in a direction towards said camming member and engaging said camming member to establish a driving relationship therewith, said gear drive means rotating said camming member in one direction when said drive motor is driven in a first direction and further rotating said camming member in a second opposite direction when said drive motor is driven in a second opposite direction such that as said camming member rotates said pedal arm is pivoted about said axis of arm rotation; and

means for mounting said drive means to said pedal arm.

36. The adjustment device as claimed in claim 30, wherein said link member further comprises an opposite end portion having an aperture defining a pivot axis, said pivot axis of said opposite end portion of said link member being coaxial with said axis of cam rotation.

37. The adjustment device as claimed in claim 15, wherein said camming member is mounted to said link member, and having a cam surface radially-spaced from said axis of cam rotation, said cam surface being juxtaposed said pedal arm, and having means for mounting said camming member to said link member; and further wherein said drive means comprises a projecting portion extending in a direction towards said camming member and is fixedly secured thereto such that as said drive means and associated projecting portion is rotated in a first direction said camming member rotates in said first direction, said drive means and associated projecting portion rotating said camming member in a second opposite direction when said drive means rotates in a second opposite direction.

38. The adjustment device as claimed in claim 10, wherein said camming member further comprises a cam surface juxtaposed said link member, and wherein said locating means comprises means for mounting said camming member to said pedal arm, said drive means comprising:

a drive housing mounted to said pedal arm;

a drive motor located in said drive housing;

gear drive means mounted in said drive housing complementary with said drive motor, said gear drive means having a projecting portion extending in a direction towards said camming member and engaging said camming member to establish a driving relationship therewith, said gear drive means rotating said camming member in one direction when said drive motor is driven in a first direction and further rotating said camming member in a second opposite direction when said drive motor is driven in a second opposite direction such that as said camming member rotates said pedal arm is pivoted about said axis of arm rotation; and

means for mounting said drive means to said pedal arm.

39. The adjustment device as claimed in claim 18, wherein said drive means further comprises an extended drive shaft interconnecting said drive means with said camming member for rotating said camming member about said axis of cam rotation.

40. A method for adjusting an automobile pedal arm adapted to rotate about an axis of arm rotation, the method comprising the steps of:

positioning rotating means, having an axis of rotation, juxtaposed said automobile pedal arm;

positioning said axis of rotation a predetermined distance from said axis of arm rotation; and

rotating said rotating means about said axis of rotation such that said automobile pedal arm is rotatively displaced relative to said axis of arm rotation.

41. The method of claim 40, further comprising the step of maintaining a constant distance between said axis of rotation and said axis of arm rotation.

42. An adjustment assembly for adjusting a pedal arm, said pedal arm being rotatable about an axis of arm rotation, comprising:

a link member rotatable about said axis of arm rotation independently of said pedal arm and extending alongside a proximate portion of said pedal arm adjacent said axis of rotation;

a coupling element on said link member at a location remote from said axis of arm rotation connectable to an operable element actuated by said pedal arm; and

a power screw rotatable about a longitudinal axis of rotation thereof, said power screw extending between said link member and said pedal arm to vary the angular separation between said link member and said pedal arm.

43. An adjustment assembly as claimed in claim 41, wherein said power screw has a free end abutting a camming surface on said proximate portion of said pedal arm.

44. An adjustment assembly as claimed in claim 43, wherein said camming surface is provided on a forward surface of said pedal arm relative to a direction of movement thereof when actuating said operable element.

45. An adjustment assembly as claimed in claim 44, wherein said power screw is threadably engaged in a boss provided on said link member.

46. An adjustment assembly as claimed in any one of claims 42 to 45, wherein said power screw is located on said link member at a location between said coupling element and said axis of arm rotation.

47. An adjustment assembly as claimed in any one of claims 42 to 46, wherein said link member is in the form of an elbow arm with a distal portion thereof deflected toward said proximate portion of said pedal arm, and said power screw is located on said distal portion of said elbow said arm.

48. An adjustment assembly as claimed in any one of claims 42 to 47, further comprising a drive motor for drivably rotating said power screw.

49. An adjustment assembly as claimed in any one of claims 42 to 47, wherein said coupling element is an eyelet for coupling to a pushrod of said operable means.

50. An adjustable pedal assembly, comprising:

a pedal arm rotatable about an axis of arm rotation;

an operable element actuated by said pedal assembly;

a link member rotatable about said axis of arm rotation independently of said pedal arm and extending alongside a proximate

portion of said pedal arm adjacent said axis of rotation;

a coupling element on said link member at a location remote from said axis of arm rotation coupled to said operable element; and

a power screw rotatable about a longitudinal axis of rotation thereof, said power screw extending between said link member and said pedal arm to vary the angular separation between said link member and said pedal arm.

51. An adjustable pedal assembly as claimed in claim 50, wherein said power screw has a free end abutting a camming surface on said proximate portion of said pedal arm.

52. An adjustable pedal assembly as claimed in claim 51, wherein said camming surface is provided on a forward surface of said pedal arm relative to a direction of movement thereof when actuating said operable element.

53. An adjustable pedal assembly as claimed in claim 51, wherein said power screw is threadably engaged in a boss provided on said link member.

54. An adjustment assembly as claimed in any one of claims 50 to 53, wherein said power screw is located on said link member at a location between said coupling element and said axis of arm rotation.

55. An adjustable pedal assembly as claimed in any one of claims 50 to 54, wherein said link member is in the form of an elbow arm with a distal portion thereof deflected toward said proximate portion of said pedal arm, and said power screw is located on said distal portion of said elbow said arm.

56. An adjustable pedal assembly as claimed in any one of claims 50 to 55, further comprising a drive motor for drivably rotating said power screw.

57. An adjustable pedal assembly as claimed in any one of claims 50 to 56, wherein said coupling element is an eyelet coupled to a pushrod of said operable element.

