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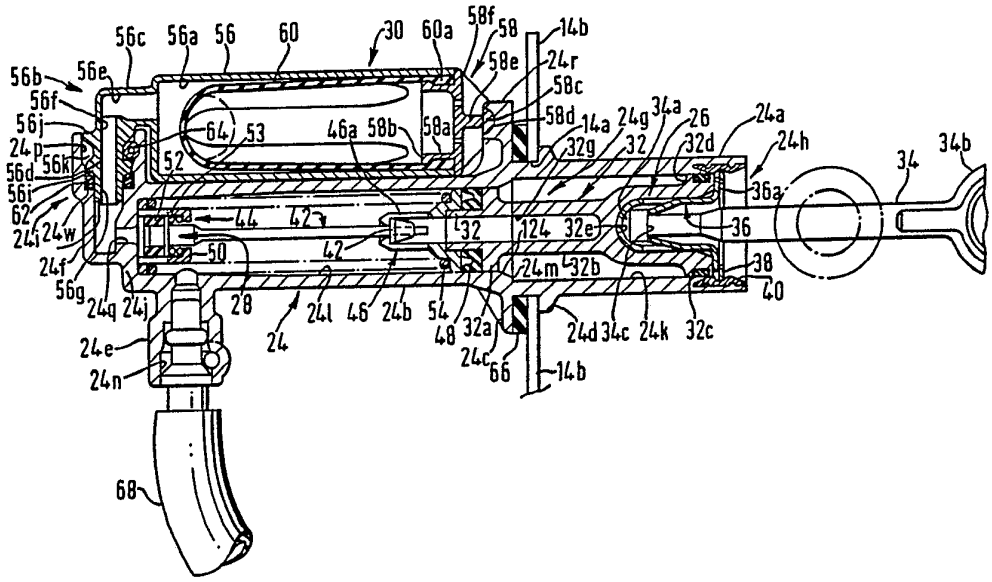

(57) Abstract

The assembly comprises a cylinder (24) having an axial bore (24g) and including a forward end (24i), a rearward end (24h), a discharge port (24n) adjacent said forward end, and a reservoir port (24q) adjacent said forward end. A piston (32) is mounted for axial movement in the bore (24g). A reservoir (30) is provided having an axial bore (56a) and including a rearward end and a discharge port (56g) adjacent its forward end. The reservoir (30) is retained on the cylinder (24) by a fitting (56d) at the forward end of the reservoir and fitting (24f) on the adjacent end of the cylinder which fittings coact in a telescopic manner and provide fluid communication between the bore, and by coacting mounting surfaces (58c, 24s) on the reservoir and cylinder respectively axially spaced from the fittings. Once the reservoir (30) is mounted on the cylinder (24) they extend substantially parallel with each other.

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HYDRAULIC CYLINDER ASSEMBLY

This invention relates to hydraulic cylinder assemblies and, more particularly, to hydraulic cylinder assemblies especially suitable for use in association with motor vehicle control systems such, for example, as clutch control systems.

Hydraulic actuator apparatus are known for operating a mechanism at a remote location by way of a master cylinder connected to a slave cylinder installed at the remote location. A conduit interconnects the master cylinder to the slave cylinder and the hydraulic apparatus is filled with hydraulic fluid such that when the piston of the master cylinder is actuated, the piston of the slave cylinder, and consequently the piston rod or output member, are simultaneously actuated by displacement of hydraulic fluid from the master cylinder to the slave cylinder through the conduit.

More particularly, it is known to provide such hydraulic apparatus for operating the release mechanism of a friction clutch of a motor vehicle. As disclosed in US-A-4 407 125, US-A-4 503 678 and US-A-4 506 507, it is further known to pre-assemble friction clutch hydraulic release apparatus by filling the master cylinder, the slave cylinder, the

conduit interconnecting the cylinders, and a reservoir connected to the master cylinder with hydraulic fluid before shipment of the assembly to a motor vehicle manufacturer for installation in a motor vehicle.

Whereas such prefilled and preassembled hydraulic apparatus contribute importantly to the efficient and inexpensive assembly of the motor vehicle, the master cylinders of such apparatus are serviceable by the operator of the motor vehicle and such servicing often causes problems with respect to the functioning of the total system or with respect to leakage of hydraulic fluid from the system.

The invention is directed to the provision of a master cylinder assembly suitable for use with a prefilled hydraulic apparatus wherein the master cylinder comprises a sealed, non-serviceable unit intended for disposal in the event of malfunction.

This invention is further directed to the provision of a master cylinder assembly which is non-serviceable and which may therefore be positioned in the passenger compartment of the associated motor vehicle without concern for leakage into the passenger compartment upon attempted servicing of the

unit.

According to one aspect of the invention there is provided a hydraulic master cylinder assembly comprising a cylinder having a central axial bore and including a forward end, a rearward end, a discharge port adjacent the forward end, and a reservoir port adjacent the forward end, a piston mounted for sliding reciprocal axial movement in the cylinder bore, and an elongated reservoir having a central axial bore and including a rearward end and a discharge port adjacent its forward end, the reservoir being positioned in piggyback fashion on the cylinder with the bores extending generally parallel to each other and with the reservoir discharge port connected to the cylinder reservoir port to provide fluid communication between the reservoir bore and the cylinder bore.

According to a second aspect of the invention there s provided a hydraulic cylinder assembly comprising a cylinder having an axial bore and including a forward end, a rearward end, a discharge port adjacent said forward end, and a reservoir port adjacent said forward end, a piston mounted for axial movement in said bore and reservoir having an axial bore and including a rearward end and a discharge port

adjacent it forward end, said reservoir being retained on the cylinder by a fitting at the forward end of the reservoir and a fitting on the adjacent end of the cylinder which fittings coact in a telescopic manner and provide fluid communication between the bores and by a coacting mounting means on the reservoir and cylinder axially spaced from the fittings, the bores of the cylinders extending substantially parallel with each other.

These arrangements provide a simple and compact package which may be readily formed as a sealed non-serviceable unit.

Preferably a retention element is provided to lock the reservoir and cylinder fittings together in the telescopic direction. The retention means may be carried by one of the fittings and locates part of the other fitting. Conveniently, the retention element, which may be a pin, may locate in a circumferential groove in the other fitting. In the latter case, the pin may locate tangentially in the groove. Preferably the pin passes through opposed location bores in the outer of the fittings so that a mid-section thereof locates in the groove formed in the inner of the fittings.

The coacting mounting means preferably permits transverse movement of the reservoir relative to the cylinder during assembly and disassembly of the reservoir and the cylinder. Such transverse movement may be swinging or pivotal in nature to allow the reservoir to be quickly moved into mounting relationship on the cylinder to facilitate ready and inexpensive assembly.

The axis of pivoting may be provided by the coacting mounting means and may be transverse, e.g., normal, to the axis of the cylinder bore.

The coacting mounting means may comprise respective members on the cylinder and reservoir, which members interconnect or abut to permit the swinging or pivotal movement. One of the members may define a concave journal surface and the other member may define, for example, a convex journal surface against the concave surface. This arrangement provides an inexpensive and efficient means of pivotally mounting the rear end of the reservoir for movement into its sealed position with respect to the cylinder. In one embodiment said one member is provided on the cylinder and the concave surface faces forwardly, and the other member is provided on the reservoir and the convex surface faces rearwardly. In another

embodiment one of said members is pin-like and the other of said members is hook-like and locates around the pin. The convex surface and/or the concave surface may be part-cylindrical.

Preferably stop means is provided to inhibit relative movement of the members in the direction of the axis of pivoting. The stop means may comprise at least one surface of said one member which overlies a surface of the other member. Preferably two spaced apart surfaces of said one member lie between spaced apart surfaces of the other member or vice versa to inhibit said relative movement. Such a stop arrangement ensures positive location or retention of the rear end of the reservoir on the cylinder.

The reservoir bore preferably houses a diaphragm which is held in position in the reservoir by an end portion thereof retained between a portion of the reservoir and an end member located on the reservoir, the end member preferably carrying part of said coacting mounting. Such a method of holding the diaphragm is simple and effective and may be enhanced by locating the end portion of the diaphragm between a surface of the bore and the end member in a sealing manner.

The cylinder may comprise a relatively large diameter rearward portion and a relatively small diameter forward portion, the cylinder being integral with an external mounting flange formed adjacent a juncture between the forward and rearward portions of the bore.

According to a third aspect of the invention there is provided a hollow cylinder having an axial bore and a piston mounted for axial movement in the bore, the bore comprising a relatively large diameter rearward portion and a relatively small diameter forward portion, the cylinder being integral with an external mounting flange formed adjacent a juncture between the forward and rearward portions of the bore.

This arrangement provides a convenient means of providing a mounting flange for the master cylinder assembly while simultaneously providing a journal mount for the rearward end of the reservoir and further allows the flange to be formed in a moulding operation without producing sink marks on the inner periphery of the cylinder in the region traversed by the piston.

Preferably part of said coacting mounting means is arranged on said mounting flange.

The piston preferably has a relatively small diameter forward portion mounted for sliding reciprocal movement in said forward bore portion and a relatively large diameter rearward portion mounted for reciprocal sliding movement in said rearward portion.

