July 10, 1934. M. FIELDMAN 1,966,005

HYDRAULIC SHOCK ABSORBER

Filed Dec. 17, 1929

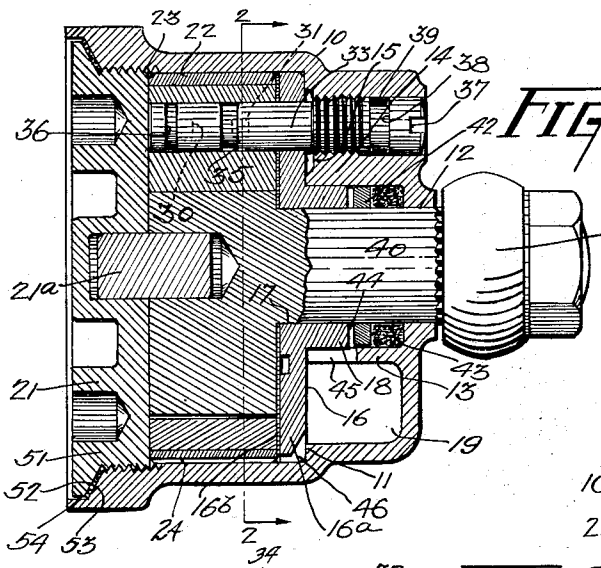


FIG. 1.

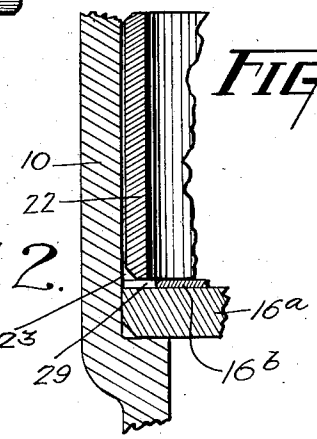


FIG. 3.

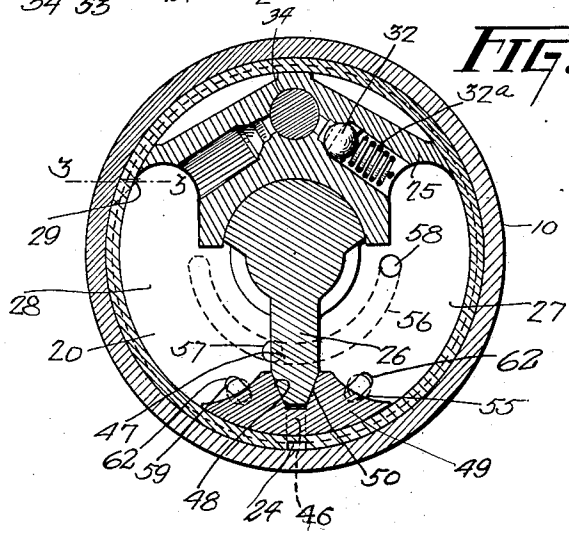
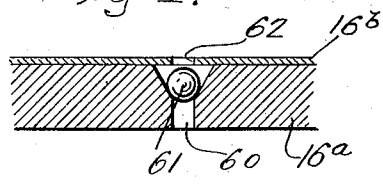


FIG. 2.

Fig. 4.



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UNITED STATES PATENT OFFICE

1,966,005

HYDRAULIC SHOCK ABSORBER

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Application December 17, 1929, Serial No. 414,726

16 Claims. (Cl. 188—89)

This invention relates to shock absorbers, and more particularly to hydraulic shock absorbers of the oscillating piston type.

An important object of the invention is the improvement of a structure of this character, and more particularly of a structure of this character and of the type exemplified in my prior applications, Serial No. 381,512, filed July 27, 1929 for Hydraulic shock absorber, and Serial No. 374,143, filed June 27, 1929 for Hydraulic shock absorber, to insure removal of the air from the working chambers of the shock absorber to relieve pressures resulting from leakage, both about the shaft of the oscillating piston and about the joints of the casing, and to provide a construction wherein wear upon the shoe constituting the free end of the oscillating piston is compensated for so that a proper fit may be maintained at all times.

A further object of the invention is the provision in a construction of this character of an arrangement providing for relief of extreme pressures.