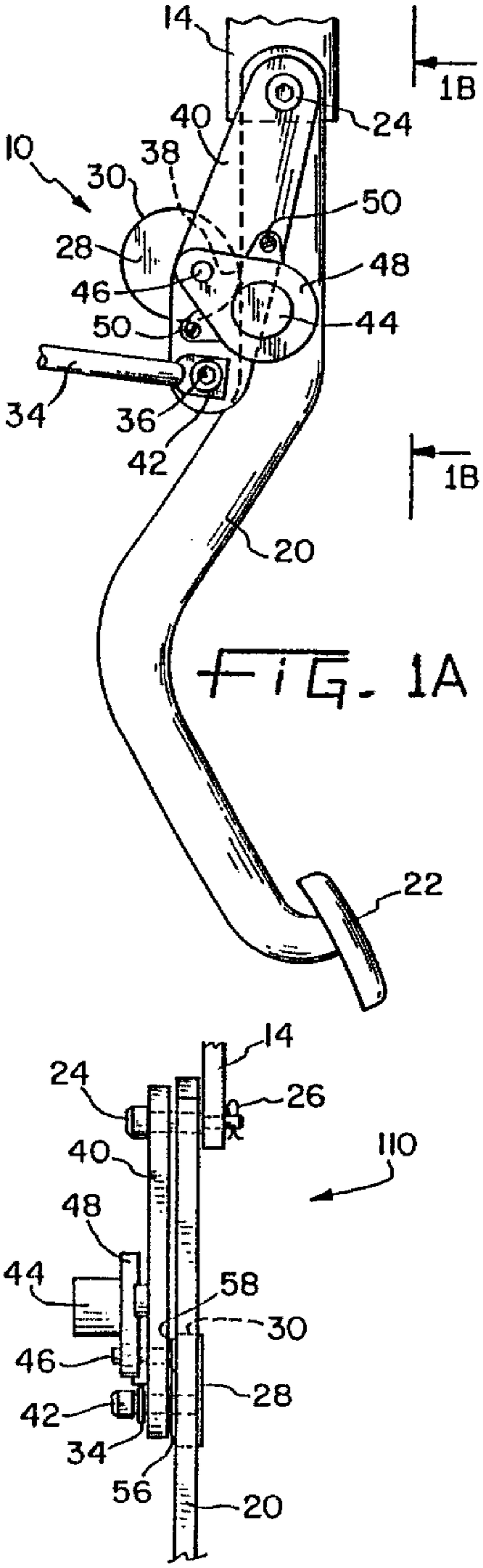

FIG. 1A

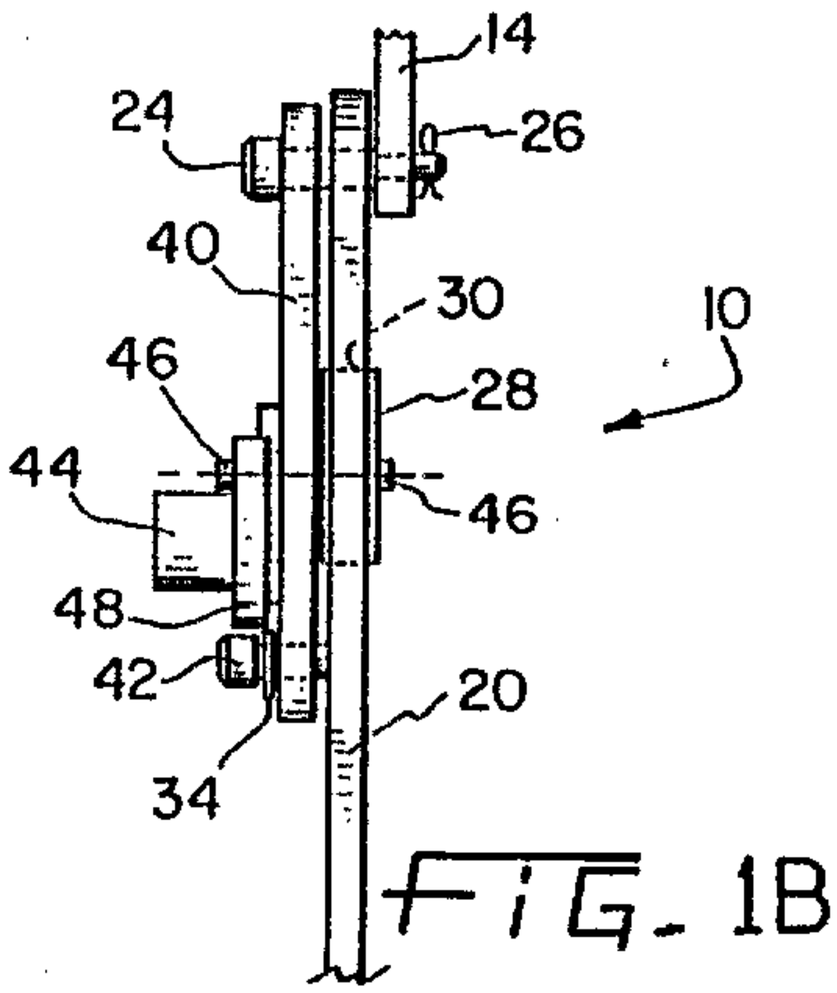

FIG. 1B

FIG. 2B