The juncture, which may be a frusto-conical shoulder, preferably includes a surface which defines the extreme forward position of the piston. The surface may be defined at the rear end of said frusto-conical shoulder. This arrangement allows the annular shoulder surface on the piston to coact with the bore shoulder surface in the cylinder to define the extreme forward position of the piston in the cylinder bore.

According to a fourth aspect of the invention there is provided a master cylinder assembly comprising an elongated cylinder having a central axial bore, a forward end, rearward end, and an external annular mounting flange intermediate its ends, and an elongated reservoir positioned in piggyback fashion on the cylinder and extending generally between the

mounting flange and the closed forward end of the cylinder.

In any of the aforesaid aspects of the invention and sub-clauses relating thereto, the hydraulic cylinder assembly may include a bracket structure and a pedal arm pivotally connected to said bracket structure, said cylinder being mounted on said bracket structure with a piston rod for moving the piston engaging said pedal arm whereby pivotal movement of the pedal will be transmitted to the piston rod. Where said cylinder has a mounting flange then, preferably, a portion of the cylinder rearwardly of the flange preferably passes through an aperture in the bracket structure with the flange positioned against a face of the bracket structure to position the reservoir and the portion of the cylinder forwardly of the flange forwardly of said face of the mounting structure.

The mounting structure may include a bracket part pivotally mounted on a further part of the bracket structure for adjustable pivotal movement of the bracket about said pivot axis, the cylinder, preferably being mounted on the bracket part.

The pedal may be pivotally mounted on the bracket part.

Preferably said bracket part includes a sleeve, said pedal arm being journalled on said sleeve and the bracket mounting including a pin received in said sleeve.

Preferably said bracket part has a U-configuration with a pair of generally parallel side arm portions and a bight portion interconnecting the lower ends of said arm portions, said cylinder is mounted on said bracket bight portion, said sleeve extends between said bracket arm portions adjacent upper ends thereof and an upper end of said pedal arm is journalled on said sleeve, the lower end of said pedal arm carries a pedal pad, and said piston rod engages said pedal arm intermediate the ends of said pedal arm.

Preferably one of said bracket side arm portions extends upwardly above said sleeve and said bracket mounting means further includes a slot in the upper end of said one bracket side arm portion for receipt of a fastener member. The slot may be arcuate with its centre of curvature on said pivot axis.

According to a fifth aspect of the invention there is provided a hydraulic cylinder assembly for a motor vehicle including a bracket structure, a pedal including a pedal arm pivotally mounted at one end on the bracket structure and having a pedal pad at its other end, a hydraulic cylinder assembly including a hollow cylinder having an elongate bore and including an open rearward end and a closed forward end, a piston slidably mounted in the bore, a piston rod connected at its forward end to the piston and extending out of the open rearward end of the cylinder, and an elongate reservoir positioned in piggyback fashion on the cylinder with the a bore in the reservoir and the cylinder bore extending generally parallel with each other, and means mounting the cylinder assembly on the bracket structure with the rearward end of the piston rod pivotally connected to the pedal arm. This arrangement provides a convenient means of mounting the master cylinder assembly totally within the passenger compartment of the motor vehicle.

According to a sixth aspect of the invention there is provided a hydraulic cylinder assembly including a bracket on which the cylinder of the assembly is mounted and a piston rod projecting out of the cylinder, a pedal assembly including a pedal arm

mounted for pivotal movement on the bracket about a pivot axis and pivotally connected to the free end of the piston rod at a location spaced from the pivot axis, and means for mounting the bracket for adjustable pivotal movement about the pivot axis. This arrangement provides a convenient means of mounting a master cylinder assembly in readily adjustable fashion within the passenger compartment of the motor vehicle.

In any of the aforesaid aspects of the invention and sub-clauses relating thereto, a conduit is preferably connected at one end thereof to the forward end of said cylinder in communication with said bore and a coupling is provided on the free end of said conduit which includes means operative in response to insertion of said coupling into an aperture in a vehicle bulkhead to lockingly connect said coupling and thereby said conduit to the bulkhead.

Where a pivotal pedal is provided for moving the piston, a limit switch may be provided associated with a switching element mounted in the path of pivotal movement of said pedal arm so as to be engaged by said pedal arm in response to pivotal movement of the pedal arm. Preferably the position of said limit switch is adjustable so as to allow the

position of said limit switch to be preset.

Where the pedal arm is provided, the pedal arm may include a pedal pad at a lower end thereof, a sleeve on the upper end thereof for mounting the pedal arm for pivotal movement and a pin on said pedal arm between the sleeve and pedal pad for locating the piston rod, the pedal arm, pedal pad, pin and sleeve being formed as a one piece unit moulded from plastics material. Such an arrangement simplifies the manufacture of the pedal arm. The arm may be moulded from a fibre reinforced plastics material.

The cylinder and/or reservoir may be moulded from plastics material.

According to a seventh aspect of the invention there is provided a hydraulic cylinder assembly comprising a cylinder having an axial bore and including a forward end, a rearward end, a discharge port adjacent said forward end, and a reservoir port adjacent said forward end, a piston mounted for axial movement in said bore and reservoir having an axial bore and including a rearward end and a discharge port adjacent its forward end, the cylinder and reservoir being formed as an integrally moulded part.

In the latter case, the said reservoir and said cylinder may be moulded with open forward ends with end cap means being provided closing the open forward ends of said reservoir and said cylinder. Preferably a single end cap closes both open forward ends.

Hydraulic cylinder assemblies in accordance with the invention will now be described by way of example with reference to the accompanying drawings in which:

Fig.1 is a fragmentary perspective view of a master cylinder assembly according to the invention shown in association with a motor vehicle control assembly,

Fig.2 is a view looking in a direction of the arrow 2 of Fig.1,

Fig.3 is a plan view of the master cylinder assembly of Fig.1,

Fig.4 is a perspective exploded view of the master cylinder assembly of Fig.1,

Fig.5 is a fragmentary perspective view of a pivotal mounting structure employed in the master cylinder assembly of Fig.1,

Fig.6 is a fragmentary perspective view of an alternative form of a pivotal mounting structure,

Fig.7 is a side elevational view of the master cylinder assembly of Fig.1,

Figs.8 and 9 are end views looking respectively from the left and right of Fig.7,

Fig.10 is a cross-sectional view taken on line 10-10 of Fig.7,

Figs.11-14 disclose an alternate form of the invention master cylinder assembly,

Figs.15-18 illustrate a quick connect coupling for use with the invention master cylinder assembly and

Figs.19-22 illustrate a further alternate form of the invention master cylinder assembly.

The master cylinder assembly 10 of the invention is seen in Fig.1 in association with a motor vehicle of the type including a fire wall 12, a pedal box or bracket structure 14, a pivot shaft 16 carried by the bracket structure, a clutch pedal assembly 18 secured at its upper end to shaft 16, a brake pedal assembly

20 secured at its upper end to shaft 16, and an accelerator pedal assembly 22 secured at its upper end to shaft 16.

Master cylinder assembly 10, broadly considered, includes a cylinder 24, a piston assembly 26, a valving assembly 28, and a reservoir 30.

Cylinder 24 is preferably formed of a suitable plastics material in a moulding operation and includes a relatively large diameter rearward end portion 24a, a relatively small diameter forward end portion 24b, a mounting flange 24c, a flange lock 24d, a discharge fitting 24e, and a reservoir fitting 24f.

Cylinder 24 defines a central axial bore 24g, an open rearward end 24h, and a forward end 24i closed by an end wall 24j.

Central bore 24g includes a relatively large diameter rearward portion 24k defined by relatively large diameter cylinder portion 24a and a relatively small diameter bore portion 241 defined by relatively small diameter cylinder portion 24b. An annular rearwardly facing shoulder surface 24m is defined at the rear end of a frusto conical shoulder 124 defining a

juncture of bore portions 24k and 24l. Discharge fitting 24e projects integrally and laterally from the main body portion of cylinder 24 adjacent the closed end 24i of the cylinder and defines a discharge port 24n communicating with the interior of cylinder bore 24l. Reservoir fitting 24f is moulded integrally with end wall 24j and defines a reservoir port or passage 24p including a central port 24q formed in end wall 24j.

External mounting flange 24c is formed adjacent the juncture of large diameter cylinder portion 24a and small diameter cylinder portion 24b and extends in annular fashion totally around the cylinder. Mounting flange 24c further defines a journal member 24r moulded integrally with the mounting flange at a location radially outwardly from the exterior surface of the cylinder and defining a forwardly facing concave part-cylindrical journal surface 24s. Locking flange 24d has a generally rectangular, oblong configuration and is spaced rearwardly from mounting flange 24c.

Piston assembly 26 includes a piston 32 and a piston rod 34. Piston 32 is formed of a plastic material in a moulding operation and includes a relatively small diameter forward flange portion 32a slidably received

in cylinder forward bore 231, a central spool portion 32b of reduced diameter, and a relatively large diameter rear end portion 32c slidably received in cylinder rearward bore 24k. Rearward portion 32c forms an annular forwardly facing shoulder surface 32d which coacts with bore shoulder 24m to define the extreme forward position of the piston within bore 24g. A retainer 36 is received in a hollow rearwardly opening bore 32e of piston 32 and includes an annular portion 36a engaging the rear annular end face of the piston and coacting with a snap ring 38 received in an annular groove defined by a retainer member 40 to define the extreme rearward position of the piston within the bore of the cylinder.

