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F2S BQ



(54) SHOCK ABSORBERS

(71) We, HONDA GIKEN KOGYO KABUSHIKI KAISHA, of 6-27-8, Jingumae, Shibuya-ku, Tokyo, Japan, a Corporation of Japan, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed to be particularly described in and by the following statement:—

This invention relates to hydraulinc shock absorbers, for vehicles, of the telescopic type, that is of the type in which a piston is slidably fited in an oil-filled cylinder and, in use, with the shock absorber mounted between a vehicle road wheel and the vehicle body, shocks received by the wheel are absorbed by hydraulic shock absorbing action between the wheel and the vehicle body.

In the well known MacPherson strut form of suspension, telescopic shock absorbers are utilized each as a part of a suspension link with a wheel stub axle rigid with the lower part of the cylinder, and with the upper end of the piston rod pivoted to the vehicle body, the shock absorber being inclined with the upper end of the piston rod inboard of the vehicle and the lower part of the cylinder outboard with respect to one another. In this way the shock absorber receives not only load in the axial direction, i.e., in the reciprocating direction of the piston, but also side forces act on the cylinder. As a result, bending forces act on the piston rod.

In a shock absorber for use as a suspension link the piston rod is supported at its lower end by the sliding surface of the cylinder that is engaged by the piston, and at the upper end of the cylinder by a rod guide. The rod guide functions as a bearing for the rod and therefore a bearing surface of, for example, synthetic resin is provided on the inner periphery of the rod guide to enhance smooth sliding of the rod.

Generally there is a slight clearance between the inner periphery of the rod guide and the outer periphery of the rod, this clearance being necessarily formed due to the problem of precision in manufacture, and fluctuations in finished products. However, if precision in manufacture is increased and the clearance between the inner periphery of the rod guide and the outer periphery of the rod is made very small, the friction between them will increase. Thus smooth sliding of the rod, and hence the shock absorbing performance, will be impeded and hence it is desirable to provide a slight clearance between the piston rod and the rod guide of the cylinder to obtain the necessary smooth reciprocation for the shock absorbing function to be properly performed. However, the presence of a clearance between the piston rod and the rod guide produces the following problems.

The noise of the shocks applied to the internal hydraulic pressure and shocks by frictional vibrations at the time of shock absorbing operation are emitted through such a clearance. Furthermore, by the action of the side forces, the piston rod is bent into contact with the guide and as a result vibration is transmitted to the vehicle body.

According to the present invention there is provided a telescopic hydraulic shock absorber for a vehicle that is a piston and cylinder arrangement that is connected, in use, between a wheel mounting on a vehicle and the body of the vehicle; the absorber comprising;

the cylinder of the arrangement;

the piston of the arrangement, slidably disposed in the cylinder;

a hydraulic pressure chamber disposed in the cylinder between one end of the piston and a closed portion of the cylinder;

a piston rod movable with the piston and extending out of one end of the cylinder;

a rod guide disposed between the piston rod and the cylinder to guide the piston rod;

an oil seal for the piston rod disposed between the rod guide and said one end of the cylinder; and

an elastic body within the cylinder tightly supporting the outer periphery of the piston rod in the region of the rod guide, this elastic body having a greater rigidity than the oil seal so as to apply to the guide rod a commpression force to support the rod centrally in the cylinder that is greater than the compression force applied to the rod by the oil seal. By the provision of the elastic body the effect of the clearance normally present between the inner periphery of the rod guide and the outer periphery of the rod is eliminated as much as possible so that noises occurring internally in the shock absorber are intercepted and thus the operation is quitened. Furthermore contact between the rod and the inner periphery of the rod guide caused by radial vibrations of the piston rod due to hydraulic shocks, frictional vibration, and side force fluctuations is prevented as much as possible and thereby generation of noise is further minimised, as is transmission of vibrations to the vehicle body. These effects are achieved with a structure that is simple and does not require major modification of the existing form of telescopic shock absorbers.

