Aug. 1, 1933. R. F. PEO 1,920,272

SHOCK ABSORBER

Filed March 5, 1931

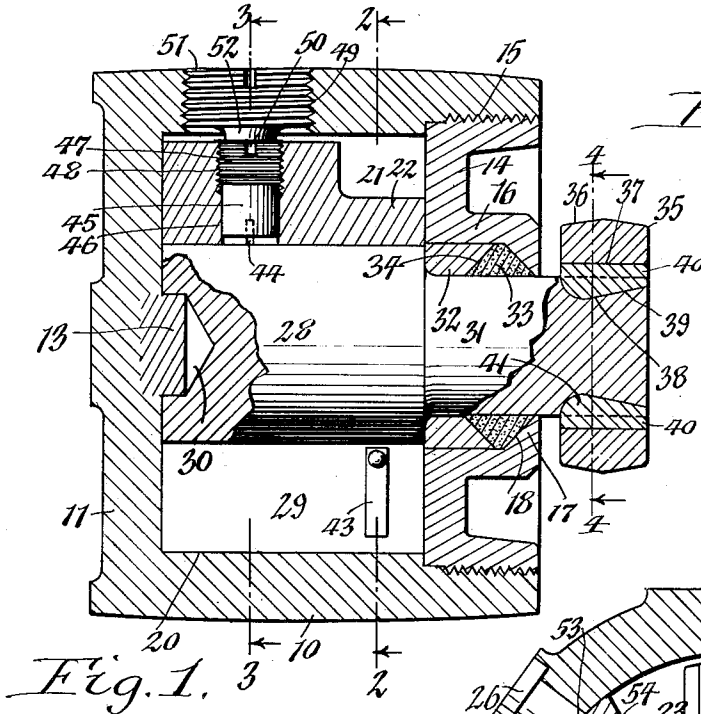

Fig. 1.

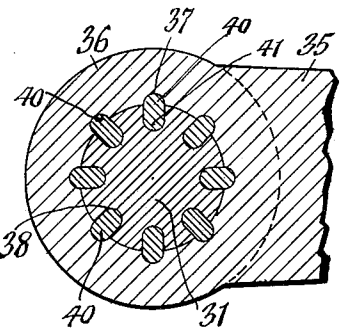

Fig. 4.

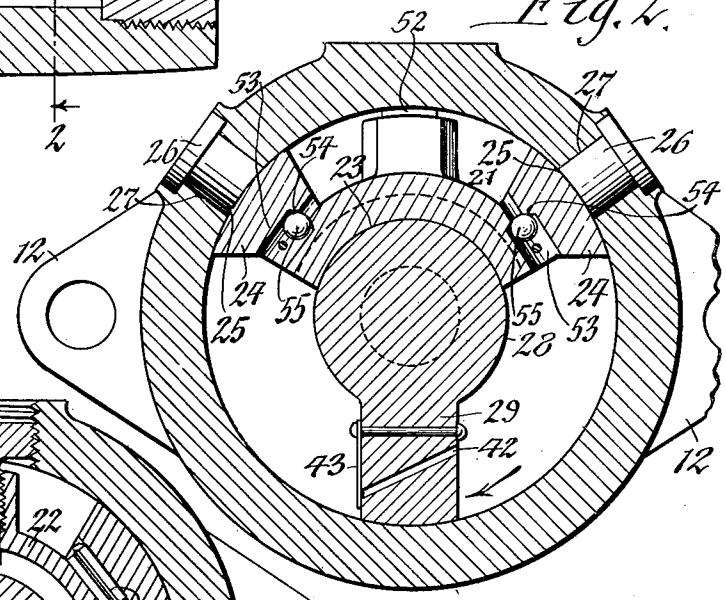

Fig. 2.

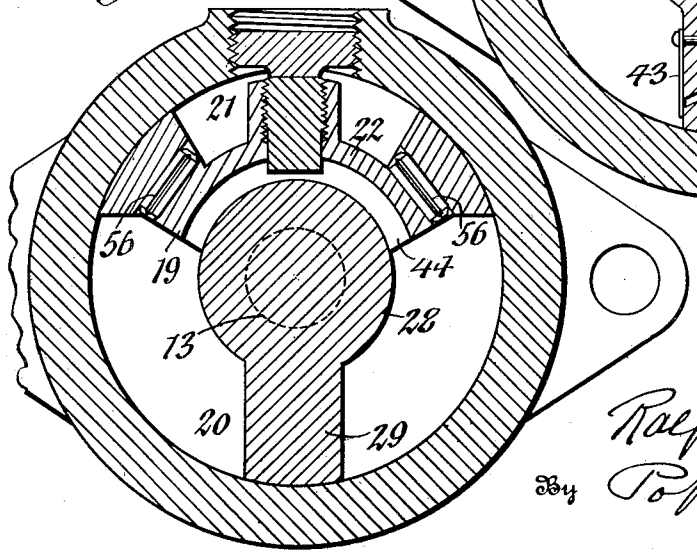

Fig. 3.