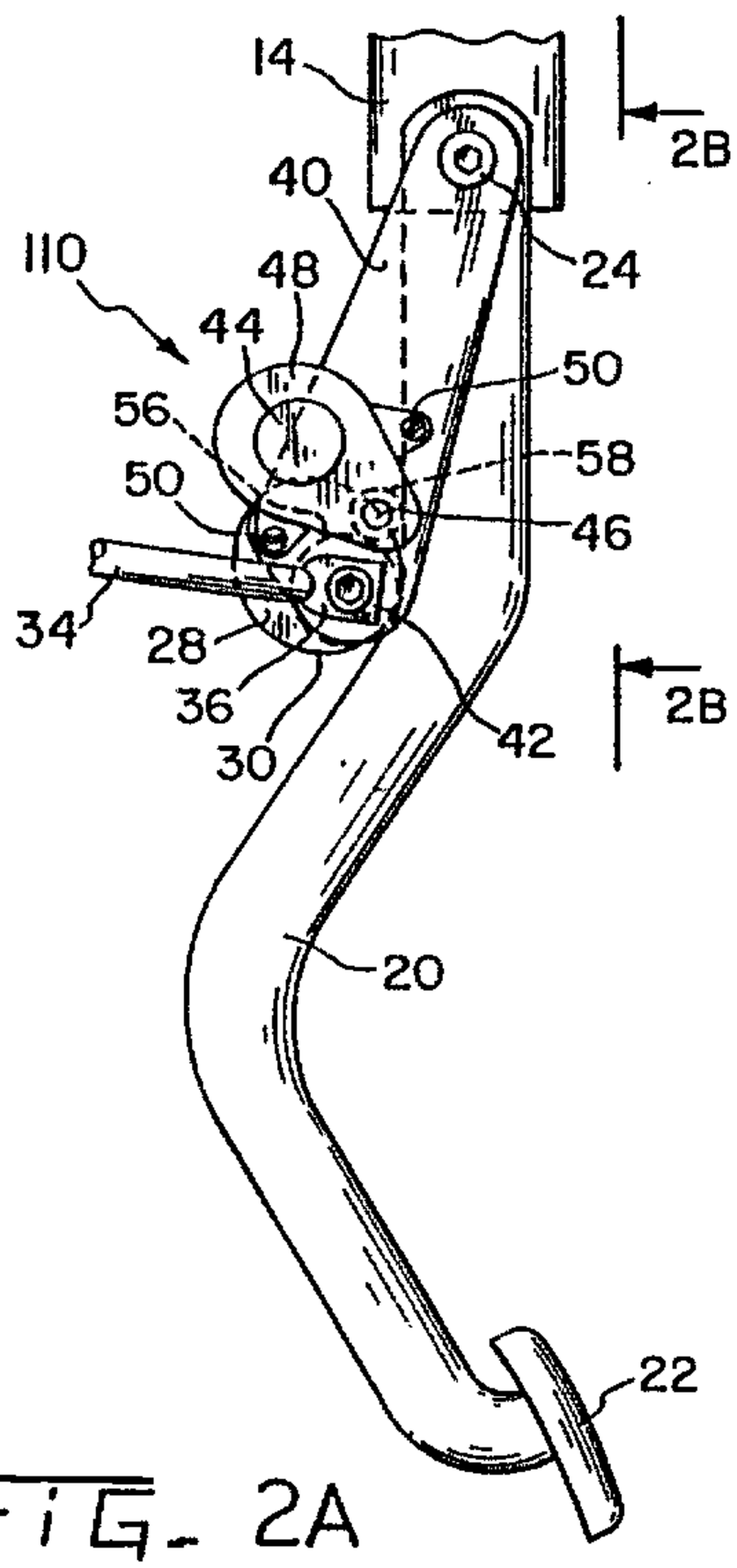

FIG. 2A

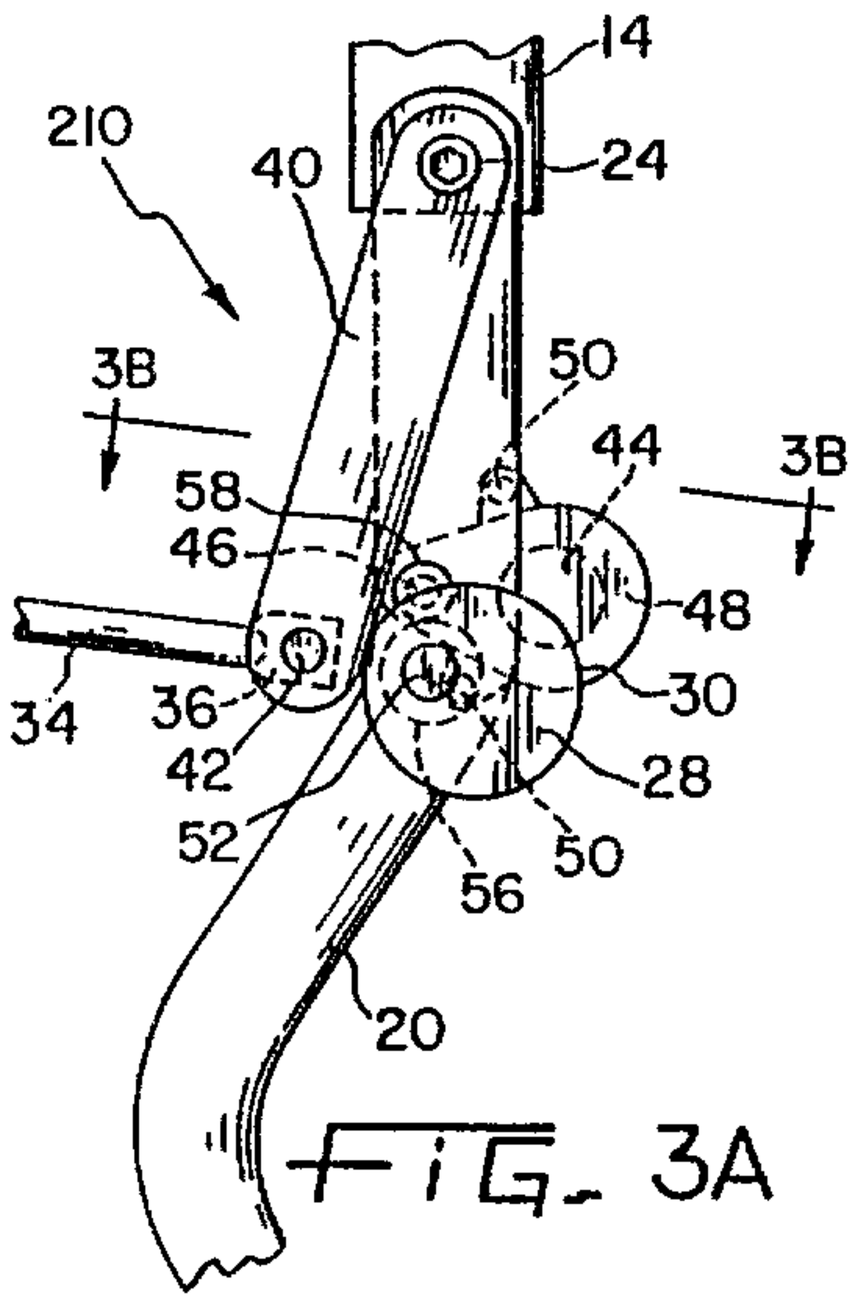

FIG. 3A

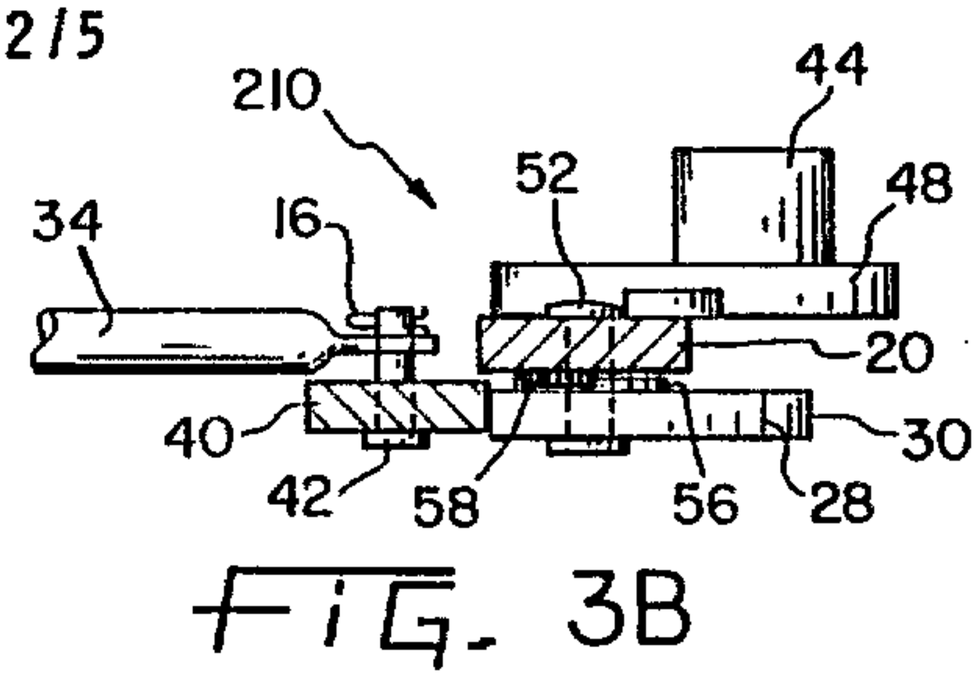