A still further object of the invention is the provision of a shock absorber in which the movement of the oscillating piston, during periods when the frame and axle of the car are separating as a result of passage of the wheels over a depression in the road, is substantiallly unresisted and, accordingly, shocks resulting from such dips by the wheels which are ordinarily transmitted to the vehicle due to the tying of the axle to the frame, are avoided.

These and other objects I attain by the construction shown in the accompanying drawing wherein, for the purpose of illustration, I have shown a preferred embodiment of my invention and wherein:

Fig. 1 is a vertical sectional view through a shock absorber constructed in accordance with my invention;

Fig. 2 is a section on line 2—2 of Fig. 1;

Fig. 3 is a detail sectional view on line 3—3 of Fig. 2; and

Fig. 4 is a detail sectional view through one of the reserve supply ports.

Referring now more particularly to the drawing, the numeral 10 generally designates a cup-shaped casing, the side walls of which are interiorly formed to produce an annular seat 11. The base of the cup is provided with an axial aperture 12 which, interiorly of the cup, is surrounded by an annular flange 13 of slightly greater diameter than the opening. At one point the wall of the casing and this flange are connected by a lug or boss 14 having its inner face 15 slightly lower than the inner end face of the flange 13 which is coplanar with the annular seat 11.

A partition plate 16 is provided which seats at its margin upon the shoulder 11 and which is formed with an axial opening 17 of approximately the same size as the opening 12 of the casing. This opening at the face of the plate which confronts the bottom of the casing is defined by an outstanding flange 18 which projects into and interiorly fits the flange 13 of the casing. This partition subdivides the casing into storage and working compartments 19 and 20, of which the storage compartment lies between the base of the casing and the partition plate, and the working compartment lies between the inner face of the partition and a cover plate 21 screwed into the mouth of the casing. Partition plate 16 comprises a main body 16—*a* which directly abuts the shoulder 11 and a thin steel facing plate 16—*b* which actually forms the rear wall of the working compartment.

Between the cover plate 21 and the partition plate an annular bushing wall 22 is clamped and serves to define the outer wall of the working chamber. This bushing wall has an external diameter slightly less than the internal diameter of the wall of casing 10 between the shoulder 11 and cover plate 21, the difference in diameters being in practice preferably in the neighborhood of 10/1000''. The outer corners of this bushing are beveled as at 23, thus providing annular channels which are normally in communication with one another due to the spacing between the walls of the bushing and the wall of the casing 10. For a reason hereinafter to appear, this communication is further assured by relieving the outer face of the bushing transversely. In the present instance the bushing is illustrated as having its outer face grooved at 24. This relief, however, may be provided by simply grinding a flat on the face of the bushing if so desired.

The working chamber 20 has disposed therein a partitioning member 25 and a piston 26 combined to subdivide the working chamber into low and high pressure compartments 27 and 28. The upper end of the high pressure compartment 28 is in communication with the inner groove 23 through a port 29 formed by notching the plate 16—*b* with a V-shaped notch, the apex of which lies inwardly of the inner face of bushing 22, thus providing a minute port. Communication between the high and low pressure ports is established through high and low pressure control channels 30 and 31, each of these channels having arranged therein a check ball 32

seating toward the chamber which the channel is intended to control. Check balls 32 are seated by springs 32—*a* and act to control passage during slight movements of the piston in the manner described in the previous applications above noted.

Control during rapid movements of the piston 26 in response to great checks is provided by a combined dowel and valve element 33 projecting into a bore 34 which interrupts channels 30 and 31. The portion of the dowel occupying this bore has formed therein grooves 35 and 36 determining the maximum size of the low and high pressure passages in the manner set forth in said applications. This dowel is threaded into the lug and has its outer end accessible to a screw driver or other adjusting means as indicated at 37. Inwardly of the rear end of the dowel the head thereof is circumferentially grooved as at 38 and has disposed therein a rubber grommet 39. Piston 26 is carried by a shaft 40 to the outer end of which is attached the usual connection arm 41. Upon this shaft at the rear end of the flange 18 a collar 42 is affixed and packing 43 surrounds the shaft between this collar and the rear wall of the casing. A slight space is provided between the front face of collar 42 and the rear end of the flange 18, as indicated at 44, and this space is in communication with the storage compartment 19 through an opening in flange 13, preferably provided by slotting the lower portion of this flange as indicated at 45.