Piston rod 34 includes a forward spherical end 34a and a rearward end 34b in the form of an eye. Spherical forward end 34a mounts pivotally within retainer member 36 and is precluded from rearward movement relative to the retainer member by retainer spring finger portions 36b engaging an annular shoulder 34c formed at the rear end of spherical end 34a.

Valving assembly 28 includes a valve stem 42, a valve assembly 44, and a retainer member 46.

Retainer member 46 is secured to a front, nose portion 32f of piston 32 as by sonic welding and coacts with nose portion 32f and flange portion 32a to define a seal groove for receipt of an elastomeric seal 48.

Valve assembly 44 includes a retainer member 50 seated against end wall 24j and an annular elastomeric member 52 carried on the forward end of valve stem 42 and sealingly coacting with reservoir port 24q to selectively open and close that port. Valve stem 42 extends rearwardly in bore 241 from valve assembly 44 and includes a head portion 42a at its rearward end snappingly engaged by finger portions 46a of retainer 46.

Piston 32 includes a central forwardly opening bore 32g sized to slidably receive valve stem end portion 42a. A return coil spring 54 is positioned in bore 241 and extends from seating engagement at its forward end with retainer 50 to seating engagement at its rearward end with retainer 46. It will be understood that with the piston in its fully retracted position as illustrated in Fig.10, fingers 46a of retainer 46 engage head portion 42a of valve stem 42 to maintain annular elastomeric member 52 in axially spaced disposition with respect to reservoir

port 24q so as to establish communication between cylinder bore 241 and the reservoir port and that, as the piston is advanced forwardly in the cylinder in response to appropriate stroking input from piston rod 34, valve stem head portion 42a moves telescopically into piston bore 32g and elastomeric member 52 is moved into sealing engagement with reservoir port 24q by an internal coil spring 53 in valve retainer 50 so as to cut off communication between cylinder bore 241 and reservoir 30.

Reservoir 30 is formed in a moulding operation of a suitable plastics material and includes a main body sleeve portion 56 defining a central axial bore 56a, a discharge fitting 56b provided at the front of the reservoir and formed integrally with sleeve 56, and a rear end cap 58. Sleeve 56 has a diameter approximating the diameter of cylinder reduced diameter portion 24b and has a length dimensioned to fit comfortably between cylinder reservoir fitting 24f and cylinder mounting flange 24c.

Discharge fitting 56b includes an axially extending portion 56c extending forwardly from the forward end of the reservoir and a radially extending portion 56d. Axially extending portion 56c defines a passage 56e communicating with a radial passage 56f defined

by radially extending fitting portion 56d. Passage 56f terminates in a discharge port 56g. Radially extending fitting portion 56d includes a nose portion 56h, an external flange 56i, and a further external flange 56j forming an annular groove 56k in coaction with flange 56i.

End cap 58 fits telescopically within the rear end of sleeve 56 and includes an annular skirt portion 58a defining an annular bead 58b for trapping receipt of end lip portion 60a of an elastomeric diaphragm 60 positioned within reservoir bore 56a. End cap 58 further defines a journal member 58c including a convex rearwardly facing arcuate journal surface 58d sized to fit snugly within concave journal surface 24s defined by journal means 24r. Journal member 58c is supported by a central rib 58e and by spaced triangular flanges 58f which extend rearwardly beyond arcuate journal surface 58d.

To assembly the invention master cylinder assembly, assuming that piston assembly 26 and valving assembly 28 have previously been installed within the cylinder 24, convex journal surface 58d on reservoir 30 is positioned in concave journal surface 24s on cylinder 24 and the reservoir is thereafter pivoted about the axis defined by journal surfaces 58d and 24s on

cylinder 24 and the reservoir to bring reservoir discharge fitting 56d into telescopic relation with cylinder fitting 24f. Flanges 58f coact with the upper and lower surfaces 24t and 24u of journal means 24r to preclude vertical displacement of journal member 58c relative to journal surface 24r. As reservoir fitting 56d moves telescopically into cylinder fitting 24f, an o-ring 62 positioned on nose portion 56h of fitting 56d moves into seating and sealing engagement with a shoulder 24w defined within fitting 24f to sealingly position fitting 56d within fitting 24f, whereafter a pin 64 is passed through openings 24s in fitting 24f and into tangential position with respect to groove 56k. Pin 24 precludes axial withdrawal of fitting 56d from fitting 24f and allows the reservoir 30 to pivot about the axis of fitting 56d. Reservoir 30 is thus mounted in permanently sealed, piggyback fashion with respect to cylinder 24.

In the alternative form of journal structure seen in Fig.6, the journal provided on flange 24c comprises a pin 24v carried by radially outwardly extending and circumferentially spaced finger portions 24w and the journal provided on reservoir 30 comprises a hook member 58g extending rearwardly from end cap 58 and sized to engage under and around pin 24v to provide a

pivotal connection for the reservoir to the cylinder.

In the utilization of the invention master cylinder assembly in the vehicle control assembly seen in Fig.1, an annular resilient member 66 is positioned on the rearward face of mounting flange 24c, piston rod 34 and rearward cylinder portion 24a are passed rearwardly and upwardly through a rectangular opening 14a in a downwardly and rearwardly angled plate portion 14b of bracket structure 14 to bring resilient member 66 into sealing and seating engagement with the under, forward face of plate portion 14b to position reservoir 30 and cylinder forward portion 24b forwardly and below bracket plate portion 14b, the master cylinder assembly is thereafter turned through approximately 45 degrees to allow locking flange 24d to lockingly engage the upper face of plate portion 14b, a high pressure conduit 68 is inserted into discharge port 24n and passed through an opening 12a in fire wall 12 for attachment in known manner to a slave cylinder (not shown) situated in the engine compartment of the vehicle adjacent the clutch of the vehicle, and eye 34b of piston rod 34 is suitably secured to the pedal arm 18a of clutch pedal assembly 18 between shaft 16 and clutch pedal 18b so that pivotal movement of the clutch pedal assembly about the axis of shaft 16

serves to reciprocate piston 26 within the bore of the cylinder and selectively deliver pressurized fluid through conduit 68 to disengage and engage the clutch upon operator command.

In the alternative form of the invention seen in Figs.11-14, the master cylinder assembly 10, rather than being mounted on an angled plate portion, such as the portion 14b, of the pedal bracket structure is mounted on a separate bracket which is adjustably secured to the primary pedal bracket structure. Specifically, the master cylinder assembly is mounted on a bracket 70 which in turn is secured to the pedal box or pedal bracket 14.

Bracket 70 has a generally U configuration and includes an arm portion 70a, a further arm portion 70b, and a bight portion 70c. Master cylinder assembly 10a is mounted through an aperture 70d in bight portion 70c with cylinder rearward end portion 24a projecting rearwardly and upwardly from bight portion 70c and cylinder forward end portion 24b projecting downwardly and rearwardly from bight portion 70c. A sleeve 72 extends between the upper end of arm portion 70a and the confronting portion of arm portion 70b and includes a portion 72a extending beyond arm portion 70b. Sleeve 72 passes through

aligned apertures in bracket portions 70a and 70b and is held in position relative to bracket 70 by a snap ring 73 and a collar portion 72b of the sleeve. Sleeve 72 defines a central bore 72c. Pedal arm assembly 18 includes a pedal arm 18a, a pedal 18b, a journal sleeve 74, and a pivot pin 76. Journal sleeve 74 is welded to the upper end of pedal arm 18a and is journalled on sleeve 72 between bracket arm portion 70a and 70b to provide the required pivotal movement of the pedal arm. Pivot pin 76 is welded to pedal arm 18a intermediate the ends of arm 18a and pivotally receives the eye 34b of piston rod 34. Alternatively, as seen in Fig.14, pedal arm assembly 18, including arm 18a, pedal 18b, sleeve 74, and pin 76, may comprise a unitary moulded part formed of a glass or carbon fibre reinforced plastics material.

Arm portion 70b extends upwardly above bushing 72 in the form of an inwardly angled portion 70e which includes a slot 70f at its upper end. Slot 70f is arcuate and is centred on the pivot axis defined by sleeve 72. In this form of the invention, pivot shaft 16 includes a portion 16a projecting laterally from pedal box 14, and an aperture 14a is provided in pedal box 14 generally above pivot shaft extension 16a. To mount the bracket 70 with the master cylinder assembly mounted thereon on the pedal

bracket 14, sleeve 72 is passed over pivot shaft extension 16a and a suitable fastener 78 is passed through bracket aperture 14a and through slot 70f to secure the bracket 70 to the pedal bracket 14. The position of the bracket 70 relative to the pedal bracket 14, and thereby the position of clutch pedal assembly 18, may be selectively varied by loosening the fastener 78 and rotating the bracket 70 about the axis of shaft extension 16a with the pivotal movement of the bracket being accommodated by movement of fastener 74 in arcuate slot 70f. When the desired position of annular adjustment of the bracket relative to the pedal bracket has been achieved, fastener 78 is again tightened to lock the bracket 70, and thereby the master cylinder assembly, in the desired position of angular adjustment to provide clutch disengagement in response to a precise and consistent amount of pedal stroke irrespective of manufacturing tolerances in each vehicle in which the master cylinder assembly is installed.