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SHOCK ABSORBER

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8 Claims. (Cl. 188—89.)

This invention relates to a hydraulic shock absorber and has the object to provide an absorber of this character which is simple in construction, low in cost of manufacture and efficient in operation.

In the accompanying drawing:

Fig. 1 is a vertical longitudinal section of a shock absorber embodying my improvements.

Figs. 2, 3 and 4 are vertical transverse sections of the same taken on the correspondingly numbered lines in Fig. 1.

In the following description similar characters of reference indicate like parts in the several figures of the drawing.

The body of the absorber comprises a cylindrical wall 10, the rear end of which is closed by a transverse head 11 and provided with laterally projecting attaching lugs 12 by which the body may be connected with one of the relatively movable members between which the shock is to be absorbed. In the present case it will be assumed that the lugs 12 are connected with the frame or body of an automobile or motor car which is mounted by a spring suspension system on the axles of the car and is movable toward and from the axle while the car is running over roadways.

This cylindrical wall, the rear head and attaching lugs are made integrally by casting same of iron or the like.

On its inner or front side the rear head is provided with a rear bearing or pilot pin 13 which has its periphery concentric with the bore of the cylindrical wall and is preferably connected with the rear head by electric welding, as shown in Fig. 1.

To the front edge of the peripheral wall 10 a front transverse head 14 is secured by a screw joint 15 or other suitable means and provided with a tubular neck 16 which is concentric with the wall 10 and opens at its rear end toward the space within the body while its front end has an inwardly projecting flange 17 which is bevelled on its rear side, as shown at 18, in Fig. 1. The front wall and its neck are also preferably constructed of cast metal such as iron.

Within the upper part of the cylindrical space, enclosed by the housing composed of the circular wall 10, rear head 11 and front head 14, is arranged a partition 19 which divides this space into a lower segment shaped working chamber 20 adapted to receive the resistance liquid which absorbs the shock and an upper replenishing chamber 21 adapted to hold in reserve a supply of resistance liquid which is fed to the working chamber as required. This partition is preferably constructed of cast steel and comprises a segmental intermediate web 22 which is equal in length to the distance between the front and rear walls and engages the inner sides of the same and has an inner bearing face 23 which is concentric with the axis of the working chamber, and two flanges 24 projecting radially outward from opposite ends of the web 22 and having outer curved faces 25 which are concentric with the bore of the wall 10 and engage with the inner side of the same.

This partition may be held in place within the body in any suitable manner but preferably by means of two metal plugs 26 inserted through radial openings 27 in the wall 10 and welded by an electric current or by a flame to the outer faces 25 of the partition flanges and to the peripheral wall so as to render these parts integral.

Within the working chamber is arranged a piston which oscillates about an axis concentric with this chamber, extends from the front head to the rear head thereof, and comprises a cylindrical hub 28 engaging its upper part with the curved underside 23 of the partition, and a wing 29 extending radially from the hub and engaging its outer end with the curved bore of the working chamber, as shown in Figs. 2 and 3. The rear end of the hub of the piston is provided with a bearing recess 30 which receives the bearing pin 13 of the rear wall and the front end of this hub is connected with the rear end of an operating shaft 31 which extends forwardly through the tubular neck of the front wall. This shaft is journaled in a bearing sleeve 32 which is secured with a tight fit in the inner end of the neck 16 of the front wall. Leakage of resistance fluid through the joint between the operating shaft and the neck of the front wall is prevented by an annular packing 33 arranged between this shaft and said neck and engaging its front end with its bevelled face 18 on the rear side of the flange 17 and its rear end with the bevelled face 34 on the front end of the bearing sleeve 32, as shown in Fig. 1.

When the front head 14 is screwed into assembled position on the wall 10 the packing will be compressed between the sleeve and the flange.