The lower end of the partition plate 16 is notched through both elements thereof as at 46, this notch communicating with the lower portion of the storage compartment and with the inner channel 23 provided by beveling the bushing at its corners. Since the outer channel is in communication with the inner channel, as previously described, both channels are thus in communication with the source of reserve supply.

The piston 26 consists of a radial arm 47 on shaft 40, which arm terminates short of the inner face of the bushing 22 and has its side faces beveled at the free ends, as indicated at 48, and a slipper 49 having a notch 50, the walls of which are correspondingly tapered on its inner face and having its outer face curved to conform to the curve of the inner face of the bushing. Both arm 47 and slipper 49 are of the same width as the distance between adjacent faces of the partition and the inner face of cover plate 21. Cover plate 21 and shaft 40 are preferably axially bored for the reception of a gudgeon pin 21—*a* to assist in steadying the operation of the piston, although this piston will be very rigidly held due to the elongated bearings provided through flange 18 and the walls of opening 12 as described in the co-pending applications hereinbefore mentioned.

Cover plate 21 has an inner threaded portion 51 terminating in an outer enlarged section 52 adapted to seat upon a shoulder 53 produced upon the end wall of the casing 10 through the intermediary of a soft gasket 54.

In operation, the action of the shock absorber is substantially as described in the previously-mentioned applications, oscillation of the piston resulting in the formation of pressures between the advancing face of the piston and the confronting face of the partition element 25, and these pressures being relieved by passage of the fluid through the ports 30 or 31 depending upon the direction of movement of the piston.

In event the movement of the piston is so rapid that excess pressure is generated however, bushing 22 due to the fact that it is of less diameter than the casing is free to move permitting a slight leakage from one compartment to the other due to the deformation of the bushing thus resulting. This deformation of the bushing occurs as a result of an actual sliding of the bushing end faces upon the plate 16—*b* and cover plate 21, the clamping action between these elements being sufficient to prevent such movement under all ordinary circumstances but insufficient to prevent it under excessive pressures. The leakage will occur between the piston and bushing where a solid piston is employed. Where the slipper foot employed in the present instance is used, the foot will, of course, maintain the seal and under these circumstances the deformation of the bushing occurs about the partition element 25 permitting leakage between the bushing and partition element. It will be understood that the actual movement of the bushing is infinitesimal and barely susceptible to measurement. The bushing, when inserted, will have only a clearance amounting to a few thousandths of an inch when the total clearance in the direction of any given diameter is considered. The possible movement is, therefore, only about one-half of this distance. This construction not only provides safety in event of heavy pressures but likewise leads to economy in manufacture since it is obviously cheaper to assemble the sections where they fit freely, as they may in the present instance, than it is where these sections are so constructed that a forced fit must be employed. Under all ordinary circumstances a perfect seal will be maintained between the piston and the bushing due principally to the slipper construction provided. It will be noted that pressures acting upon the beveled end faces 55 of the slipper will tend to urge this slipper outwardly and to hold it against rotation so that the wedge face of the groove 50 will be engaged against the tapered face of the arm 47 increasing the tendency to outward movement and effecting a seal between the arm and slipper. As the face of the slipper wears, this seal will be maintained so that the effective life of the piston is materially increased. Attention is directed to the fact that since the grooves 23 are in communication with a storage chamber these grooves and the space provided by the retraction of the face of lug 14, which is likewise in communication with the storage chamber, are at atmospheric pressure. Accordingly, any leakage by the edges of the bushing or about dowel valve 33 will be immediately returned to this storage chamber. Leakage along the shaft 40 will be relieved through the space 44 and opening 45 and, accordingly, all spaces which have any communication with a closure for the casing are at low pressures and the use of soft gaskets or packings will suffice to effect a perfect seal. Any air trapped in the high pressure chamber 28, to which any air entering either of the chambers will eventually pass, will be passed through the port 29 and the associated groove 23 to the storage chamber 19 from which it may not again escape due to the fact that the point of entry is at the lower end of this chamber.