The master cylinder assembly 10 of the Figs.11 - 14 embodiment further includes an electrical limit switch 80 secured to a tab 70g struck from arm portion 70a of bracket 70 and including a contact plunger 82 positioned in the path of pivotal movement of pedal arm 18a as the arm pivots about its pivot

axis. Switch 80 includes adjustment means so that the position of plunger 82 relative to arm 18a in the fully retracted position of the master cylinder assembly may be adjusted and preset to provide actuation of the clutch interlock circuit of the associated vehicle at such time as the clutch is fully disengaged.

The quick connect coupling shown in Figs.15 - 18 is utilized to facilitate mounting of the conduit 68 in the vehicle bulkhead 12.

The quick connect coupling, generally designated by the reference numeral 84, includes a main body member 86 of generally cylindrical construction, a plug member 88 positioned in one end of main body member 86, a fitting 90 including an enlarged diameter tubular portion 90a positioned in the other end of main body member 86 and a reduced diameter tubular portion 90b receiving the free end of conduit 68, a coil spring 92 positioned within member 86 and biasing plug 88 into a position sealing the adjacent end of member 86, and a collar 94 suitably secured to member 86 in surrounding relation to reduced diameter fitting portion 90b. Collar 94 includes a main body tubular portion 94a, and a pair of diametrically opposed ear portions 94c at the other end of tubular

position 94a. In use, the free end of conduit 68 is fitted over reduced diameter portion 90b of fitting 90 and the coupling is passed through an aperture in the bulkhead 12 having a diameter less than the diameter of flange portion 94b of collar 94 and less than the relaxed diametrical extend of ears 94c. As the coupling is passed through the aperture in the bulkhead, ears 94c flex radially inwardly in cantilever fashion to allow the ears to pass through the aperture, whereafter the ears snap radially outwardly to trap the bulkhead 12 between ears 94c and flange 94b and securely position the coupling in the bulkhead 12, whereafter a female coupling, not shown, may be fitted over coupling 84 in known manner to move plug 88 away from the open end of member 86 and provide fluid communication through coupling 84.

It will be understood that master cylinder assembly 10 would normally be delivered to the motor vehicle manufacturer as part of a prefilled and pretested package including the master cylinder assembly, conduit 68, and an associated slave cylinder with the filling of the total package being accomplished by appropriate bleeding at the slave cylinder and then filling of the package through the reservoir port 56h formed integrally with reservoir sleeve 56. Depending on the installation, the prefilled and

pretested package may also include one or more quick disconnect fittings to enable the components of the package to be separated during assembly and then reconnected without loss of their prefilled condition.

A further form of master cylinder assembly according to the invention is seen in Figs.19 - 22. The embodiment of Figs.19 - 22 is generally similar to the embodiment of Figs.1 - 10 with the exception that the reservoir and cylinder are formed as a unitary moulded member rather than being formed as separate members with the reservoir separably mounted on the cylinder. Specifically, the cylinder 100, in addition to a relatively large diameter rearward portion 100a and a relatively small diameter forward portion 100b further includes a reservoir portion 100c moulded integrally with forward portion 100b so as to form, as best seen in Fig.19, a generally "figure of 8" configuration with one portion of the figure 8 constituting the relatively small diameter forward portion of the cylinder and the other portion of the figure 8 defining the reservoir. The forward cylinder portion 100b and reservoir portion 100c are moulded with open forward ends. Cylinder portion 100b includes a discharge fitting 100d defining a discharge port 100e, and a partition 100f is provided

adjacent but spaced rearwardly from the open forward end of cylinder portion 100b. The open forward ends of cylinder portion 100b and reservoir portion 100c are closed by an end cap 102, seen as a separate element in Fig.21 and seen in its assembled relation to the cylinder in Figs.18 and 20. End cap 102 includes a main body portion 102a, an annular reservoir closure portion 102b, and an annular cylinder closure portion 102c. In the assembled relation of the end cap and the cylinder, annular reservoir closure portion 102b is fitting into the open forward end of reservoir portion 100c and traps the annular lip 60a of the elastomeric diaphragm 60 positioned within the reservoir, and annular cylinder closure portion 102c is fitted into the open forward end of cylinder portion 100b and coacts with an o-ring 104 to preclude leakage of fluid out of the open end of cylinder portion 100b. With end cap 102 in place, fluid communication is established between the internal bore 100g of cylinder portion 100b and the internal bore 100h of reservoir portion 100c by a central reservoir port 100i provided in partition 100f, a chamber 100j defined rearwardly of end cap 102 and forwardly of partition 100f, and an angled reservoir discharge port 100k extending between chamber 100j and reservoir bore 100h. It will be understood that a piston and valve assembly of the

general type disclosed in the Figs.1 - 10 embodiment is also included in the Figs.18 - 21 embodiment so that communication is blocked between cylinder portion 100b and reservoir portion 100c in response to forward, stroking movement of piston rod 34 and communication between reservoir portion 100c and cylinder portion 100b is re-established upon rearward, retracting movement of piston rod 34.

The invention master cylinder assembly will be seen to provide many important advantages. The piggyback mounting of the reservoir on the cylinder provides an extremely compact package and thereby facilitates installation in the extremely cramped environments of modern day motor vehicles. The pivotal mounting of the reservoir on the cylinder allows the cylinder and reservoir to be readily and inexpensively assembled so as to provide a relatively inexpensive final product. The simple manner in which the reservoir and cylinder pivotally and sealingly coact enables the master cylinder assembly to be delivered as a permanently sealed unit to the motor vehicle manufacturer and thereby allows the unit to be installed in the passenger compartment of the motor vehicle and replaced when necessary without fear of contamination of the passenger compartment during the course of attempts to service the master cylinder

assembly. The compact nature of the master cylinder assembly also allows it to be installed in the relatively crowded and confined environment of the passenger compartment. The two-step bore of the master cylinder allows the external mounting flange of the master cylinder to be provided at the juncture of the small diameter and large diameter bores so that any sink marks created on the internal periphery of the cylinder as a result of the draw created by the mounting flange in the moulding process will not interfere with the smooth reciprocal sliding movement of the piston within the cylinder, and the multi-step bore also provides a convenient and positive means of defining the extreme forward position of the piston within the cylinder by allowing the annular shoulder on the piston to seat against the annular shoulder 24m defined at the rear end of the juncture 124 between the large diameter bore portion and the small bore diameter bore portion. The multi-step bore also simplifies the plastic moulding operation of the cylinder by minimizing the length of bore along which the bore dimensions must be carefully controlled during the moulding process.

Whereas preferred embodiments of the invention have been illustrated and described in detail, it will be apparent that various changes may be made in the

disclosed embodiments without departing from the scope or spirit of the invention as defined by the appended claims.

CLAIMS

1. A hydraulic cylinder assembly comprising a cylinder having an axial bore and including a forward end, a rearward end, a discharge port adjacent said forward end, and a reservoir port adjacent said forward end, a piston mounted for axial movement in said bore, and a reservoir having an axial bore and including a rearward end and a discharge port adjacent its forward end, said reservoir being retained on the cylinder by a fitting at the forward end of the reservoir and a fitting on the adjacent end of the cylinder which fittings coact in a telescopic manner and provide fluid communication between the bores and by a coacting mounting means on the reservoir and cylinder axially spaced from the fittings, the bores of the cylinders extending substantially parallel with each other.

2. A cylinder assembly according to Claim 1 in which a retention element is provided to lock the reservoir and cylinder fittings together in the telescopic direction.

3. A cylinder assembly according to Claim 2 in which the retention element is carried by one of the fittings and locates part of the other fitting.

4. A cylinder assembly according to Claim 3 in which the retention element locates in a circumferential groove in the other fitting.

5. A cylinder assembly according to Claim 2, 3 or 4 in which the retention element is a pin.

6. A cylinder assembly according to Claim 5 and where the pin locates in a groove, in which the pin locates tangentially in the groove.

7. A cylinder assembly according to Claim 6 in which the pin passes through opposed location bores in the outer of the fittings so that a mid-section thereof locates in the groove formed in the inner of the fittings.

8. A cylinder assembly according to any preceding Claim in which the coacting mounting means permits transverse movement of the reservoir relative to the cylinder during assembly and disassembly of the reservoir and the cylinder.

9. A cylinder assembly according to Claim 8 in which the transverse movement is a swinging or pivotal movement.

10. A cylinder assembly according to Claim 9 in which the axis of pivoting is provided by the coacting mounting means.

11. A cylinder assembly according to Claim 10 in which the axis of pivoting is transverse to the axis of the cylinder bore.

12. A cylinder assembly according to Claim 9, 10 or 11 in which the coacting mounting means comprise respective members on the cylinder and reservoir, which members interconnect or abut to permit the swinging or pivotal movement.

13. A cylinder assembly according to Claim 12 in which one of said members defines a concave journal surface and the other member defines a convex journal surface arranged to journal against the concave surface.

14. A cylinder assembly according to Claim 13 in which said one member is provided on the cylinder and the concave surface faces forwardly, and the other member is provided on the reservoir and the convex surface faces rearwardly.

15. A cylinder assembly according to Claim 12 or 13 in which one of said members is pin-like and the other of said members is hook-like and locates around the pin.

16. A cylinder assembly according to Claim 13, 14 or 15 in which the concave surface is part-cylindrical.

17. A cylinder assembly according to claim 13, 14, 15 or 16 in which the convex surface is part-cylindrical.

18. A cylinder assembly according to any of Claims 13 to 17 in which stop means is provided to inhibit relative movement of the members in the direction of the axis of pivoting.