To the front end of the operating shaft is secured an operating arm or lever 35 which is connected with the other of the two members between which the shock is to be absorbed, in this case one of the axles of the car. The connection between the operating shaft and arm

may be effected in any suitable manner but preferably in accordance with my invention which is constructed as follows:

The hub 36 of the operating arm which surrounds the front end of the operating shaft is provided in its bore with a plurality of longitudinal grooves 37 which are half-round in cross section, and each of these grooves registers with a longitudinal groove 38 in the periphery of the operating shaft which last mentioned groove is shallow at its front and rear ends and gradually deepens towards its rear end, the front part of each of these grooves in the operating shaft being thus inclined, as shown at 39, so that the front parts of the several grooves in the operating shaft form rearwardly tapering surfaces.

Into each of the longitudinal openings thus formed between a groove 37 in the operating arm and a groove 38 in the operating shaft is inserted a straight longitudinal key or pin 40 and after such insertion this pin is exposed to a welding heat derived either from an electric current or otherwise so that the metal of the pin flows and fills the grooves and is fused to the lever 35 and shaft 31.

By this welding means the operating lever is anchored on the operating shaft so that these parts are held against torsion relative to one another, and the same are also reliably interlocked and incapable of being displaced by either a pulling or pushing on the same in a direction lengthwise of the axis of the operating shaft and arm.

Means are provided for permitting the resistance liquid to flow through the piston while the wing of the same is moving to the low from the high compression end of the working chamber which direction is opposite to that indicated by the arrow associated with the piston in Figure 2, but while the piston is moving in the opposite direction the resistance liquid is prevented from flowing through the piston thereby causing the resistance liquid to offer a greater resistance to the movement of the piston during rebound of the spring system of the vehicle than during the compressing action of the same.

Although various means may be employed for accomplishing this purpose those shown in the drawing are satisfactory and consist of a bypass port 42 formed in the wing of the piston and extending from one side to the other, and a leaf valve 43 secured to the wing and adapted to close the port 42 during the high compression strokes of the piston and to uncover said port during the low compression strokes of the piston.

In order to permit of regulating the resistance which the liquid offers to the movement of the piston in the working chamber to suit the load which the shock absorber is intended to carry regulating means are provided which are constructed as follows:—

Formed in the concave or underside of the partition is a regulating or metering passage 44 which extends circumferentially from one end of the partition to the other and therefore connects the high and low compression ends of the working chamber. This regulating passage has the form of a narrow groove which is closed throughout its lower longitudinal side by the periphery of the hub of the piston. This groove may be formed by a simple boring operation and permits of a range of adjustment of the resistance liquid which is uniform isasmuch as it provides a long viscous passage the surface friction of which aids materially in controlling the flow of the resistance liquid whenever sudden bumps are encountered by the car on the roadway.

The effective cross sectional area of the regulating passage may be regulated to suit different requirements or conditions by means of a metering or regulating valve 45 movable vertically in a seat 46 formed radially in the central part of the web of the partition so as to intersect the adjacent part of the regulating or metering passage. Upon moving the metering valve vertically in its seat the regulating passage may be obstructed more or less and thus adapt the shock absorbing capacity of the instrument according to the load imposed on the same. The adjusting movement of the regulating valve is effected by means of an external screw thread 47 on the upper part of the regulating valve engaging with an internal screw thread 48 in the upper part of the regulating valve seat whereby upon turning the regulating valve its lower end will extend more or less across the regulating passage. The regulating valve may be turned for this purpose by passing a tool, such as a screw driver, through an opening 49 in the top of the peripheral wall 10 and engaging the same with a notch 50 in the upper end of the metering valve and turning the latter the requisite extent. This opening is preferably utilized for the additional purpose of filling the replenishing chamber or reservoir 21 with a reserve supply of resistance liquid and under normal conditions this filling opening 49 is closed by a screw plug or cover 51.

The valve seat 46 preferably extends from the lower to the upper side of the partition 19 and any leakage of liquid past the regulating valve due to the pressure against the same in the working chamber will cause such leakage to flow from the inner side of the partition past the joint between the metering valve and the partition into the replenishing chamber. The screw cap or plug 51 which closes the filling opening is preferably utilized as a fastening means for holding said metering or regulating valve against turning out of position after being adjusted for which purpose the plug 51 when in its fully closed position engages the outer end of the valve 45 and clamp the same in place. To further guard against displacement of the regulating valve 45 when the instrument is in use the screw threads of the connection between the regulating valve are of different pitch from those connecting the filler plug 51 with the peripheral wall, as shown in Fig. 1, thereby preventing these screw members from turning in unison and instead causing the same to lock each other.