FIG. 3B

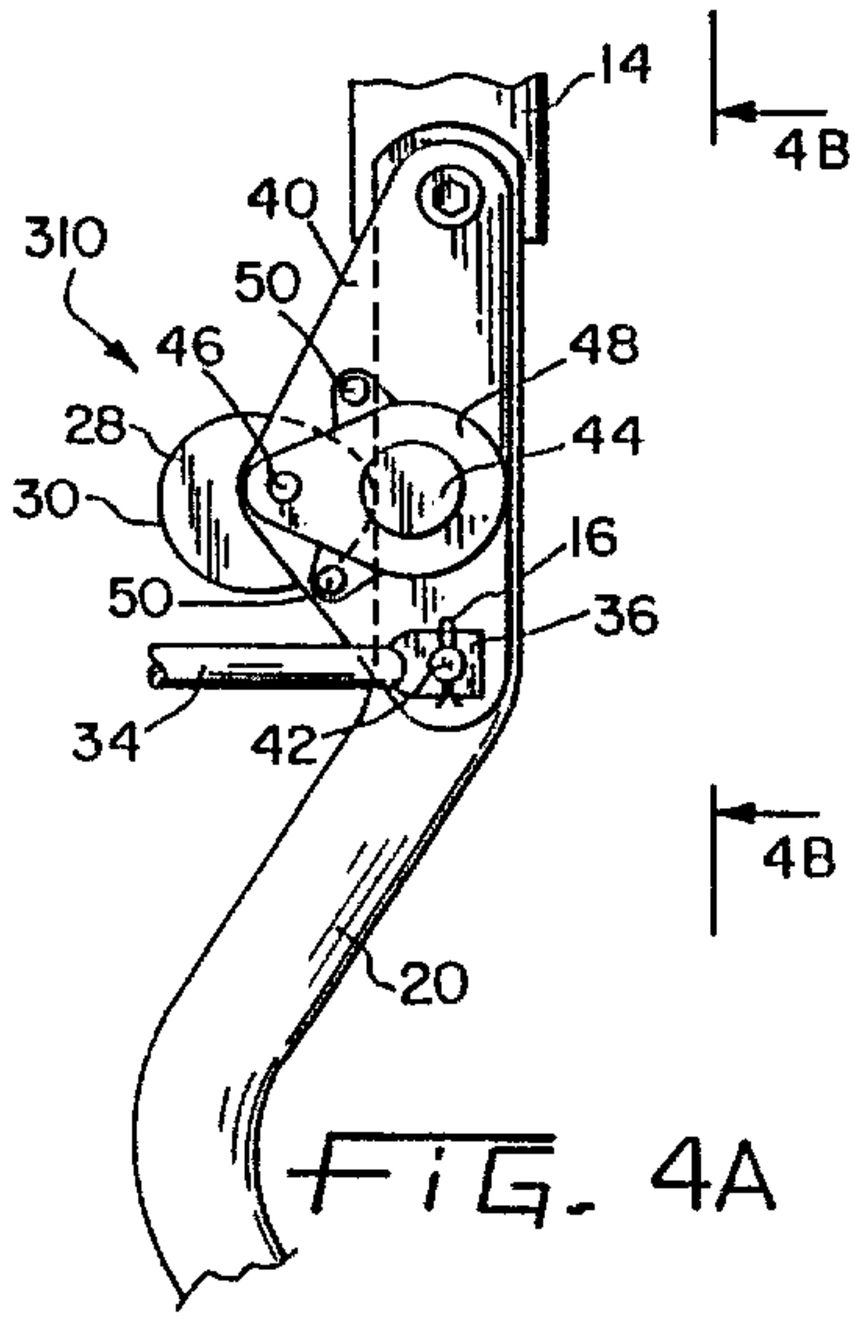

FIG. 4A

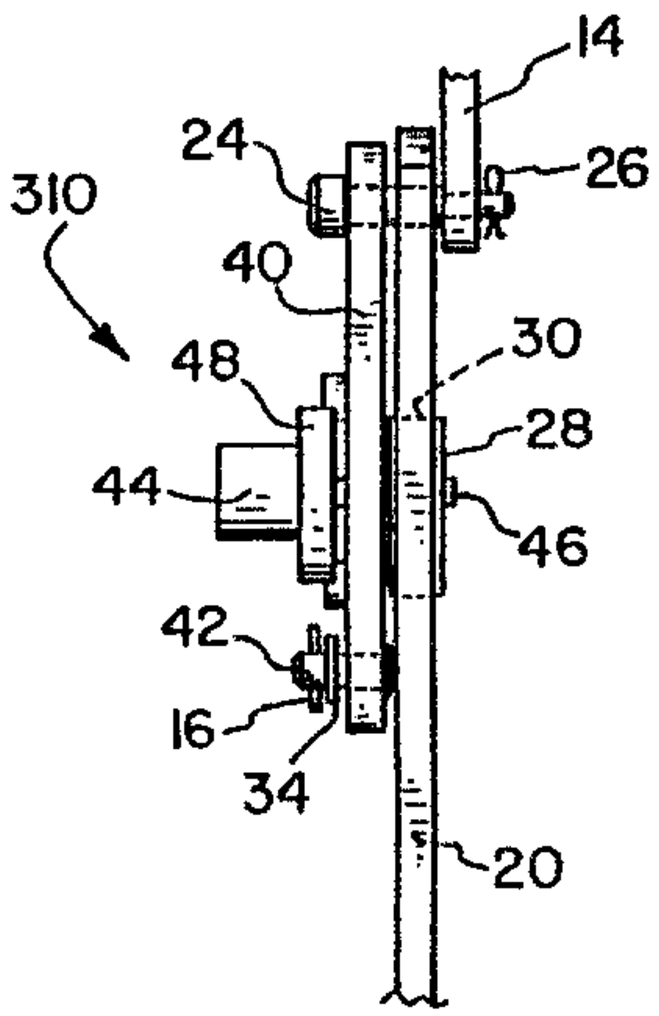

FIG. 4B

