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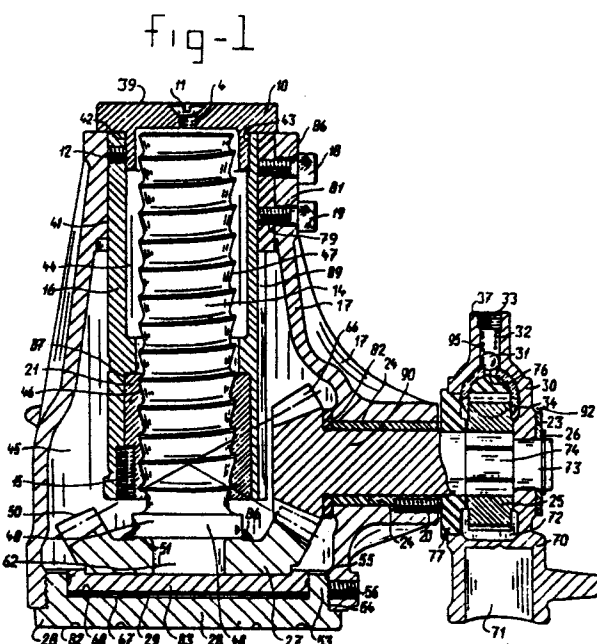
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(64) Sliding pad lifting jack.

(57) The invention aims at obtaining a mechanical lifting jack of minimum height and in which friction on rotation of the rotating parts is low even under high load. The lifting jack comprises a rigid body - (17) defining a cylindrical ram passage (41) and a planar base (28). A cylindrical plate (83) rests above the interior surface of base (28) and supports a beveled gear (27). A threaded screw bar (14) is attached to beveled gear (27) and extends upwardly therefrom. A threaded sleeve (21) is received by screw base (14) and supports a ram (16). The latter is movable within ram passage (41) and terminates in a load bearing head (10). A pinion gear (90) is supported in engagement with beveled gear (27) and is coupled to a conventional ratchet drive (92). A sliding pad (29) formed of a layer of a fluorine resin material having a low frictional coefficient and self-lubricating property, is interposed between plate - (83) and base (28) to act as a bearing for beveled gear (27).



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Sliding Pad Lifting Jack

Background of the Invention:

(1) Field of the Invention:

This invention relates generally to screw type lifting jacks and particularly to those used in tightly defined situations under heavy loads such as supporting wall structures in buildings or raising heavy loads in construction environments such as bridges, shipbuilding, and other similar works. The typical construction of lifting jack to which the present invention relates comprises a rigid housing defining a base and an interior cavity in which a threaded screw bar is supported in a vertical orientation. In most devices a generally planar beveled gear is positioned within the cavity and upon the interior of the base and is attached to the screw bar. A pinion gear driven from a source of torque either motor or otherwise engages the beveled gear and provides rotation of the screw bar. A threaded sleeve threaded to cooperate with and be borne upon the threads of the screw bar is attached to and supports a generally cylindrical ram. The latter terminates on its upper end in a pedestal or head suitable for supporting a heavy load. In typical operation such as described above, the lifting jack is placed beneath the to-be-lifted object and the pinion shaft is rotated which in turn drives the beveled gear and rotates the screw bar. The cooperation of the threads of the screw bar and the threaded sleeve cause the latter to be driven upward upon the screw bar which in turn lifts the ram and head into contact with the load. Continued rotation of the pinion shaft continues the upward movement of the jack's head and lifts the load.

While the construction of such lifting jacks in the prior art varies greatly, all tend to have the above-described common features. In particular relevance to the present invention is the manner in which the beveled gear, which in most lifting jacks constructions must carry the full load imposed upon the jack, is supported. In the various constructions provided in the art a problem arises due to the load imposed upon the beveled gear or its support. In general, a bearing either roller or ball construction is situated between the interior surface of the base and the under surface of the beveled gear. The object is to permit the beveled gear to remain rotatable notwithstanding the substantial loads imposed upon it by the lifting action of the jack. As has been found, such bearings when subjected to substantial stresses have thus far not proven to be a completely satisfactory method of maintaining a low friction interaction between the

beveled gear and the interior surface of the lifting jack base. In addition, lifting jacks of the type to which the present invention is directed are frequently used in outdoor environments and subjected therefore to extremes temperature, weather, precipitation and in many instances corrosive environments. The foregoing tends to be a difficult environment in which to maintain the proper functioning of roller or ball bearings or their equivalents.