In order that the piston may have substantially unrestricted movement in the normal sphere of action of the springs of the vehicle, a port is provided for relieving the major portion of generated pressures during movement of the piston through a corresponding arc. This port is preferably in the form of an arcuate groove 56

formed in the front face of the body plate 16—*a* of the partition 16 and between the assembly of the plates of this partition formed as a channel. This groove preferably extends an equal distance to opposite sides of the normal position of the piston which is illustrated in Fig. 2 and the front plate 16—*b* has formed therein a pair of openings 57 and 58, one of which is so positioned that it opens to one side of the piston arm and adjacent such piston arm and the other of which is so positioned that it communicates with the end of the port 56 at the opposite side of this arm. The positions of these ports will be reversed as regards the piston in the assembly of the shock absorber to produce rights and lefts, this reversal being accomplished by reversing the plate 16—*b*.

As a means for replenishing fluid leaking from the high and low pressure compartments 28 and 27, the partition has check valved openings 59 placing each chamber in communication with the storage space 19. For convenience in assembly, the main plate 16—*a* is formed with the ports 60, the forward ends of which are formed as tapered seats for the reception of check balls 61. Plate 16—*b* is formed with ovate slots 62 which are correspondingly arranged to ports 60 and which have a mean diameter less than the diameter of the ball.

It will be obvious that a shock absorber of this character may be very readily manufactured, since the casing can be produced as a die casting, or of cast iron, requiring but little machining and the remaining details of the construction are such that the assembly of the device and its adjustment are materially facilitated.

Since this construction is obviously capable of a certain range of change and modification without in any manner departing from the spirit of my invention, I do not wish to be understood as limiting myself thereto except as hereinafter claimed.

I claim:

1. In a hydraulic shock absorber of the oscillatory piston type. a working chamber for the piston having end walls one of which is axially movable in installation, and an annular side wall clamped between said end walls and having sealing engagement at its ends with said end walls and capable of slight radial deformation.

2. In a hydraulic shock absorber of the oscillatory piston type, a working chamber for the piston having end walls one of which is axially movable, a side wall clamped between said end walls and having sealing engagement at its ends with said end walls, and a housing for said working chamber having an interiorly-formed seat for the other end wall of the working chamber, the movable end wall of said working chamber forming an end wall for said housing, said side wall having an external diameter slightly less than the internal diameter of the confronting portions of the housing.

3. In a hydraulic shock absorber of the oscillatory piston type, a working chamber for the piston having end walls one of which is axially movable, a side wall clamped between said end walls and having sealing engagement at its ends with said end walls, and a housing for said working chamber having an interiorly-formed seat for the other end wall of the working chamber, the movable end wall of said working chamber forming an end wall for said housing, said side wall having an external diameter slightly less than the internal diameter of the confronting portions of the housing, the housing including a storage chamber and means for returning fluids leaking by the edges of the side walls to said storage chamber.

4. In a shock absorber of the oscillating piston type, a working chamber having a partition and an oscillating piston dividing the same, said working chamber including end walls and an annular side wall with which the free end of the piston co-acts, said side wall being radially movable to permit escape of fluid by the piston under excess pressures and a housing for the working chamber having a side wall limiting the movement of the side wall of the working chamber.

5. In a shock absorber of the oscillating piston type, a working chamber having a partition and an oscillating piston dividing the same, said working chamber including end walls and an annular side wall with which the free end of the piston co-acts, said side wall being radially movable to permit escape of fluid by the piston under excess pressures, the piston being formed in two sections relatively freely movable in a direction radial to the axis of rotation of the piston and means for maintaining a seal between the sections.

6. In a hydraulic shock absorber of the oscillatory piston type, a working chamber for the piston having end walls one of which is axially movable, a side wall clamped between said end walls and having sealing engagement at its ends with said end walls, a housing for said working chamber having an interiorly-formed seat for the other end wall of the working chamber, the movable end wall of said working chamber forming an end wall for said housing, the housing including a storage chamber, means providing channels between the side wall at the end edges thereof and the housing and means establishing communication between said channels and the storage chamber.