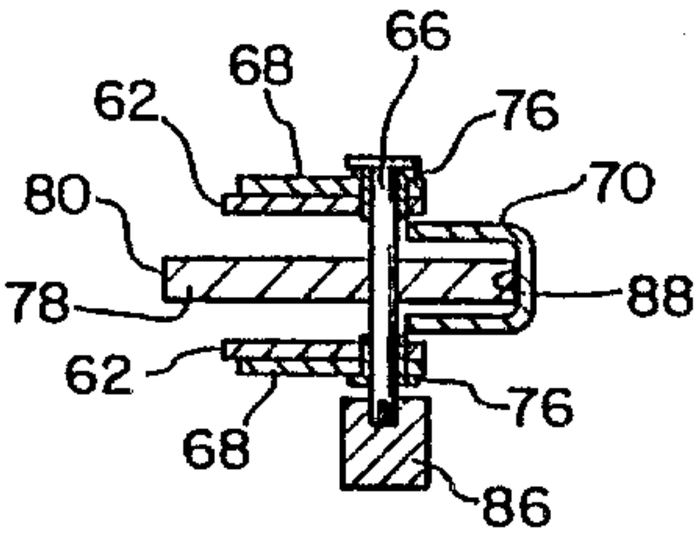

FIG. 5B

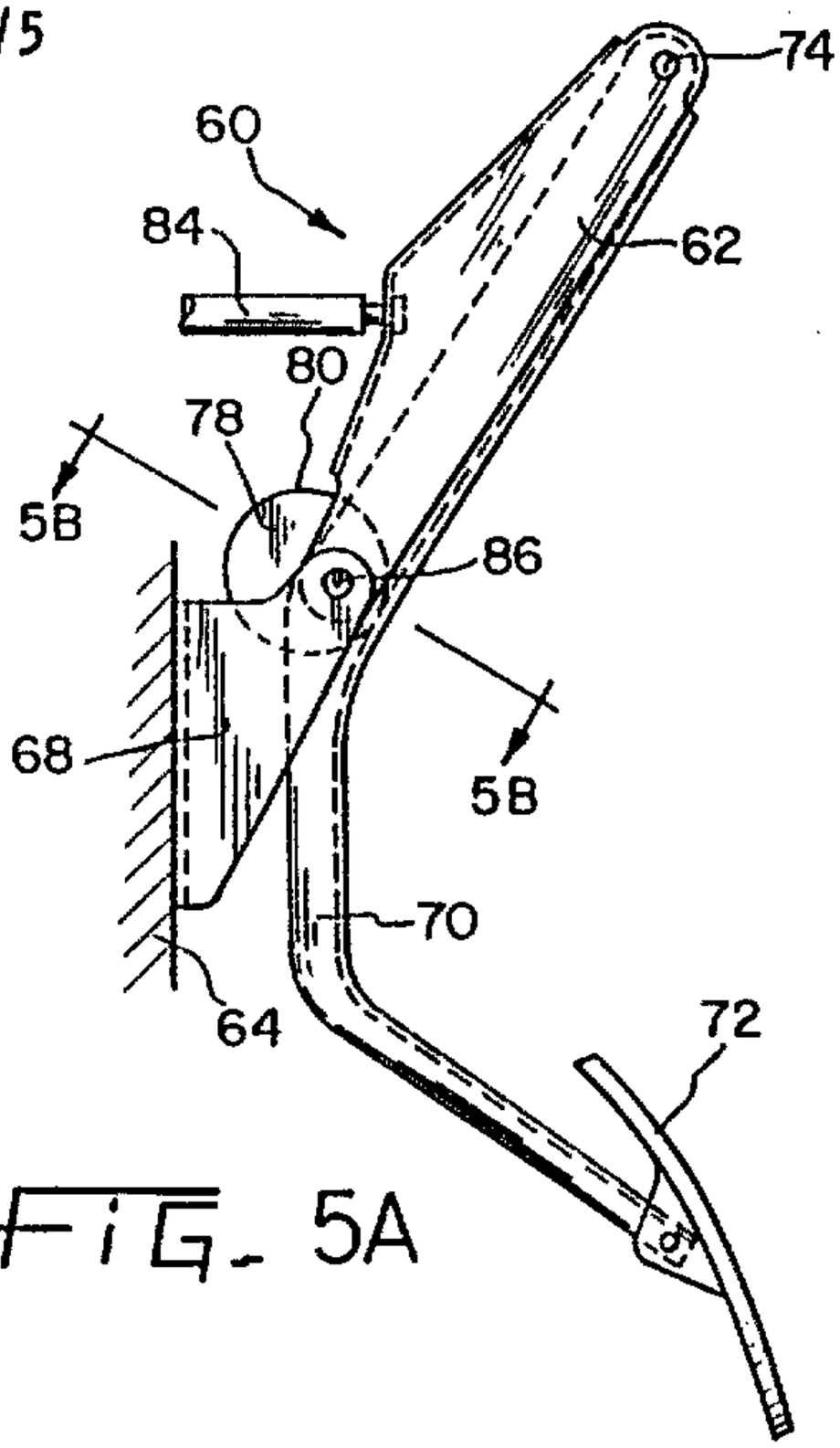

FIG. 5A

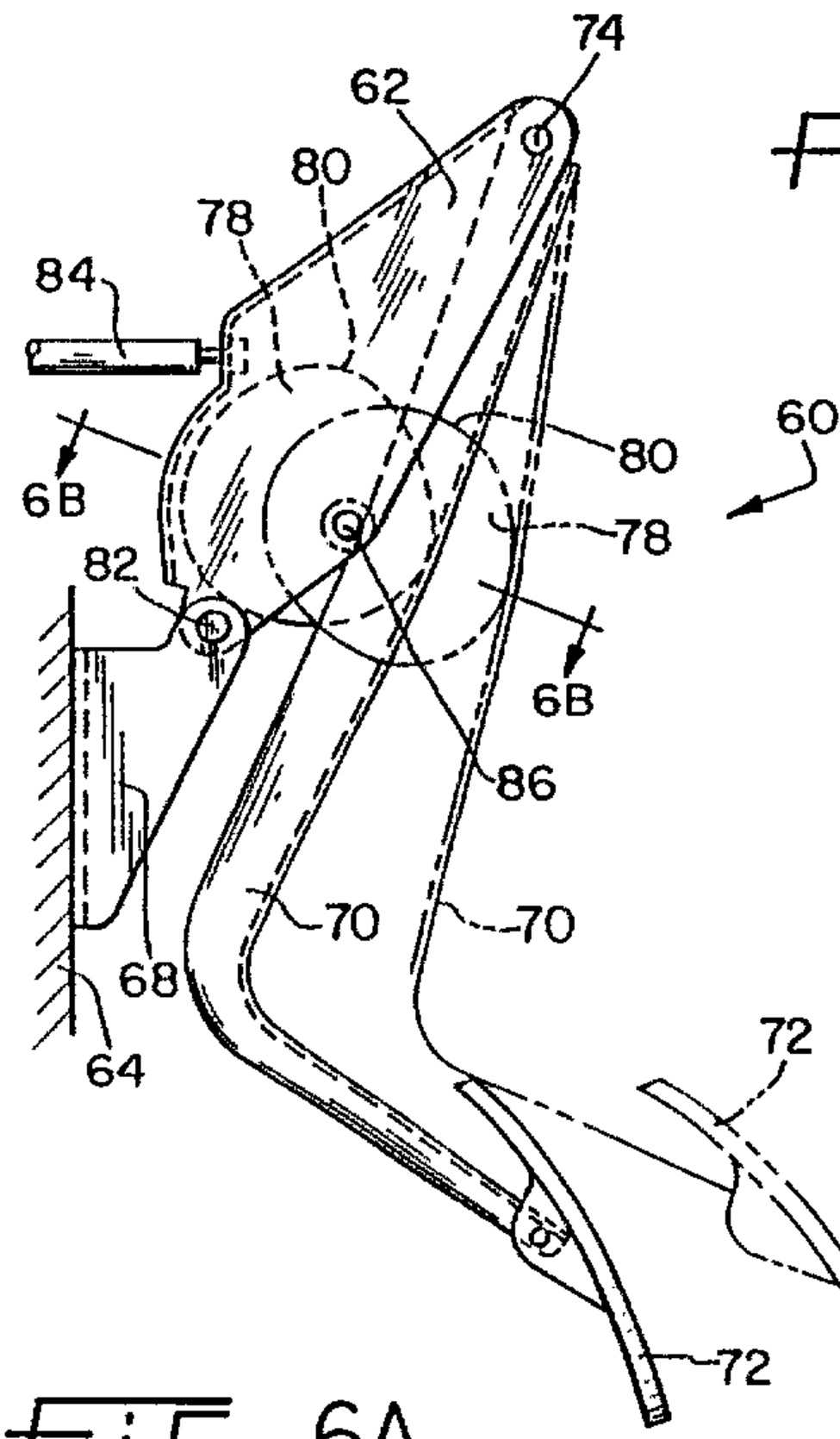