(2) Prior Art:

The foregoing problems in construction of lifting jacks have been addressed in various structures provided in the prior art. In U.S. Patent 808,041 there is set forth a lifting jack of the type generally described above in which a cylindrical ram is carried upon a threaded screw bar which in turn is driven by a beveled gear and pinion drive gear arrangement. In the described structure of the '041 Patent, the beveled gear is affixed to the screw bar in a manner whereby it does not contact the interior surface of the lifting jack base. In the construction shown, an extension of the screw bar passes beyond the undersurface of the beveled gear and is received in a small cavity within the lifting jack base. The object of the '041 structure is to provide a bearing surface between the extension of the screw bar and the cavity in the jack base to avoid imposing a load upon the beveled gear.

U.S. Patent 306,340 sets forth a structure for a lifting jack similar in design to the above-described '041 Patent in that it uses a similar arrangement of raising the beveled gear beyond the point of contact between the load transmitting screw bar and the load supporting surface of the jack base. In the '40 Patent, a portion of the load is supported by an additional sleeve member which encloses the screw bar and carries a portion of the imposed force to the base of the lifting jack.

U.S. Patent 944,617 sets forth another variant of the lifting jack described in the '041 Patent. In pertinent part, the beveled gear is supported upon the screw bar in a manner similar to that shown in the '041 Patent in that the beveled gear does not contact the interior of the base and does not bear any portion of the load. Instead, the screw bar extends beyond the beveled gear and is received in a cavity within the base.

U.S. Patent 975,548 sets forth a lifting jack in which the beveled gear is supported upon the screw bar and in which a flat bearing is formed in the base structure which cooperates with a bearing surface on the underside of the beveled gear to support the load.

U.S. Patent 1,106,835 sets forth a lifting jack in which the beveled gear defines a downwardly extending cylindrical member which terminates in a convex bearing surface. The lifting jack base defines a cavity configured to receive the extension of the beveled gear. A bearing of generally cylindrical shape and having an upwardly facing convex surface is supported at the bottom of the cavity in the base. The load imposed upon the jack is borne by the convex surfaces of the bearing and the beveled gear extension. The intent in the '835 Patent is to provide a small area of contact for the bearing surface and thereby reduce the friction.

U.S. Patent 1,377,640 and U.S. Patent 1,395,341 both set forth similar structures in relation to the present invention in that an annular bearing plate is interposed between the beveled gear and the base of the jack to support the imposed load.

The "OJ" journal jack, model JJ-2513 marketed by Osaka Jack Limited of Japan sets forth a structure in which a roller or ball bearing is interposed between the beveled gear and the base surface. The load imposed upon the jack is transmitted to the base through the roller or ball bearing. As described above the intent of the structure in the model JJ-2513 device is to provide a low-friction coupling between the beveled gear and the base thereby permitting the beveled gear to be rotated notwithstanding the imposition of heavy loads.

While the foregoing described devices which are representative of the prior art provide through their various structures some measure of reduction of the friction and wear caused by load bearing within the lifting jack structure, all represent a compromise between the extent of load which may be borne and the need for minimizing the concomitant frictional force between the rotating members and the base. In addition, the foregoing described structures contribute to an increase in the overall height of the lifting jack device. The latter is additionally troublesome in environments where the lifting jack must be used in confined spaces. In many uses, the utility of the lifting jack is enhanced if its overall height is maintained as low as possible for a given lifting height capability.

There remains therefore a need in the art for a lifting jack capable of bearing substantial loads while maintaining undue frictional losses and wear and tear within the device. There remains a further

need to provide such a structure which is suitable for use in environments where the lifting jack is subjected to weathering or corrosive environments.