19. A cylinder assembly according to Claim 18 in which the stop means comprises at least one surface of said one member which overlies a surface of the other member.

20. A cylinder assembly according to Claim 19 in which two spaced apart surfaces of said one member lie between spaced apart surfaces of the other member to inhibit said relative movement.

21. A cylinder assembly according to any preceding Claim in which the reservoir bore houses a diaphragm which is held in position in the reservoir by an end portion thereof which is retained between a portion of the reservoir and an end member located on the reservoir.

22. A cylinder assembly according to any preceding Claim in which the cylinder bore comprises a relatively large diameter rearward portion and a relatively small diameter forward portion the cylinder being integral with an external mounting flange formed adjacent a juncture between the forward and rearward portions of the bore.

23. A hydraulic cylinder assembly comprising a hollow cylinder having an axial bore and a piston mounted for axial movement in the bore, the bore comprising a relatively large diameter rearward portion and a relatively small diameter forward portion the cylinder being integral with an external mounting flange formed adjacent a juncture between the forward and rearward portions of the bore.

24. A cylinder assembly according to Claim 22 or 23 in which part of said coacting mounting means is

arranged on said mounting flange.

25. A cylinder assembly according to Claims 22, 23 or 24 in which the piston has a relatively small diameter forward portion mounted for sliding reciprocal movement in said forward bore portion and a relatively large diameter rearward portion mounted for reciprocal sliding movement in said rearward portion.

26. A cylinder assembly according to any of Claims 22 to 25 and where the piston has a relatively small diameter forward portion and a relatively large diameter rearward portion, in which the juncture defines a stop which defines the extreme forward position of the portion.

27. A cylinder assembly according to any preceding Claim including a bracket structure, a pedal arm pivotally connected to said bracket structure, said cylinder being mounted on said bracket structure with a piston rod for moving the piston engaging said pedal arm whereby pivotal movement of the pedal will be transmitted to the piston rod.

28. A cylinder assembly according to Claim 27 and where said cylinder has said external mounting flange, in which a portion of the cylinder rearwardly of the flange passes through an aperture in the bracket structure with the flange positioned against a face of the bracket structure to position the reservoir and the portion of the cylinder forwardly of the flange forwardly of said face of the mounting structure.

29. A cylinder assembly according to Claim 27 or 28 in which the mounting structure includes a bracket part pivotally mounted on a further part of the bracket structure for adjustable pivotal movement of the bracket about said pivot axis, the cylinder being mounted on the bracket part.

30. A cylinder assembly according to Claim 29 in which the pedal is pivotally mounted on the bracket part.

31. A cylinder assembly according to Claim 20 or 30 in which said bracket part includes a sleeve, said pedal arm is journalled on said sleeve and the bracket mounting including a pin received in said sleeve.

32. A cylinder assembly according to Claim 31 in which said bracket part has a U configuration with a pair of generally parallel side arm portions and a bight portion interconnecting the lower ends of said arm portions said cylinder is mounted on said bracket bight portion, said sleeve extends between said bracket arm portions adjacent upper ends thereof and an upper end of said pedal arm is journalled on said sleeve, the lower end of said pedal arm carries a pedal pad, and said piston rod engages said pedal arm intermediate the ends of said pedal arm.

33. A cylinder assembly according to Claim 32 in which one of said bracket side arm portions extends upwardly above said sleeve and said bracket mounting means further includes a slot in the upper end of said one bracket side arm portion for receipt of a fastener member.

34. A cylinder assembly according to Claim 33 in which said slot is arcuate with its centre of curvature on said pivot axis.

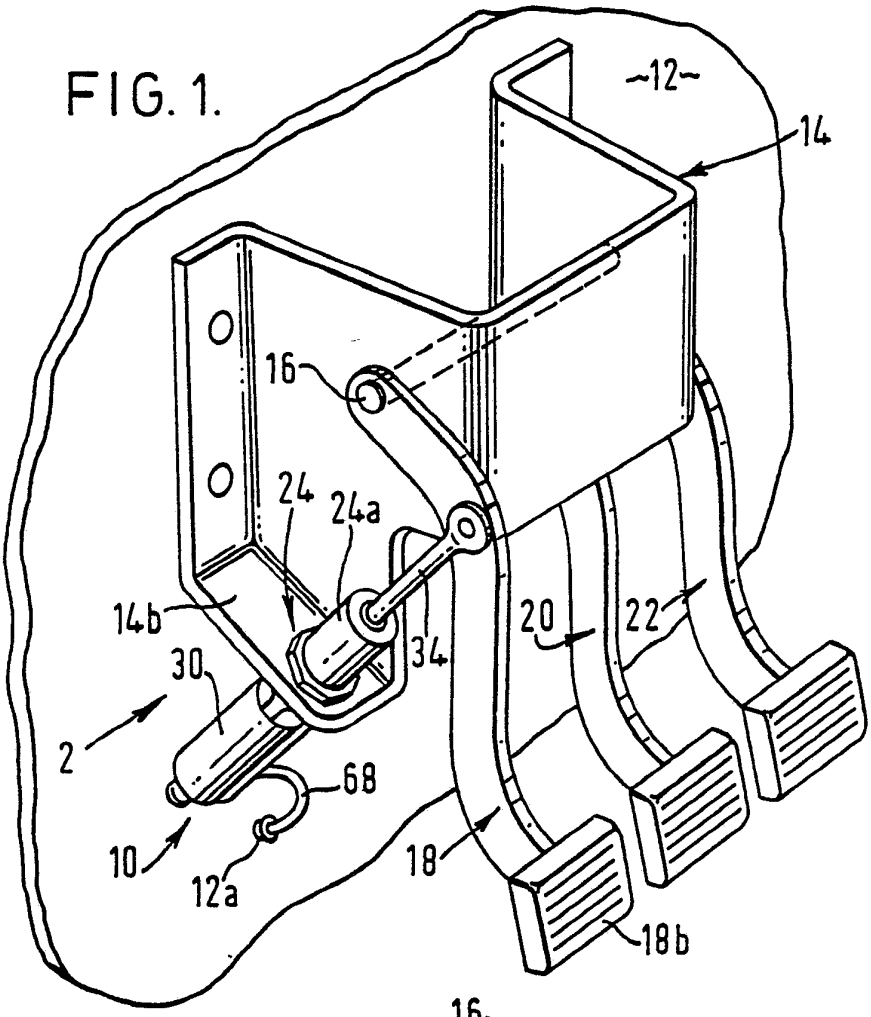
35. A cylinder assembly according to any preceding Claim in which a conduit is connected at one end thereof to the forward end of said cylinder in communication with said bore and a coupling is

provided on the free end of said conduit which includes means operative in response to insertion of said coupling into an aperture in a vehicle bulkhead to lockingly connect said coupling and thereby said conduit to the bulkhead.

36. A cylinder assembly according to any preceding claim in which a pivotable pedal arm is provided for moving said piston and a limit switch is provided associated with a switching element mounted in the path of pivotal movement of said pedal arm so as to be engaged by said pedal arm in response to pivotal movement of the pedal arm.

37. A cylinder assembly according to any preceding Claim and where a pedal arm is provided for moving said piston, in which the pedal arm includes a pedal pad at a lower end thereof, a sleeve on the upper end thereof for mounting the pedal arm for pivotal movement, and a pin on said pedal arm between the sleeve and pedal pad for locating the piston rod, the pedal arm, pedal pad, pin and sleeve being formed as a one-piece unit moulded from plastics material.

FIG. 1.


12
14
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24a
14b
34
20
22
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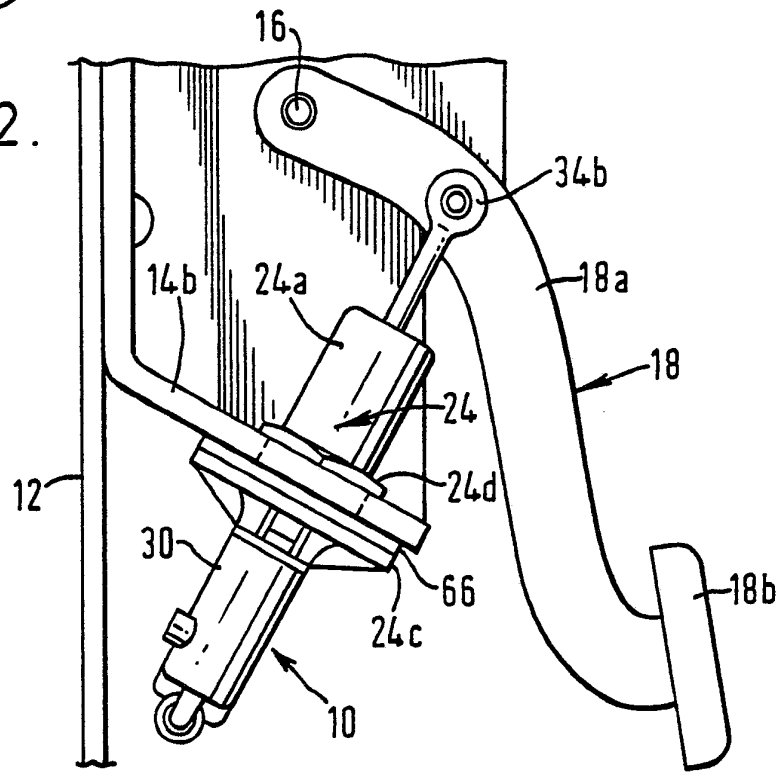
2
68
10
12a
18
18b