For a better understanding of the invention, and to show how the same may be carried into effect, reference will now be made, by way of example, to the accoc-panying drawings, in which:—

Figure 1 is a sectional side view illustrating the general construction of a hydraulic shock absorber,

Figure 2 is a sectional side view on a larger scale than Figure 1 showing part of a first form of shock absorber (of the general construction illustrated in Figure 1) in greater detail,

Figures 3 to 6 are sectional views on the same scale as Figure 1 of different forms of an elastic body that can be fitted in the shock absorber of Figure 2,

Figure 7 is a sectional view of part of a modified form of the shock absorber of Figure 2,

Figures 8, 11 and 14 are similar sectional views each of part of a further form of shock absorber,

Figures 9, 12 and 15 are similar sectional plan views of an elastic body fitted in the shock absorber of Figure 8, 11 or 14 respectively, and

Figures 10, 13 and 16 are similar plan views, each of a modified form of the elastic body of Figure 9, 12 or 15 respectively.

Referring first to Figures 1 and 2, a cylinder 21 of the hydraulic shock absorber 20 is a double cylinder having inner and outer cylinder walls 22 and 23 closed at the bottom by a base member 24. The space between the cylinder walls 22 and 23 constitutes a reservoir chamber 25. A hydraulic pressure generating chamber 26 which is partitioned from the chamber 25 by the wall 22 is provided within the wall 22, the chambers 25 and 26 being in communication with each other through a passage or check valve (not illustrated) provided in the base member 24.

A piston 27 is slidably fitted within the cylinder wall 22 and is provided with an orifice and check valve (not illustrated) in conventional fashion. A piston rod 28 extending axially upwardly (in Figure 1) from the centre of the piston 27, projects out of the double cylinder 21.

A bracket 29 for securing the cylinder 21 rigidly with the stub axle of a vehicle is provided on a part of the outer periphery of the lower part of the double cylinder 21. A spring receiver 30 for supporting one end of a return spring, for example a coil spring, the other end of which will be engaged with the vehicle body, is provided intermediate the ends of the outer periphery of the double cylinder 21.

A piston rod guide 40, which also serves as a spacer for relatively positioning the upper ends of the cylinder walls 22 and 23, is fitted to the upper end of the double cylinder 21. This guide 40 is of stepped formation having a large diameter part 41 and a small diameter part 42. The part 41 is fitted into the inner periphery of the upper end part 31 of the outer cylinder wall 23 and the part 42 is fitted into the inner periphery of the upper end part 32 of the inner cylinder wall 22 to hold the cylinder walls 22 and 23 concentrically in predetermined positions with a predetermined clearance between them.

A through guide bore 43 (Figure 2) for the rod 28 is formed in the centre of the guide 40, this bore having a diameter larger than the outside diameter of the rod 28. A bush 44, which serves as a bearing member and may be made of a synthetic resin, is fast in the hole 43. A clearance is provided between the bush 44 and the rod 28. The bush 44 is made preferably, for example, of "Teflon TFE" (a trademark of Dupont, U.S.A.) which has a low coefficient of friction and is high in heat-proofness, wear-resistance and mechanical strength.

A dish-shaped recess 45 (Figure 2) is provided in the upper surface of the guide 40 to retain oil leaking through and between the bush 44 and the rod 28. An oil passage 46 is provided in the large diameter part 41, in communication with the recess

45, to return the retained oil to the reservoir chamber 25.

A ring-shaped oil seal 50 (shown only schematically in Figure 1) is provided in the upper end part of the cylinder wall 23 above the guide 40 to seal the outer periphery of the rod 28 and to prevent oil from leaking out of the double cylinder 21. The seal 50 is held by a ring-shaped seal holder 51 provided in the upper end part of the cylinder wall 23, a recessed step part 52 (Figure 2) provided internally in the holder 51 locking the seal 50 in place.

The guide 40 and the seal 50 with its holder 51 are axially separated from each other with a ring-shaped elastic body 60 interposed between them.

The elastic body 60 is formed of elastic material such as a rubber or a synthetic resin such as "Nylon" (a trademark of Dupont, U.S.A.) so as to have an elasticity and rigidity greater than that of the seal 50. The inside diameter 61 of the body 60 is smaller by a predetermined amount than the outside diameter of the rod 28 so that there is some interference with the rod 28 and accordingly the elastic body applies to the rod 28 a compression force greater than that applied by the oil seal.

The outer periphery of the body 6 is held by a retainer 64, made for example of metal and is secured, by for example baking, to the inner periphery of the retainer 64. Around the inner periphery of the body 60 there are upper and lower lips 62 and 63. The surface of each of these lips that is remote from the other lip is convex whilst the surfaces that are adjacent one another are concave. The lips 62 and 63 contact the outer periphery of the rod 28 so as to embrace it tightly and elastically whereby the entire outer periphery of the rod 28 is held tightly with a clearance between the inner periphery of the bush 24 and the outer periphery of the rod 28.