In order to avoid obstructing the flow of any leakage liquid from the inner side of the partition, past the regulating valve into the replenishing chamber by engagement of the filler plug with the outer end of the regulating valve, the inner end of the filler plug is provided with a bearing boss 52 for engagement with the outer end of the regulating valve which is of smaller diameter than the latter, as shown in Figs. 1 and 3, thereby preventing the filling plug from overlapping the screw joint between the regulating valve and the partition and permitting flow of leakage fluid through the same from the working chamber into the replenishing chamber.

Liquid for replenishing the loss in the working chamber is supplied to both ends of the latter from the replenishing chamber or reservoir 21 by replenishing ports 53 formed in ends of the partition and each extending from the replen-

ishing chamber to the uppermost part of one end of the working chamber and each having a valve seat 54 which faces toward the working chamber and a check valve 55 arranged in said port and adapted to move toward and from said seat for closing and opening the same. As the piston moves away from one of the check valves 55 the latter will open and permit resistance liquid to be drawn from the replenishing chamber into the working chamber and upon moving the piston toward the respective replenishing valve the same will be moved into its closed position, so that the liquid in the respective end of the working chamber will be subjected to pressure and cause shock to be absorbed.

Any air or gas which may be present in the resistance liquid is free to escape from the working chamber to the replenishing chamber by two vents 56 arranged in the opposite ends of the partition at the uppermost parts of the ends of the working chamber and each connecting the respective parts of those chambers, as shown in Fig. 3.

By arranging the replenishing valves and vents at opposite ends of the partitions the same are in the lowest parts thereof and next to the highest parts of the working chamber, thereby enabling the liquid in the replenishing chamber to flow into the working chamber as long as there is any liquid in the replenishing chamber, and reducing to a minimum the liability of the shock absorber getting dry, as well as prevent the same from getting air bound.

Briefly summing up the operation, the body of the shock absorber is secured to a vehicle chassis and the lever 35 is connected with the axle. During passage of the vehicle over ordinary road irregularities the oil may freely flow between the high pressure and low pressure sides of the working chamber 20 so that the normal operation of the vehicle spring will not be interfered with. Under abnormal road conditions, should the chassis and axle be suddenly brought together the piston will swing to the low pressure side of the working chamber and the valve 43 will open to assist the passageway 44 for free flow of oil into the high pressure side of the working chamber. However, when the vehicle spring tends to separate the chassis and axle the piston moves in the opposite direction and the valve 43 will be closed so that the oil can escape from the high pressure side to the low pressure side only through the pasageway 44 and the recoil action of the spring will be retarded and the shock thereof absorbed. The regulating or metering passage 44 being in the form of a narrow groove, introduces surface friction to the passage of the oil therethrough which adds materially in gradually softening and absorbing the spring rebound and shock. The resistance to flow is of course readily further adjustable by means of the valve 45.

As the piston swings to one side of the working chamber the replenishing valve 55 at that side will be closed but the replenishing valve for the other side of the chamber will open so that such other side will be fully filled with oil for reverse movement of the piston. Any air which may have been entrapped in the working chamber will be driven out to the replenishing chamber through the restricted vent passages 56 and although these vent pasages are open at all times, very little oil will escape therethrough owing to the resistance so that these air vents will not interfere with the proper operation of the device to absorb shocks. Any air or gases which have been driven through the vents 56 will rise and accumulate at the top of the replenishing chamber where they cannot interfere with the proper operation of the device.

I claim as my invention:

1. A hydraulic shock absorber comprising a housing enclosing a cylindrical space, a partition in said housing dividing said space into a lower segmental working chamber and an upper replenishing chamber, the underside of said partition having a segmental bearing surface which is concentric with said working chamber, a circumferential groove in said bearing surface, and a vertical valve seat intersecting said groove, a regulating valve arranged in said seat and having a screw connection with said partition for moving said valve more or less across said groove, a piston oscillating in said working chamber and having a hub engaging said bearing surface and extending across said groove, said housing provided with a filling opening above said regulating valve and a closure for said filling opening.