7. In a hydraulic shock absorber of the oscillatory piston type, a working chamber for the piston having end walls one of which is axially movable, a side wall clamped between said end walls and having sealing engagement at its ends with said end walls, a housing for said working chamber having an interiorly-formed seat for the other end wall of the working chamber, the movable end wall of said working chamber forming an end wall for said housing, the housing including a storage chamber, means providing channels between the side wall at the end edges thereof and the housing, means establishing communication between said channels and the storage chamber, and means sealing the movable end wall to the housing outwardly of its point of contact with the side wall.

8. In a shock absorber, a casing, a partition in the casing subdividing the same into working and storage chambers, a partitioning element in the working chamber, a piston likewise in the working chamber and combining with said partitioning element to subdivide the same into high and low pressure compartments disposed at opposite sides of the piston, the partition having a notch the inner end of which communicates with the upper end of the high pressure compartment and means placing said notch in communication with the lower end of the storage chamber.

9. In a shock absorber, a casing, a partition in the casing subdividing the same into working and storage chambers, a partitioning element in the working chamber, a piston likewise in the working chamber and combining with said partitioning element to subdivide the same into

high and low pressure compartments disposed at opposite sides of the piston, the side wall of the working chamber comprising a bushing inserted in the casing, said bushing combining with the casing to provide annular channels, said channels being in communication with the lower end of the storage chamber.

10. In a shock absorber, a casing, a partition in the casing subdividing the same into working and storage chambers, a partitioning element in the working chamber, a piston likewise in the working chamber and combining with said partitioning element to subdivide the same into high and low pressure compartments disposed at opposite sides of the piston, the side wall of the working chamber comprising a bushing inserted in the casing, said bushing combining with the casing to provide annular channels, said channels being in communication with the lower end of the storage chamber, a partition element having a notch communicating at one end with the upper end of the high pressure compartment and at its opposite end with one of said channels.

11. In a shock absorber, a casing, a partitioning element in the casing subdividing the casing into working and storage chambers, a partitioning element in the working chamber, a piston likewise in the chamber and combining with said partitioning element to subdivide the chamber into compartments disposed at opposite sides of the piston, the partitioning element of the casing being formed in two sections one of which has an arcuate groove in the face thereof confronting the working chamber, said groove extending to opposite sides of a normal position of the piston, the other of the sections being reversible upon the first-named section and having openings for co-action with said groove alternated in their positions with respect to the piston by the reversal thereof.

12. In a hydraulic shock absorber, a casing having a piston movable therein to opposite sides of a normal central position, a wall of the casing having a groove extending equidistantly to opposite sides of the piston and a plate applied to said wall having openings therein controlling the effective length of the groove.

13. In a hydraulic shock absorber, a casing having a piston movable therein to opposite sides of a normal central position, a wall of the casing having a groove extending equidistantly to opposite sides of the piston and a plate applied to said wall having openings therein controlling the effective length of the groove, said plate being reversible.

14. In a shock absorber, a casing, a partition in the casing subdividing the same into working and storage chambers, a partitioning element in the working chamber, a piston likewise in the working chamber and combining with said partitioning element to subdivide the same into high and low pressure compartments disposed at opposite sides of the piston, the side wall of the working chamber comprising a bushing inserted in the casing, said bushing combining with the casing to provide annular channels, said channels being in communication with the lower end of the storage chamber, one of said channels being in communication with the upper end of one of the said compartments.

15. In a shock absorber of the oscillating piston type, a cup-shaped casing having side and end walls and providing a working chamber, a partition element and an oscillating piston in said chamber combining to sub-divide the chamber into pressure compartments, a cup-shaped housing for said casing of greater depth than said casing, said housing having side and end walls and having a seat intermediate the ends of its side walls for the casing, a common closure for the working chamber and said housing, the housing and the casing combining to produce a storage chamber between the end walls thereof and providing a space between the side walls thereof, and means for conducting fluids from said space to said storage chamber.

16. A device as claimed in claim 15 wherein means are provided for establishing communication between the upper end of one of the compartments and the space between the side walls of the housing and the casing.

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