As shown in Figures 3 to 6, various other shapes can be adopted for the cross-section of the elastic body.

The elastic body 70 shown in Figure 3 has a structure in which lips 11 and 72 are again provided around the inner periphery of the body, and in which the outer periphery is held by the retainer 64, the lips in this case being straight edged in section.

The body 73 shown in Figure 4 has a plain inner periphery 74 that is inclined with respect to the rod 28 as viewed in section, the inside diameter of the periphery 74 being smaller at the bottom as viewed in Figure 4.

The elastic body 75 shown in Figure 5 has a plain inner periphery 76 that is parallel with the outer periphery of the rod 28.

The elastic body 77 shown in Figure 6 also has a plain inner periphery which, in this form, is inclined with respect to the rod as viewed in section such that the smaller inside diameter is at the top. Furthermore a groove 79 is provided in the lower wall of this body 77 to enhance the flexibility of the inner part of the body 77.

Other configurations, not illustrated, are also possible for the elastic body.

Turning to Figure 7 there is here shown a form in which the retainer 64 is omitted and the elastic body 60 is held by the seal holder 51 instead. In this form the lower part of the seal holder 51 is extend and the elastic body 60 is fitted inside the inner periphery 54 of this extension 53. As before, the outer periphey of the rod 28 is held tightly suported by the inner periphery 61 of the body 60. The seal 50 is still provided above the body 60, an anular spacer 55 being interposed between the seal 50 and the body 60. Thus the rod 28 is tightly supported below the spacer 55 and is oil-sealed above it.

Thus, without using a retainer, the body 60 may be supported along with the oil seal by the same holder.

As in the forms already described, the body 60 is interposed between the guide 40 and the seal 50 so that the rod 28 is held centrally within the double cylinder, able to float, by the elastic tightening and supporting action of the body 60.

In all the forms so far described the clearance between the inner periphery of the bush 44 and the outer periphery of the rod 28 is closed by the body 60 (or 70, or 73, or 75, or 77) located above the bush 44. Therefore, noises of the hydraulic shocks, and shocks and vibrations caused by the sliding friction of the piston, will be transmitted out of the double cylinder 21 through the rod 28, but will be attenuated and reduced to be as low as possible because the rod 28 is tightly supported by the body 60 above the guide 40. Due to vibrations caused by hydraulic shocks, vibration caused by friction at the time of sliding of the piston, and fluctuations in the side forces, vibrations in the radial direction are generated in use in the rod 28, and the rod 28 thus tends to bend to contact the inside periphery of the bush 44. However, under such conditions, the body 60 acts to hold the rod 28 centrally, thereby to prevent contact with the bush as much as possible. The body 60 also inhibits and prevents as much as possible the vibrations generated being transmitted to the vehicle body.

It is to be noted that if the elastic body 60 becomes a little worn this has no detrimental influence on the inherent shock absorbing function of the shock absorber.

Turning to Figures 8 and 9, a bush 162 made of synthetic resin, such as "Teflon"

(Registered Trade Mark) forms the inner periphery of an elastic body 160 that performs also a sealing action, preventing leakage of the internal oil, this oil sealing action being performed together with a seal 150. The body 160 has an outer part 161 made of a nitrile rubber or the like which is fast with the inner bush 162, the securing of the bush 162 to the body 161 being effected by, for example, baking. As shown in Figure 9, axial grooves 163 are provided in the outer periphery of the outer part 161 to enhence flexing so as to facilitate tightening the body 160 and pressing it into the rod guide 140. In addition, common axial portions of the body part 161 and the bush 162 are cut away to provide a gap 164 which further facilitates flexure at the time of tightening the body 160. As compared with what has already been described, the body 160 has a smaller outside diameter, and no retainer is provided. The body 160 is supported as follows.

An annular recessed step part 147, of such a depth as to receive substantially half the axial length of the body 160, is provided in the upper part of a bore 143 in the rod guide 140, in which bore is a bush 144. The body 160 is forcibly fitted by being pressed into the step part 147, the projecting portion of the body 160 being received in a dish-shaped recess 145 corresponding to the recess 45 already described. The top of the body 160 is flush with the upper surface of the guide 140. A ring-shaped spacer 155 is provided between the body 160 and the oil seal 150 which is in holder 151. As both the bush 162 and the outer part 161 are cut off together to provide the gap 164, the part 161 and the bush 162 tighten to hold the outer periphery of the rod 28 and act as already described. Because the bush 162 is formed of a synthetic resin that has a low coefficient of friction, such as "Teflon", (Registered Trade Mark), even through the rod 28 is tightly supported, the friction-resistance is as low as possible and the rod 28 is able smoothly to slid while remaining tightly supported. In the same manner as already described emission of internal shock noises and vibration, transmission of vibrations to the vehicle body, and contact with the rod guide by vibration are minimised.