2. A hydraulic shock absorber comprising a housing enclosing a cylindrical space, a partition in said housing dividing said space into a lower segmental working chamber and an upper replenishing chamber, the underside of said partition having a segmental bearing surface which is concentric with said working chamber, a circumferential groove in said bearing surface, and a vertical valve seat intersecting said groove, a regulating valve arranged in said seat and having a screw connection with said partition for moving said valve more or less across said groove, a piston oscillating in said working chamber and having a hub engaging said bearing surface and extending across said groove, said housing provided with a filling opening above said regulating valve, and a closure for said opening engaging said regulating valve.

3. A hydraulic shock absorber comprising a housing enclosing a cylindrical space, a partition in said housing dividing said space into a lower segmental working chamber and an upper replenishing chamber, the underside of said partition having a segmental bearing surface which is concentric with said working chamber, a circumferential groove in said bearing surface, and a vertical valve seat intersecting said groove, a regulating valve arranged in said seat and having a screw connection with said partition for moving said valve more or less across said groove, a piston oscillating in said working chamber and having a hub engaging said bearing surface and extending across said groove, said housing provided with a filling opening above said regulating valve, a screw plug closing said opening and engaging said regulating valve, the screw threads of said valve and plug being of different pitches.

4. A hydraulic shock absorber comprising a housing enclosing a cylindrical space, a partition in said housing dividing said space into a lower segmental working chamber and an upper replenishing chamber, the underside of said partition having a segmental bearing surface which is concentric with said working chamber, a circumferential groove in said bearing surface, and a vertical valve seat intersecting said groove, a regulating valve arranged in said seat and having a screw connection with said partition for moving said valve more or less across said groove, a piston oscillating in said working chamber and having a hub engaging said bearing surface and extending across said groove said housing being

provided with a filling opening above said regulating valve, and a screw plug closing said filling opening and provided at its inner end with a boss which bears on said regulating valve and is of smaller diameter than said valve seat.

5. A hydraulic shock absorber comprising a housing having a cylindrical wall, a rear head, and a front head provided with a tubular neck having an inwardly extending flange at the front end thereof, said housing enclosing a working chamber, a hub extending through said chamber and a piston extending therefrom, a driving shaft for said hub extending through said neck, a bearing bushing within said neck surrounding said shaft and abutting said hub, and packing between said bushing and said flange, said front head being secured to said cylindrical wall by threaded engagement therewith whereby when said head is assembled on said wall said packing will be compressed between said bushing and flange.

6. A hydraulic shock absorber comprising a housing enclosing a cylindrical space, a partition in said housing dividing said space into a lower segmental working chamber and an upper replenishing chamber, the underside of said partition having a segmental bearing surface, a piston oscillating in said working chamber and having a hub which engages said bearing surface, said partition having a circumferential groove extending therethrough and communicating at its ends with said working chamber at opposite sides of said piston and having its underside closed by said hub, said groove being of rectangular cross-section with its radial walls comparatively close together so that the surface friction will interpose retarding resistance to the flow of oil through said groove, and a valve intersecting said groove and being adjustable for controlling the rate of flow therethrough.

7. A hydraulic shock absorber comprising a housing enclosing a cylindrical space, a partition in said housing dividing said space into a lower segmental working chamber and an upper replenishing chamber, the underside of said partition having a segmental bearing surface which is concentric with said working chamber, a piston adapted to oscillate in said working chamber and having a hub engaging said bearing surface, there being a groove between said partition and said hub communicating at its ends with said working chamber at opposite sides of said piston, a regulating valve having screw connection with said partition for adjustment of said valve to extend more or less across said groove to control the flow of fluid therethrough, said housing having a filling opening in registration with said valve through which said valve is accessible for adjustment, and a closure for said filling opening for engaging said valve to lock said valve in adjusted position.

8. A hydraulic shock absorber comprising a housing enclosing a cylindrical space, a partition in said housing dividing said space into a lower segmental working chamber and an upper replenishing chamber, the underside of said partition having a segmental bearing surface which is concentric with said working chamber, a piston adapted to oscillate in said working chamber and having a hub engaging said bearing surface, there being a groove between said partition and said hub communicating at its ends with said working chamber at opposite sides of said piston, a regulating valve having screw connection with said partition for adjustment of said valve to extend more or less across said groove to control the flow of fluid therethrough, said housing having a filling opening in registration with said valve through which said valve is accessible for adjustment, and a closure for said filling opening for engaging said valve to lock said valve in adjusted position, said closure having screw threaded engagement with said housing and the screw threading of said closure and of said valve being of different pitch.

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