(e) Summary of the Invention:

It is a general object of the present invention to provide an improved lifting jack operable from a rotatable source of energy in which the overall jack height is minimized and in which the friction resulting from rotation of the rotatable members within the jack employed to accomplish lifting is minimized. It is a further object of the present invention to provide such an improved lifting jack which is suitable for use in outdoor or corrosive element environments.

In accordance with the present invention, there is provided a lifting jack having a substantially rigid housing defining an interior cavity and having a generally planar base member supported in the bottom thereof. A vertical channel within the housing supports a ram of generally cylindrical construction in a slidable engagement overlying the base member. The ram terminates at its upper end in a head and a receptacle on the lower end. A threaded sleeve is received within the lower end of the ram and defines an interior thread. A screw bar defining an external thread suitable for cooperating with the interior thread of the threaded sleeve is attached to the beveled gear and passes through the threaded sleeve. A pinion gear is coupled to a source of rotary power and is positioned to transmit such rotary power to the beveled gear. A sliding pad formed of a low friction self-lubricating material such as a fluorine resin or material such as the teflon product of DuPont Company having a generally planar structure is positioned between the beveled gear and the interior surface of the base. In the structure provided, the load imposed upon the jack is received by the sliding pad. The sliding pad having a very low coefficient of friction provides an efficient bearing surface for the coupling between the beveled gear and the base.

(f) Brief Description of the Drawings:

Figure 1 is a sectional elevation view of a lifting jack constructed in accordance with the present invention; and

Figure 2 is a partially sectioned elevation view showing details of the ratchet structure of the present invention lifting jack.

(g) Description of the Invention:

Figure 1 shows a section view of a lifting jack constructed in accordance with the present invention. A body (17) formed of a rigid material such as cast iron or steel defines a base cavity (45) and a cylindrical ram passage (41) and a pinion passage (66). The latter is generally perpendicular to ram passage (41) for reasons set forth below in greater detail. Body (17) further defines a circular threaded passage (55) which is generally concentric with ram passage (41). A generally cylindrical base (28) defines a base surface (82) and an upwardly extending wall (53). Wall (53) defines an external thread (54) which cooperates with thread (55) of body (17) to secure and attach base (28) to the lower end of body (17). Base (28) provides the resting surface for the lifting jack and defines a bearing surface (67) on its interior. Bearing surface (67) is generally flat and recessed in correspondence with wall (53). A plate (83) having a substantially annular construction is received within the interior of base (28) and overlies bearing surface (67). Plate (83) defines a planar bearing surface (68). A sliding pad (29) formed of a fluorine resin material such as DuPont Teflon or similar self-lubricating low friction material is interposed between bearing surfaces (67 and 68) in accordance with an important aspect of the present invention.

A beveled gear (27) having a structure generally in accordance with the prior art defines a plurality of angularly positioned teeth (50) and a center aperture (85). Beveled gear (27) rests upon and is attached to plate (83). A generally cylindrical elongated screw bar (14) defines an external thread (47) for the upward portion of its length and terminates at its lower end in a rim (48) having a generally cylindrical construction and extending beyond the perimeter of threads (47). Screw bar (14) further defines an extension (52) having a generally cylindrical shape which passes through aperture (85) in beveled gear (27). Rim (48) further defines a surface (51) which rests upon beveled gear (27). A bond (86) which may for example comprise a weld bead encircles the junction of rim (48) and beveled gear (27) to insure a complete attachment therebetween. As a result, rotation of beveled gear (27) causes a corresponding angular rotation of screw bar (14). A generally cylindrical ram (16) having a substantially hollow construction and formed of a rigid material such as steel, is received within ram passage (41) and defines a thread (43) over a portion of its upper inner surface. Ram (16) further defines a shoulder (89). A threaded sleeve (21) having an exterior surface substantially conforming to the interior surface of ram (16) and an internal thread (46) which corresponds to thread (47) of screw bar (14) is received within a cavity (87) of

ram (16). A set screw (15) is received between ram (16) at cavity (87) and threaded sleeve (21) to secure the attachment of female nut (21) to ram (16). A head (10) having a generally cylindrical construction defines a center aperture (4) and a downwardly extending threaded portion (42). The latter cooperates with thread (43) of ram (16) to secure head (10) to ram (16). A set screw (12) is received within ram (16) and abuts threaded portion (42) of head (10) to secure the attachment between head (10) and ram (16). A flathead screw (11) is received within aperture (4). Head (10) further defines a load surface (39).