In the further form of elastic body 170, shown in Figure 10, which can replace the body 160, an outer member 171 provided with axial grooves 173 in its outer periphery has a continuous ring-shape. A part of an inner member 172 is cut off to provided a gap 174. This gap 174 in the member 172 only is sufficient to serve the same purpose as the gap 164 of Figure 9 because the outer member 173 is made of a flexible elastic material such as rubber.

In the form of Figures 11 and 12 an elastic body 260 is provided at the lower end of a rod guide 240. This body 260 consists of an inner bush 262, for example, made of "Teflon" (Registered Trade Mark), and an outer member 261 made of, for example, a nitrile rubber. The bush 262 is thinner than the member 261 and is embedded in a central recess in the member 261 to half its radial depth. As shown in Figure 12, common parts of the bush 262 and the member 261 are cut away to provide a gap 264.

The body 260 is forcibly fitted into the cylinder wall 22 below the guide 240 to be contacted at its upper end by the lower end of the guide 240, and to tightly support the outer periphery of the rod 28. Beyond the body 260 the rod 28 passes through a bush 244 in the guide 240 and extends out through an oil seal 250.

The elastic body 270 of Figure 13, which can replace the body 260, is ring-shaped with a continuous outer member 271, and an inner bush 272 which alone is cut away to provide a gap 274 as in the case of Figure 10. Once again the outer member 271 is of a flexible elastic material such as rubber.

In the forms so far described the elastic body is formed quite separately from the rod guide, and is provided above or below the rod guide. In the form of Figures 14 and 15 the elastic body forms the guide surface of the rod guide. In this form the rod guide 240 has fundamentally the same structure as the guide already described and is formed of, for example, metal. The inner peripheral parts of the upper ends of the cylinder walls 23 and 22 are contacted and supported by a large diameter part 341 and a small diameter part 342 to be positioned and fixed relative to one another. An axial through bore 343, provided in the guide 340, has a large diameter to provide a clearance between it and the outer periphery of the rod 28.

The elastic body 360 is forcibly fitted in the hole 343 so as to be fast therein. The body 360 has an inner bush 362 made of a synthetic resin of low coefficient of friction such as "Teflon" (Registered Trade Mark) and an outer member 361 made of, for example, a nitrile rubber. The bush 362 is secured by, for example, baking to the inner periphery of the member 361. The body 360 extends over substantialy the entire length of the bore 343 so that the rod 28 passes axially through the inner periphery 365 of the bush 362 and is supported by the tightening and supporting action of the body 360. The rod 28 is so suported over substantially the entire length of the guide 340 but by the bush 362 so that axial reciprocation is made smoothly. Provided above the guide 340 including the body 360 is an oil seal

350. As shown in Figure 15, the common parts of the bush 362 and the member 361 are cut away to provide a gap 364 that facilities fitting the body 360 into the bore 343 as an alternative, and as shown in Figure 16, there may be used an elastic body 370 in which an outer member 371 is of continuous ring-shape and only a part of an inner member 372 is cut away to provide a gap 374 to facilitate fitting.

Thus, the rod guide may include an elastic body and the rod may be elastically tightly suported within the rod guide itself, the overall effect being as already described.

WHAT WE CLAIM IS:—

1. A telescopic hydraulic shock absorber, for a vehicle, that is a piston and cylinder arangement that is conected, in use, between a wheel mounting on a vehicle and the body of the vehicle; the absorber comprising;

the cylinder of the arrangement;

the piston of the arrangement, slidably disposed in the cylinder;

a hydraulic pressure chamber disposed in the cylinder between one end of the piston and a closed portion of the cylinder;

a piston rod moveable with the piston and extending out of one end of the cylinder;

a rod guide disposed between the piston rod and the cylinder to guide the piston rod;

an oil seal for the piston rod disposed between the rod guide and said one end of the cylinder; and

an elastic body within the cylinder tightly supporting the outer periphery of the piston rod in the region of the rod guide, this elastic body having a greater rigidity than the oil seal so as to apply to the guide rod a compression force to support the rod centrally in the cylinder that is greater than the compression force applied to the rod by the oil seal.