FIG. 6A

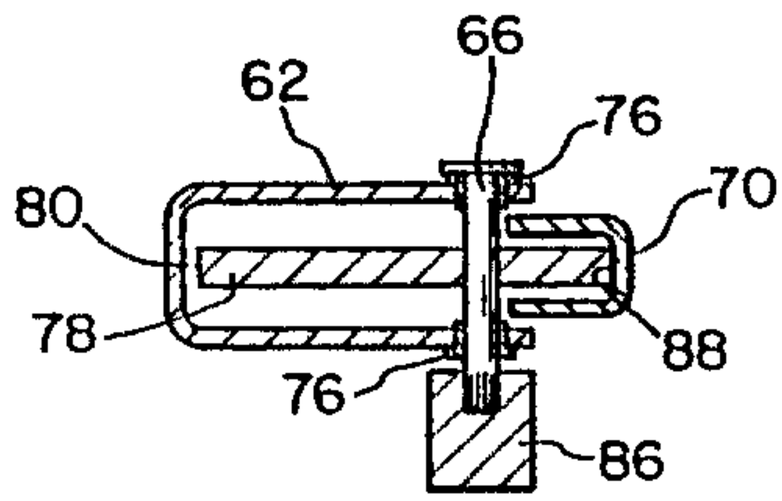

FIG. 6B

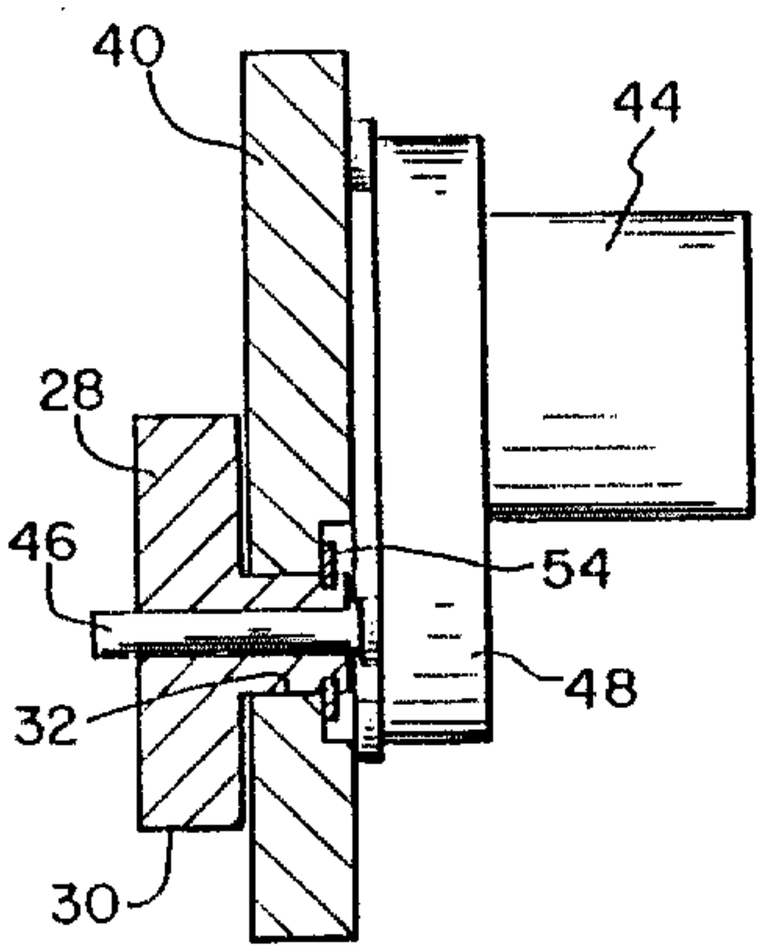

FIG. 7