Ram (16) further defines a channel (89) extending vertically over its entire length. Body (17) further defines a pair of apertures (85 and 86) in its upper wall which receive a pair of bolts (19 and 18, respectively). A key (13) having a configuration permitting it to be slidably received within channel (89) is secured to body (17) by the engagement of bolts (18 and 19) into threaded apertures (78 and 79, respectively). As ram (16) is moved vertically with respect to body (17) channel (89) moves with respect to key (13). The cooperation of key (13) and channel (89) inhibits rotation of ram (16) which would otherwise take place due to the friction between thread (46) and (47) of threaded sleeve (21) and screw bar (14) respectively.

Body (17) further defines a pinion extension (56) extending outwardly and generally perpendicular to ram passage (41) which defines a cylindrical pinion passage (66). A cylindrical pinion bushing (24) is received within pinion passage (66). A set screw (20) is engaged between pinion bushing (24) and pinion passage (66) to secure the former to the latter. A pinion gear (90) having a construction generally corresponding to the typical pinion gear in the art defines a plurality of angled teeth (66) which are configured in correspondence to teeth (50) of beveled gear (27). Pinion gear (90) further defines a pinion shaft (73) which extends outwardly through pinion passage (66) and is supported by pinion bushing (24). An annular thrust washer (82) is positioned between pinion gear (90) and pinion bushing (24) to position and support and position pinion gear (90) with respect to the axial thrust forces imposed by rotation of the gears under load. Pinion shaft (73) further defines a multi faceted portion having a generally hexagonal construction and a cylindrical terminating portion.

A ratchet wheel (25) having a construction shown more clearly in Figure 2 defines a center ratchet receptacle (75) configured to engage and be supported by the multi faceted portion of pinion shaft (73). Ratchet wheel (25) includes a plurality of external teeth (91). A ratchet case (30) having a generally cylindrical construction surrounds ratchet wheel (25) and receives the extension of pinion

shaft (73). A washer (23) is received upon pinion shaft (73) and a snap ring (26) engages the end portion of pinion shaft (73) to secure ratchet case (30) with respect to body (17) and pinion shaft (73). In accordance with well-known construction for rotatable ratchet drives of the type used for example in Model JJ-2513 described above, ratchet (92) provides a bi-directional ratcheting function in which rotation of ratchet case (30) may selectively be coupled in a ratcheting fashion to pinion shaft (73) in either direction. The structure of ratchet (92) is known in the prior art and is clearly shown in the above-described Model JJ-2513 and therefore need not be described in great detail in connection with this invention. Suffice it to say however, that ratchet case (30) defines a lateral passage which receives a ratchet liner (34), a ratchet plunger (35), is received with liner (34) and defines a plurality of teeth (93) which are configured to cooperate with and engage teeth (91) of ratchet wheel (25) when ratchet plunger (35) is moved to engagement with ratchet wheel (25). Liner (34) further defines a detent aperture (76). A housing (37) formed in ratchet case (30) defines an aperture (95) generally perpendicular to liner (34). A steel ball (31) is supported within aperture (95). A spring (32) is within aperture (95). A set screw (33) captivates spring (32) in a compressive state against steel ball (31). The resulting structure forms a spring loaded detent mechanism which cooperates to maintain liner (34) and thereby ratchet plunger (35) in a fixed position.