2. A shock absorber as claimed in claim 1, wherein the elastic body is disposed between the rod guide and the oil seal.

3. A shock absorber as claimed in claim 2, wherein the elastic body has an inner piston rod engaging bush that is formed of rubber or a synthetic resin having a flexible elasticity and which is supported by a ring-shaped outer member of harder material.

4. A shock absorber as claimed in claim 1, wherein the elastic body has an inner piston rod engaging bush that is formed of a synthetic resin having a low coefficient of friction and an elastic outer member formed, for example, of rubber.

5. A shock absorber as claimed in claim 4, wherein the elastic body is fitted in a circular recess provided in the central part of the part of the rod guide nearest said one end of the cylinder.

6. A shock absorber as claimed in claim 4 or 5, wherein a plurality of axial grooves is provided in the outer periphery of said outer member of the elastic body to facilitate flexing of the elastic body.

7. A shock absorber as claimed in claim 1, wherein the elastic body is disposed between the rod guide and piston and has an elastic outer member made of rubber and an inner piston rod engaging bush made of a synthetic resin having a low coefficient of friction.

8. A shock absorber as claimed in claim 7, wherein the bush is embedded to half its radial depth in a recess provided in the inner periphery of the outer member of the elastic body.

9. A shock absorber as claimed in claim 1, wherein the elastic body is fitted in substantially the entire length of an axial through bore in the rod guide.

10. A shock absorber as claimed in claim 9, wherein the elastic body has an outer member of, for example, rubber that is fitted in the through bore of the rod guide and an inner piston rod engaging bush that is made of a synthetic resin having a low coefficient of friction.

11. A shock absorber as claimed in any one of claims 4 to 8 or 10, wherein common parts of the bush and the outer member of the elastic body are cut away to provide a gap to facilitate flexure of the body.

12. A shock absorber as claimed in any one of claims 4 to 8, or 10, wherein the outer member of the elastic body is of continuous ring-shape, and wherein a part of the bush is cut away to provide a gap to facilitate flexure of the body.

13. A telescopic hydraulic shock absorber, for a vehicle, substantially as hereinbefore described with reference to any of the embodiments illustrated in the accompanying drawings.

HASELTINE, LAKE & CO.
Chartered Patent Agents
28 Southampton Buildings
Chancery Lane
London WC2A 1AT
—and—
Temple Gate House
Temple Gate
Bristol BS1 6PT
—and—
9 Park Square
Leeds L81 2LH

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1581971 COMPLETE SPECIFICATION