FIG. 2.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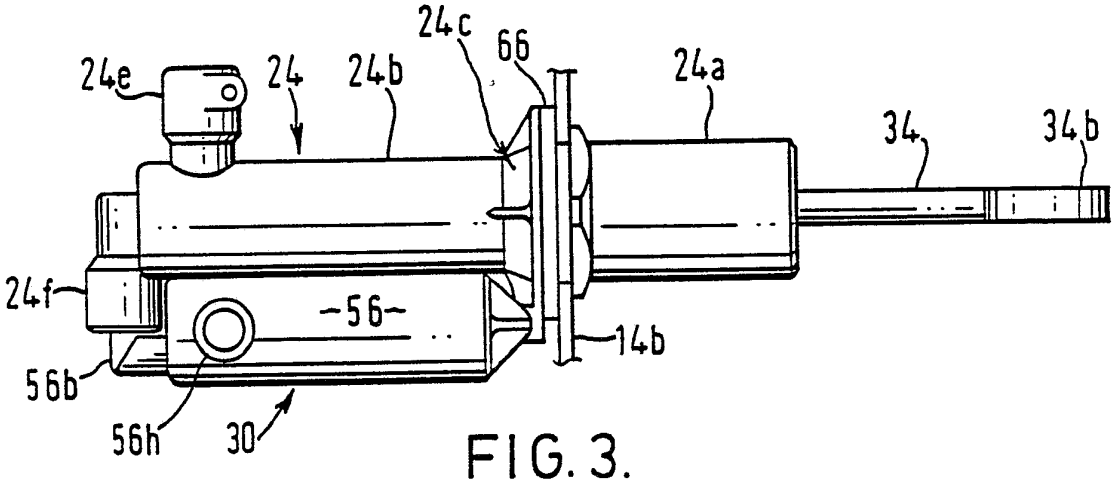
24a
18a
18
24
24d
12
30
66
24c
18b
10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24b
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34b
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14b
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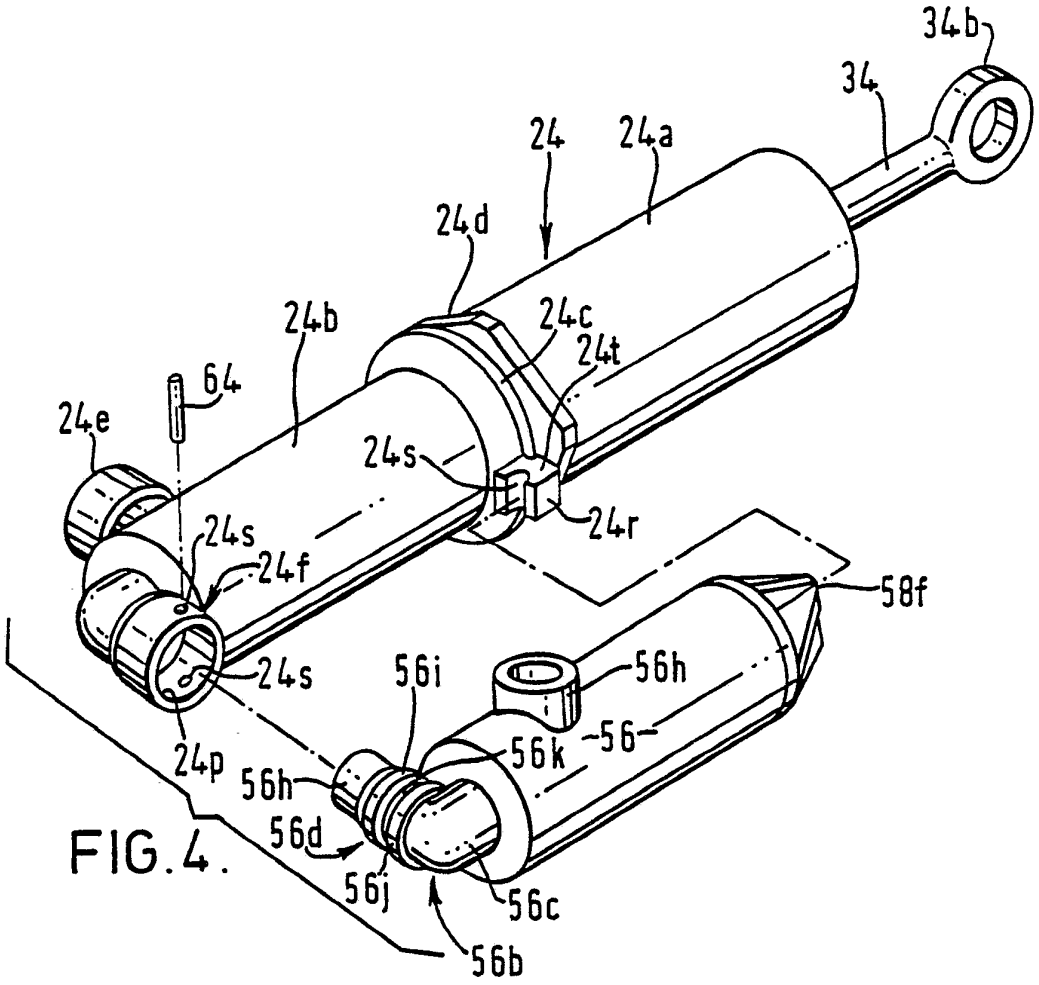
56h
30

FIG. 3.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24b
24c
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56
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24p
56h
56d
56j
56c
56b

FIG. 4.

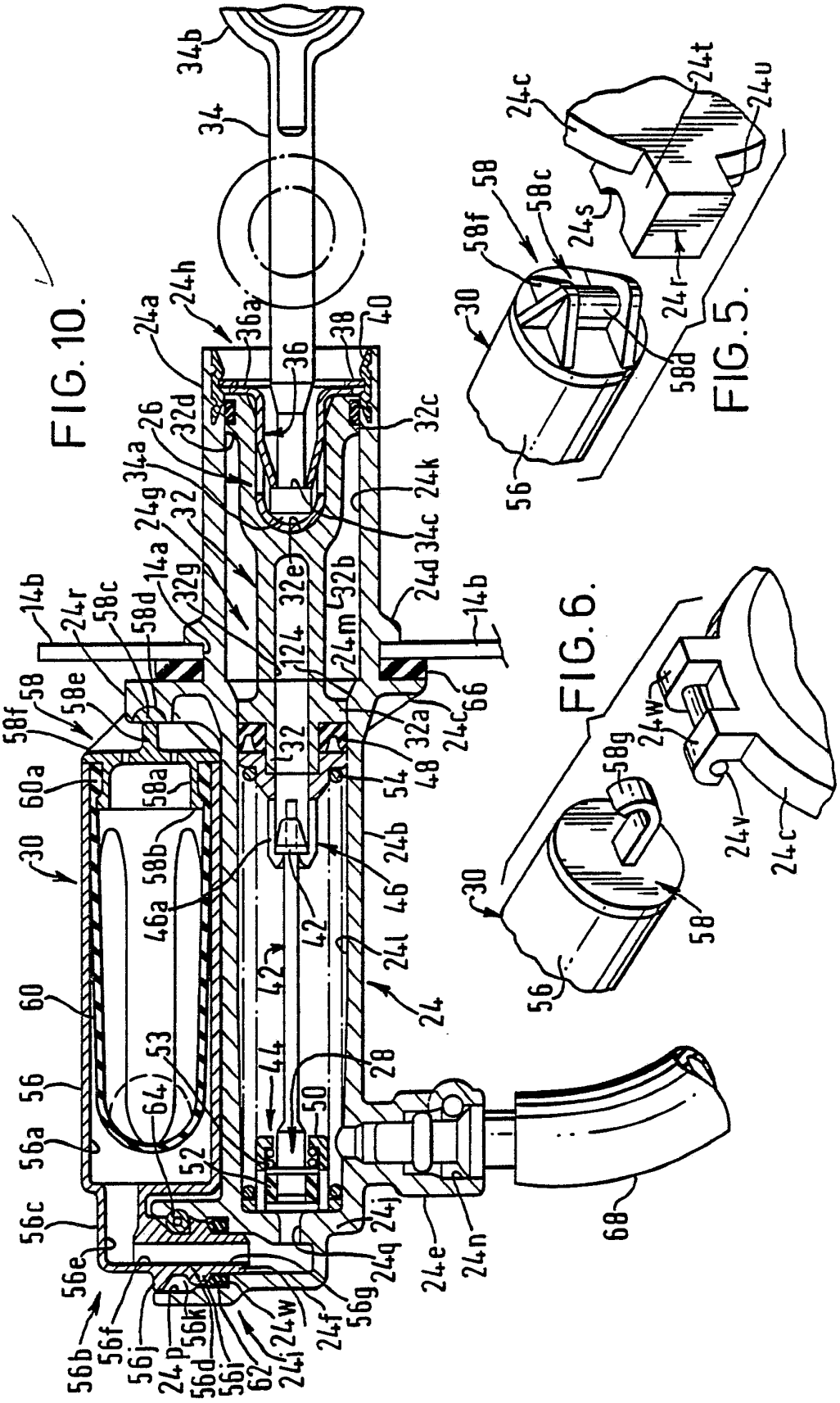


FIG. 10.