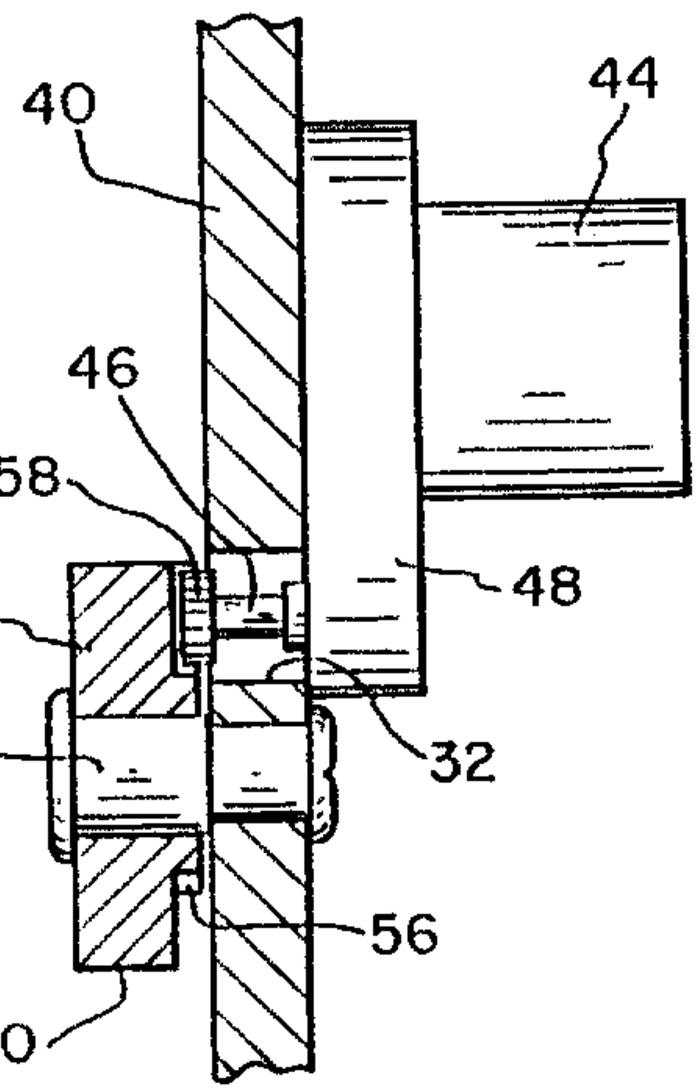

FIG. 8

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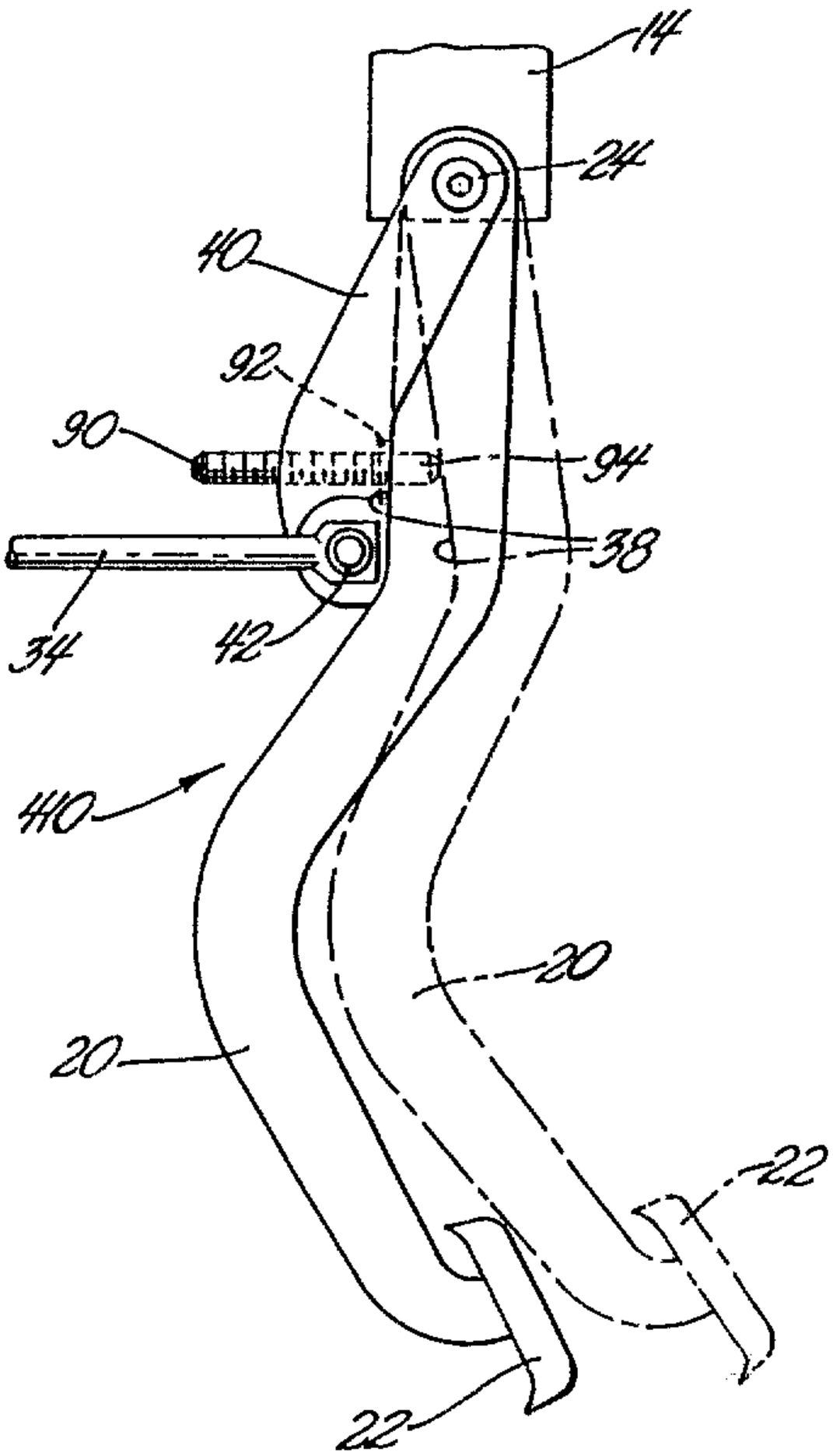