4 SHEETS This drawing is a reproduction of the Original on a reduced scale

Sheet 1

FIG. 1

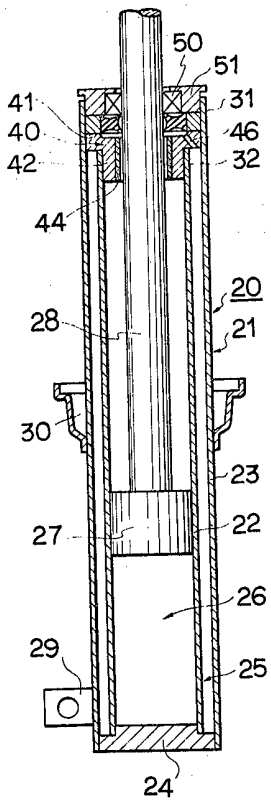


FIG. 2

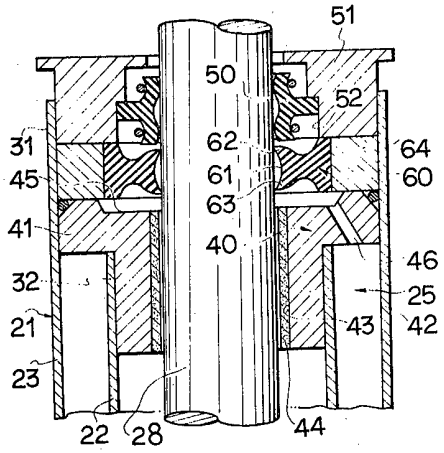


FIG. 3

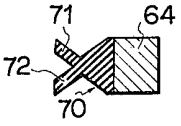


FIG. 4

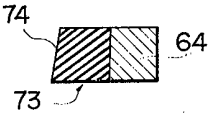


FIG. 5

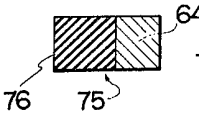


FIG. 6

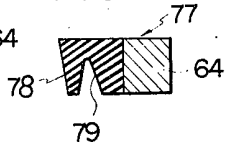


FIG. 7

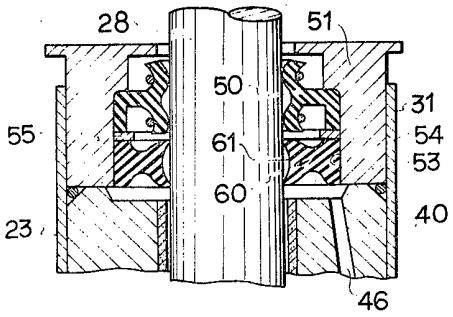


FIG. 8

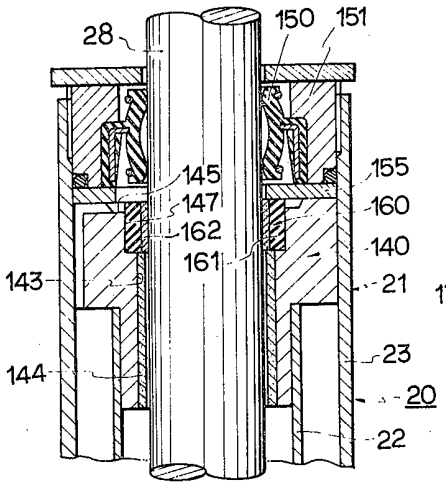


FIG. 9

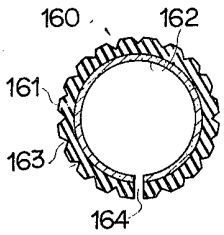


FIG. 10

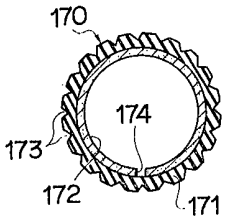


FIG.11

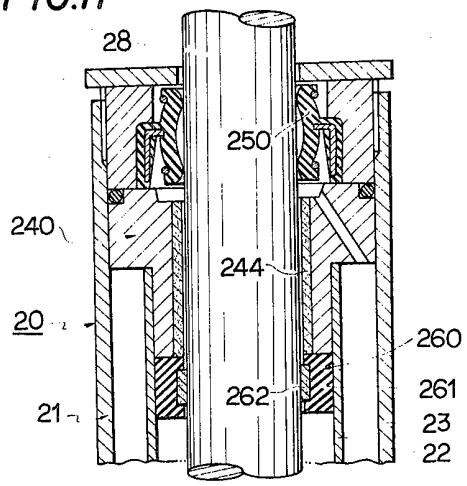


FIG.12

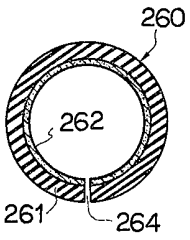


FIG.13

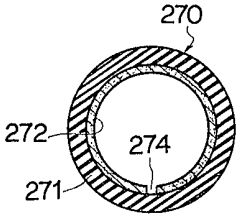


FIG.14

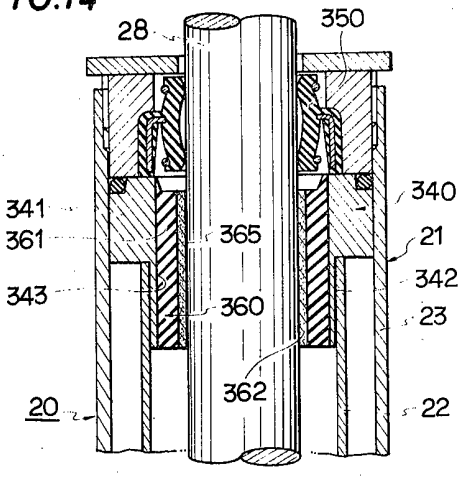


FIG.15

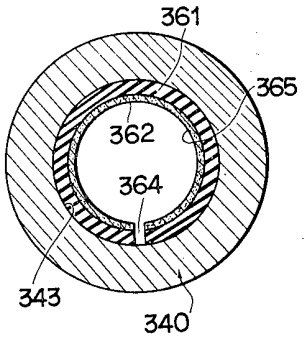


FIG.16