FIG. 5.

FIG. 6.

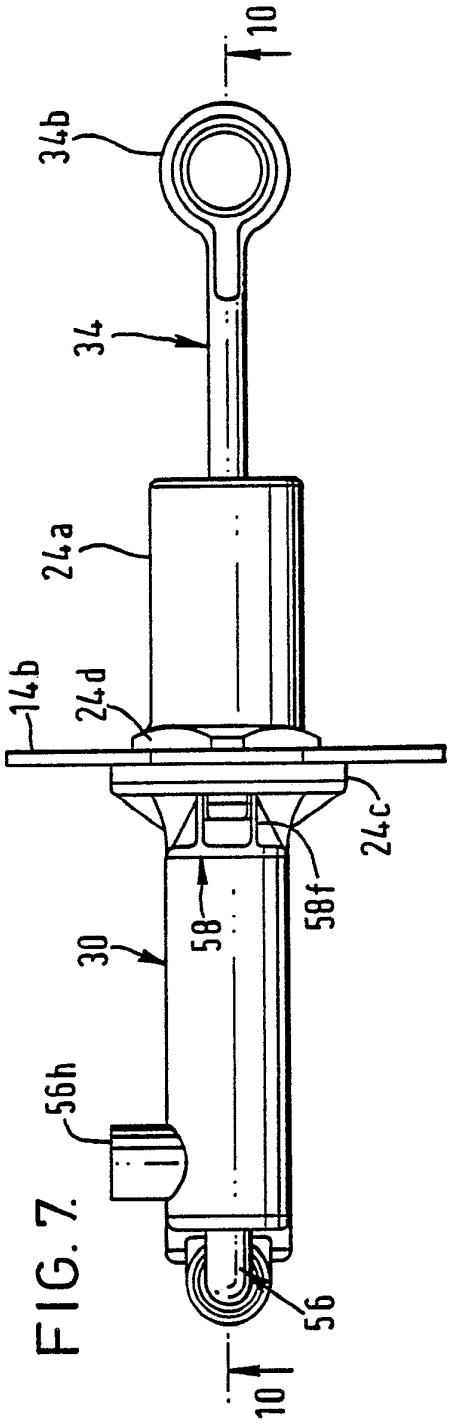


FIG. 7.

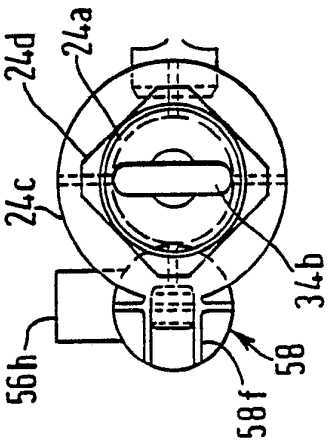


FIG. 9.

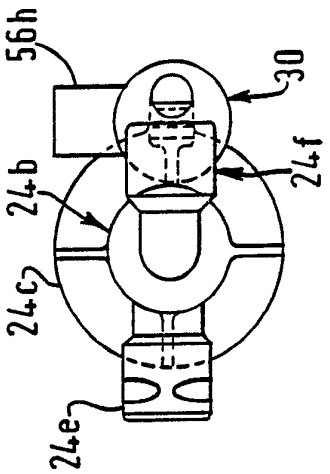


FIG. 8.

FIG.11.

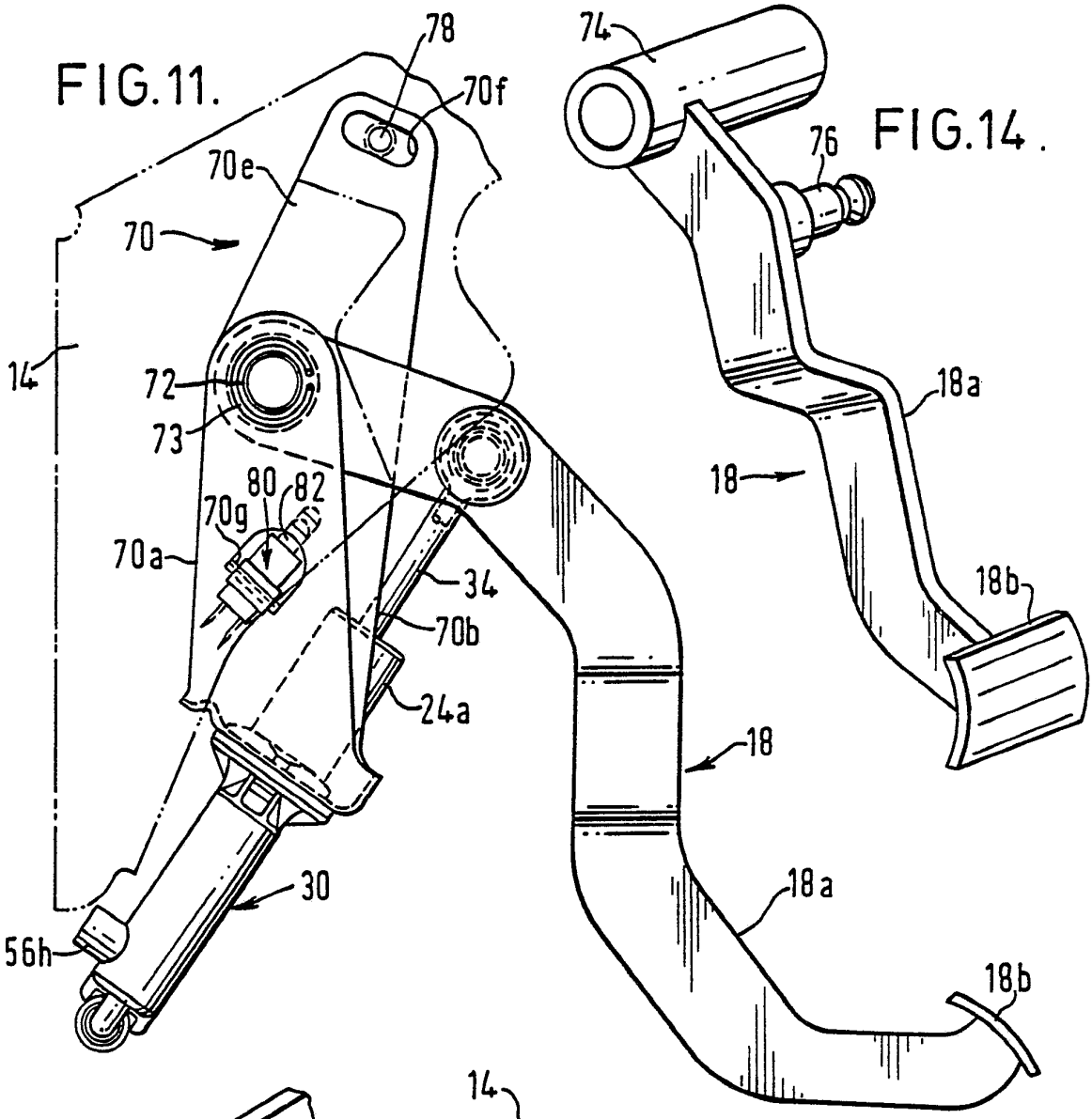


FIG.14.

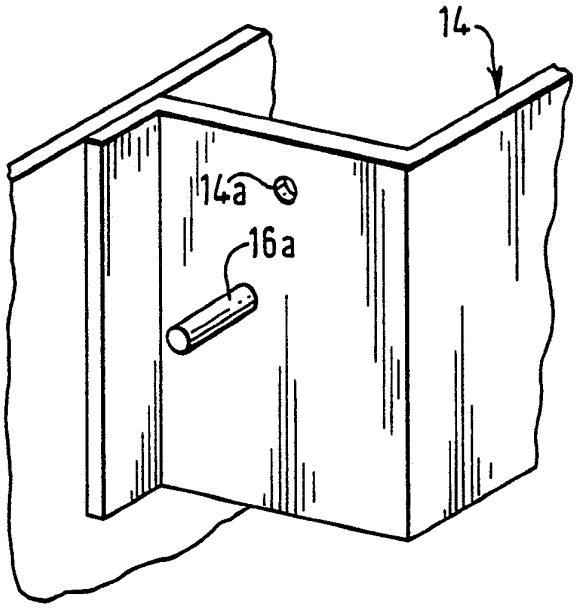


FIG. 13.

FIG.12.