FIG. 9A

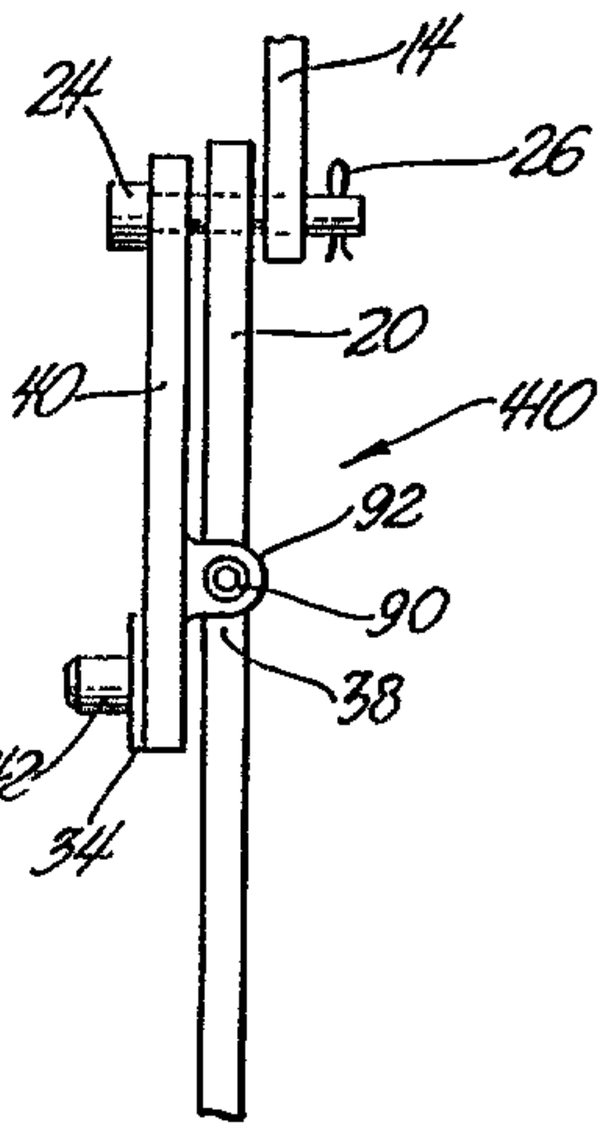
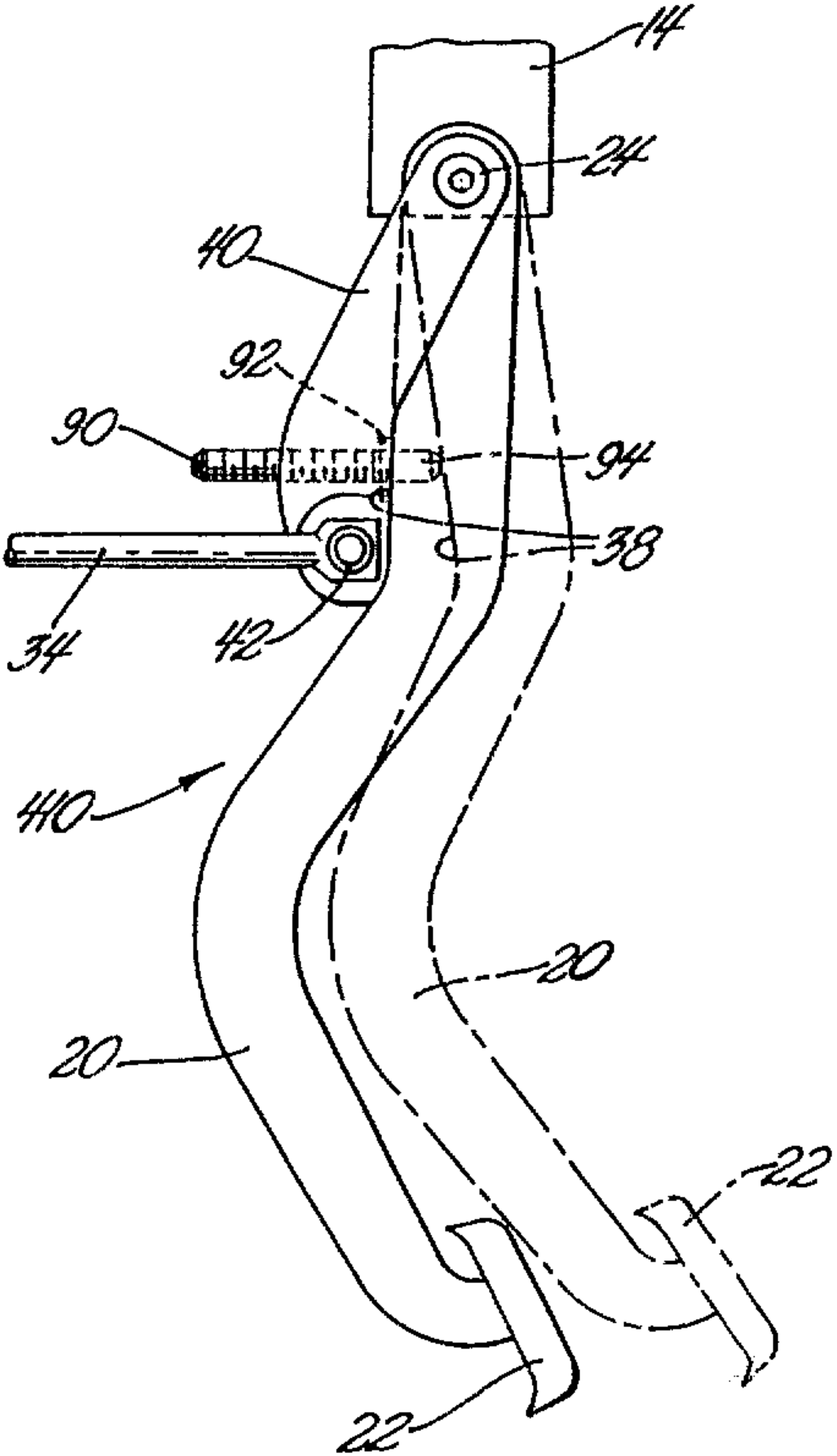


FIG. 9B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