Ratchet case (30) also defines a bar socket (70) extending downwardly from pinion shaft (73) and defining a cylindrical cavity (71). In accordance with commonly employed use of lifting jacks, cavity (71) receives a lever bar which permits the application of a substantial torque force to bar socket (70) and ratchet (92). Depending upon the position of liner (34), ratchet plunger (35) or its counterpart (not shown) will be in engagement with teeth (91) of ratchet wheel (25): The applied force to bar socket (70) will be coupled by the ratchet plunger engaging the ratchet wheel to turn pinion shaft (73). Ratcheting action is provided by the cooperation of ratchet plunger (35) and spring (36). A plate (77) is received within ratchet case (30) to complete the enclosure of the ratchet structure.

In operation, the application of a lever force to bar socket (70) causes a corresponding torque to be applied to ratchet case (30). As mentioned above and depending upon which ratchet plunger is moved into engagement with ratchet wheel (25), a corresponding torque is applied to ratchet wheel (25) and in turn to pinion shaft (73). The torque imposed on pinion shaft (73) is coupled by teeth (88) and teeth (50) to bevel gear (27). The torque applied to beveled gear (27) due to the attachment

of bevel gear (27) to screw bar (14) causes rotation of screw bar (14). Due to the cooperation of threads (46 and 47) in threaded sleeve (21) and screw bar (14) respectively, threaded sleeve (21) is driven upwardly carrying ram (16) with it. The upward travel of ram (16) due to rotation of screw bar (14) causes surface (39) of head (10) to contact the load and drive it upward.

The resulting load force imposed by the foregoing described action is borne by beveled gear (27) and is in turn transmitted to plate (83). The load imposed upon plate (83) is in turn transmitted to sliding pad (29) and base (28). Because base (28) is supported in the normal operation by some fixed support, the resulting effect of the foregoing described operation places a compressive force upon sliding pad (29). In accordance with an important aspect of the present invention, sliding pad (29) receives the compressive force and due to its low coefficient of friction distributes such force while still permitting beveled gear (27) and plate (83) to rotate with respect to base (28).

As will be apparent to those skilled in the art, the resulting structure in operation provides for imposition of substantial loads upon head (10) while maintaining a relatively low friction coupling between sliding pad (29) and base (28) and plate (83) and bevel gear (27). It will also be apparent to those skilled in the art that sliding pad (29) is substantially thinner than the prior art bearing structures and as a result reduces the overall height of the lifting jack. In further advantage the use of sliding pad (29) is not substantially affected by the presence of moisture or corrosive materials due to its inherent low friction non-metallic composition. In further advantage, no lubricant is necessary to maintain the low friction bearing surface provided by sliding pad (29).

While the foregoing has illustrated and described what is now contemplated to be the best mode of carrying out the invention, the description is, of course, subject to modifications without departing from the spirit and scope of the invention. Therefore, it is not desired to restrict the invention to the particular constructions illustrated and described, but to cover all modifications that may fall within the scope of the appended claims.

Claims

1. A lifting jack operable from a source of rotary energy comprising:

a rigid body (17) defining an interior cavity (45), a lower base surface (28) and a ram passage (41);

a beveled gear (27) having a generally annular

construction and a first circular array of teeth (50);

a pinion gear (90) having a second array of teeth (66) engageable with said first array of teeth (50) and a pinion shaft (73) coupling said second array of teeth (66) to said source of rotary energy (92);

means (24, 82) supporting said pinion gear (90) in a position of engagement with said beveled gear - (27);

a cylindrical screw bar (14) defining an exterior thread (47) perpendicular to said beveled gear (27) and attached thereto;

a threaded sleeve (21), having an interior thread - (46) cooperating with said exterior thread (47), engaged with and enclosing a portion of said screw bar (14);

a ram (16) slidably supported within said ram passage (41) and coupled to said threaded sleeve - (21); and

a planar bearing (29) formed of a low friction self-lubricating fluorine resin material interposed between said beveled gear (27) and lower base surface (28).

2. A lifting jack as set forth in claim 1 further including a ratcheted drive coupling (92) for coupling said pinion shaft (73) to said source of rotary energy.

3. A lifting jack as set forth in claim 2 wherein said lower base surface (28) comprises a substantially planar surface and wherein said lifting jack further includes a planar plate member (83) attached to said beveled gear (27) supported by said planar bearing (29).