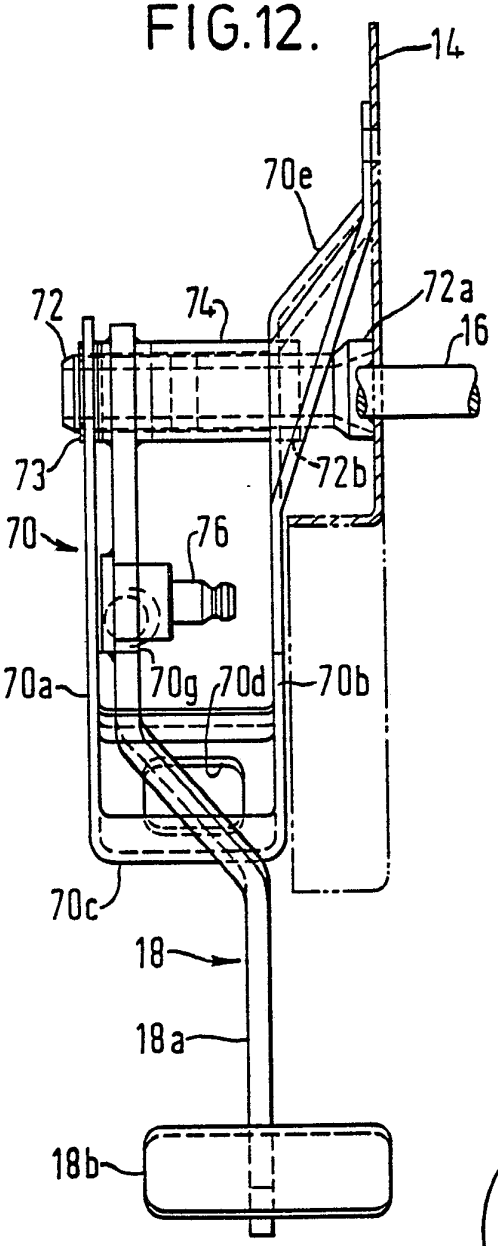


FIG.15.

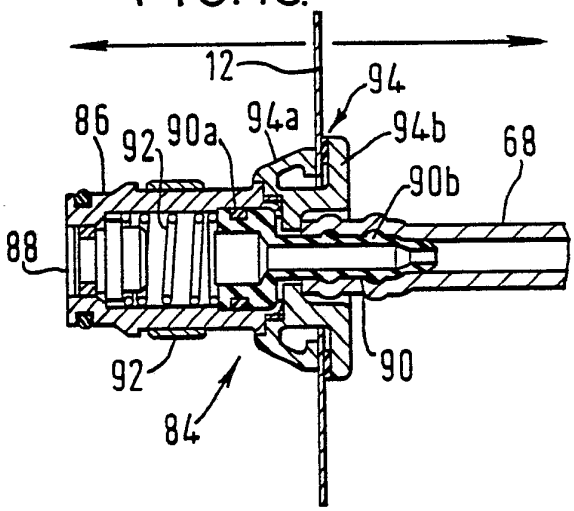
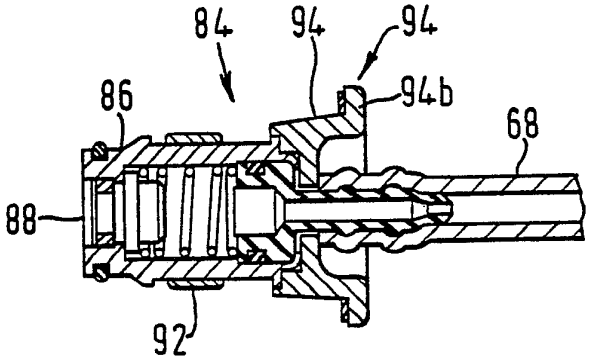


FIG.16.



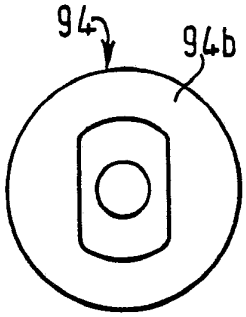


FIG.17.

FIG.18.

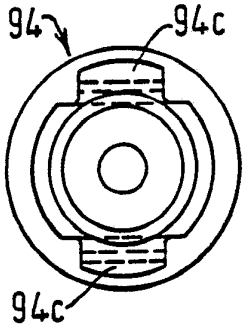


FIG. 19.

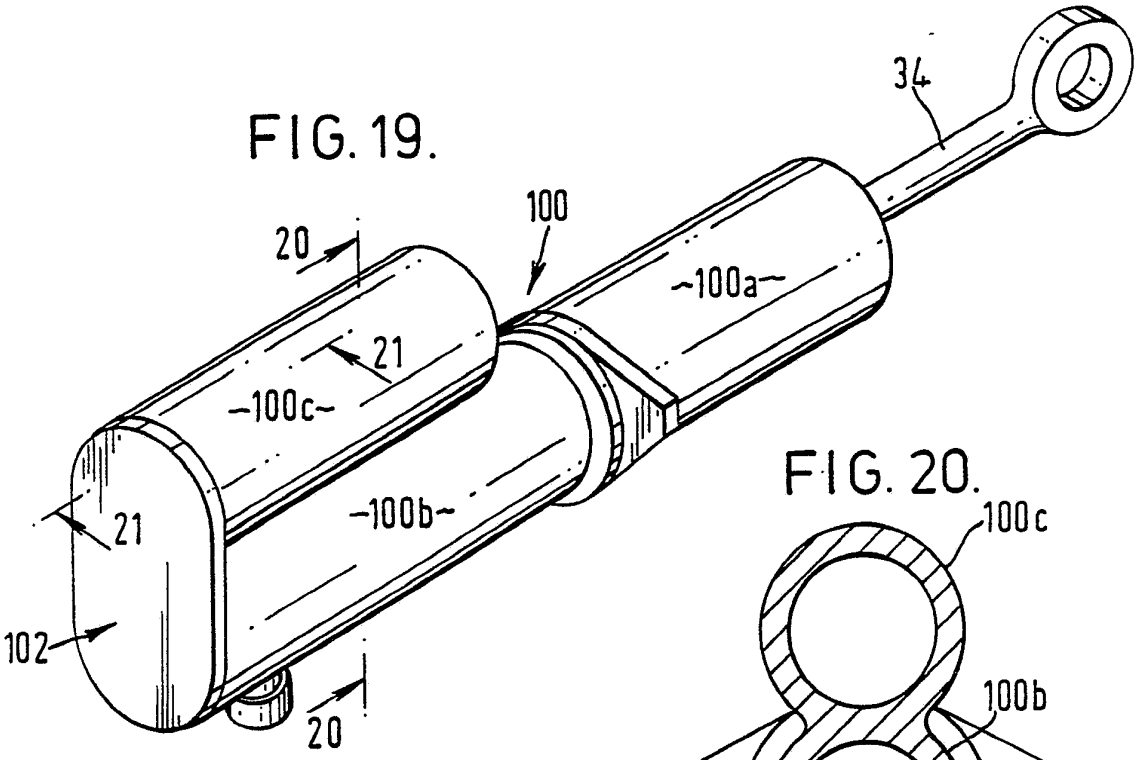


FIG. 20.

FIG. 21.

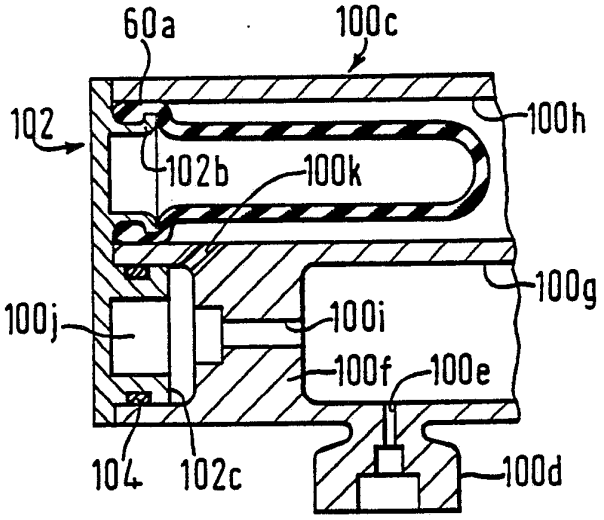
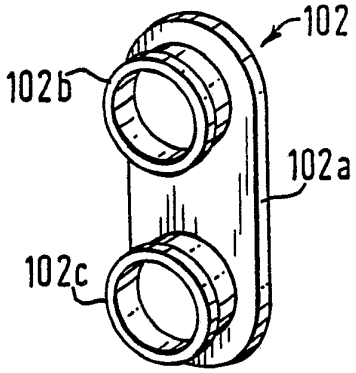


FIG. 22.



INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 89/00189

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC[4]: B 60 T 11/22; F 16 D 25/14

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC[4]	B 60 T 11/00; F 16 D 25/00

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
A	DE, B, 1246439 (AUTOMOTIVE) 3 August 1967, see the whole document	1
A	GB, A, 1065599 (AUTOMOTIVE) 19 April 1967	
A	FR, A, 1418958 (CITROËN) 1965	
A	US, A, 4407125 (PARSONS) 4 October 1983 cited in the application	
A	US, A, 4503678 (WIMBUSH) 12 March 1985 cited in the application	
A	US, A, 4506507 (WIMBUSH) 26 March 1985 cited in the application	

* Special categories of cited documents: [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
15th June 1989	12.07.89
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	P.C.G. VAN DER PUTTEN

Form PCT/ISA/210 (second sheet) (January 1985)

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. GB 8900189 SA 27598

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 23/06/89
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE-B- 1246439		GB-A- 938185	
GB-A- 1065599		None	
FR-A- 1418958		None	
US-A- 4407125	04-10-83	GB-A- 1539879	07-02-79
		DE-A,C 2615986	28-10-76
		FR-A,B 2307997	12-11-76
		JP-A- 51126478	04-11-76
		US-A- 4599860	15-07-86
US-A- 4503678	12-03-85	AU-B- 546109	15-08-85
		AU-A- 7907681	29-07-82
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		JP-A- 57140901	31-08-82
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