4. In a lifting jack having a rigid housing (17) supporting a beveled gear and pinion gear combination (27, 90) coupled to a threaded screw bar - (14) which in turn threadably engages a ram (16) such that rotation of the beveled gear (27) results in raising or lowers the ram (16), the improvement comprising:

15 a planar bearing (29), formed of a low friction self-lubricating material, interposed between the beveled gear (27) and the housing (17) such that said planar bearing receives substantially the entire force of any load which is imposed upon the lifting jack.

5. A lifting jack as set forth in claim 4 wherein said planar bearing (29) is formed of a fluorine resin material.

6. A lifting jack as set forth in claim 4 wherein said planar bearing (29) is formed of multiple layers of fluorine resin material.

7. A lifting jack as set forth in claim 4 wherein said sliding pad (29) is formed of the material sold by DuPont Corporation under the name Valflon or its equivalent.

8. A lifting jack as set forth in claim 4 wherein said sliding pad (29) is formed of the material sold by DuPont Corporation under the name Teflon or its equivalent.

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fig-1

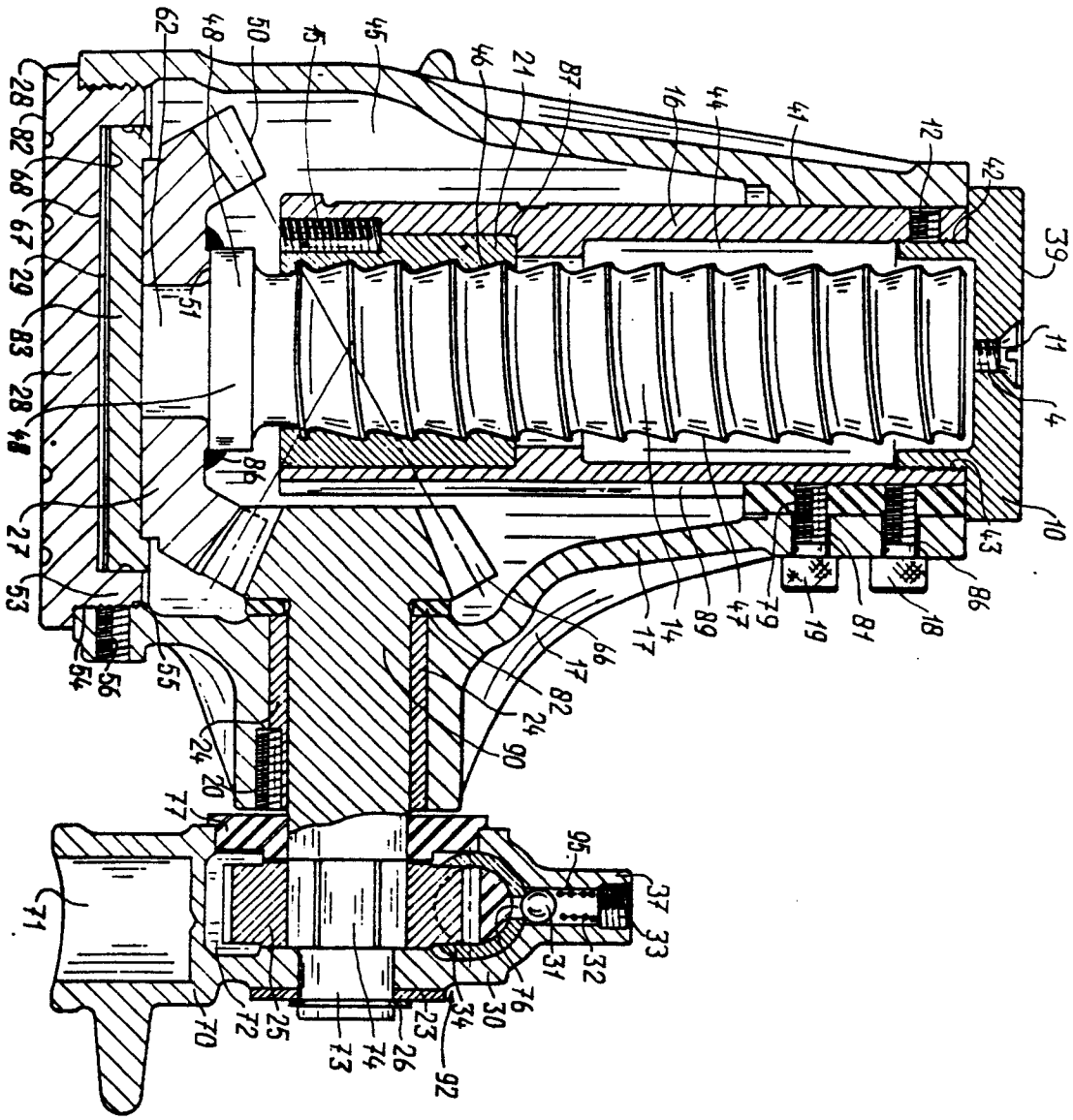
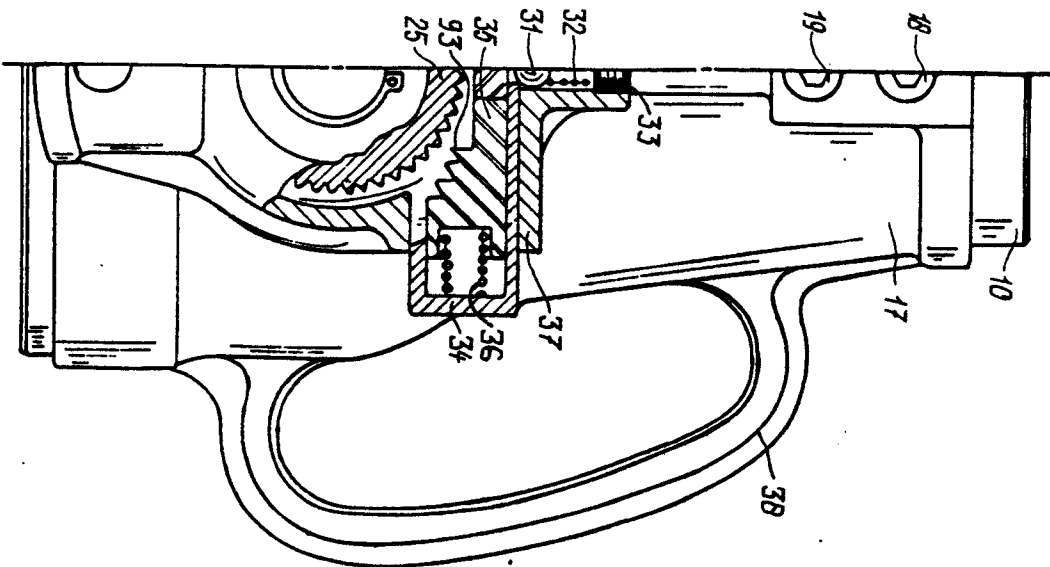


fig-2





DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
Y	US-A-4 000 880 (GRAAFSMA) * figure 1; column 3, lines 23-31 *	1,4	B 66 F 3/16 B 66 F 3/08
Y	DE-U-1 957 857 (DAIMLER-BENZ AG) * claims 1, 2; figure *	1,4	
A		3	
Y	US-A-3 412 980 (PIKOSKE) * column 1, lines 52-60; figure 3 *	1,4	
A		5,8	
A	GB-A- 856 612 (PYNFORD LTD.) * claim 1; figure 2; page 2, lines 93-96 *	1,4	
A	US-A-1 698 053 (GORMLEY) * figures 1, 8 *	1,2	
A	US-A-3 606 252 (J. DOROUGH) * figure 2; column 2, lines 49-54 *	1	
D,A	US-A-1 395 341 (GORMLEY) * figures 1-3 *	1,4	
The present search report has been drawn up for all claims			
Place of search BERLIN		Date of completion of the search 14-05-1986	Examiner KANAL P K
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	