

P. J. CUBBISON & R. G. McFARLAND.
SHOCK ABSORBER.

APPLICATION FILED AUG. 15, 1911.

1,066,255.

Patented July 1, 1913.

2 SHEETS-SHEET 1.

FIG. 1

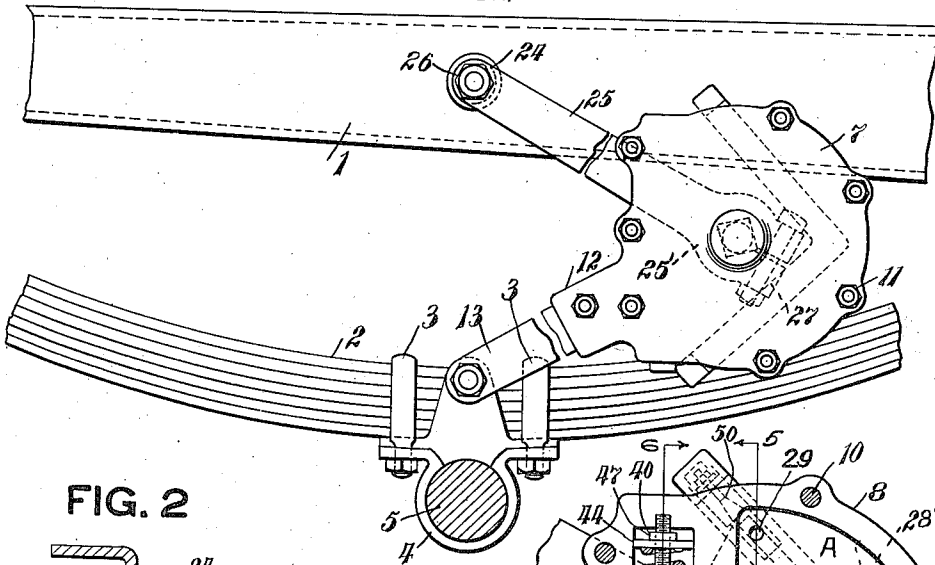


FIG. 2

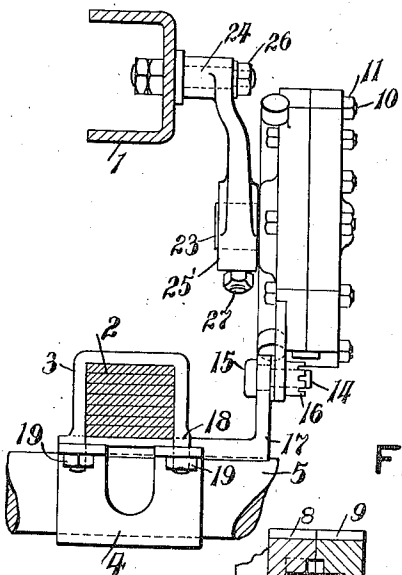


FIG. 3

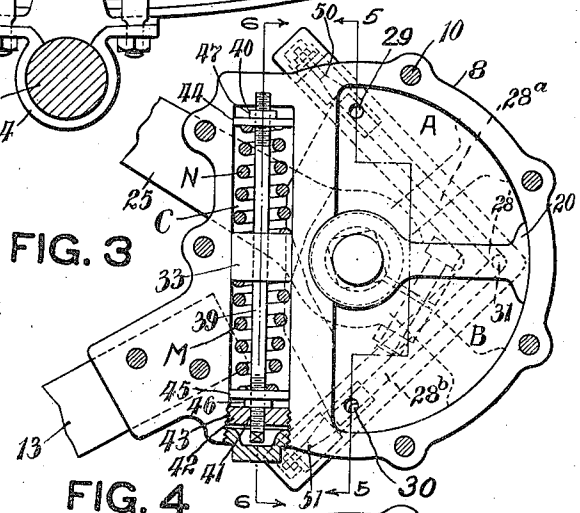


FIG. 4

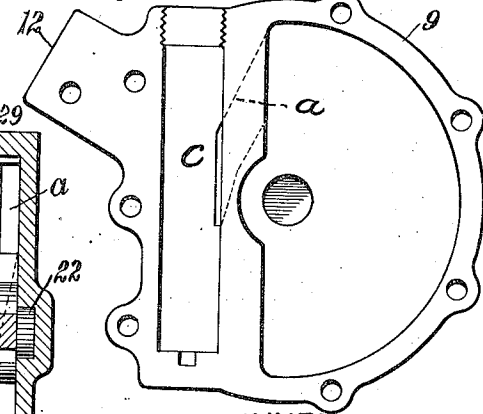


FIG. 5

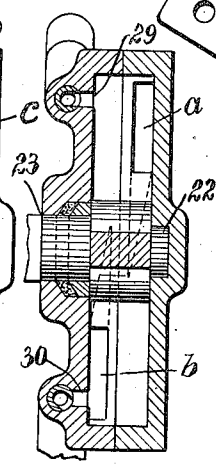
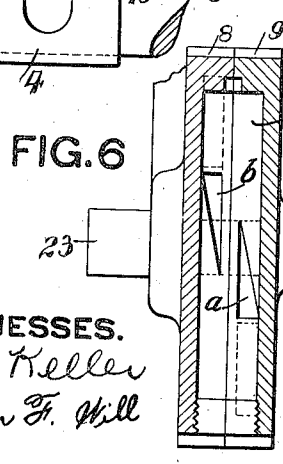


FIG. 6



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2 SHEETS-SHEET 2.

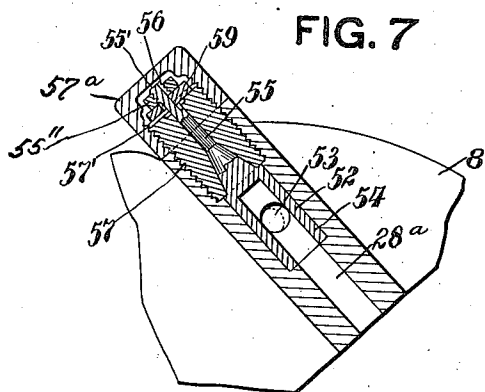


FIG. 7

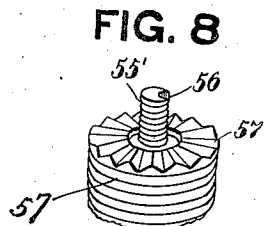


FIG. 8

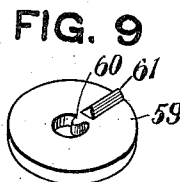


FIG. 9

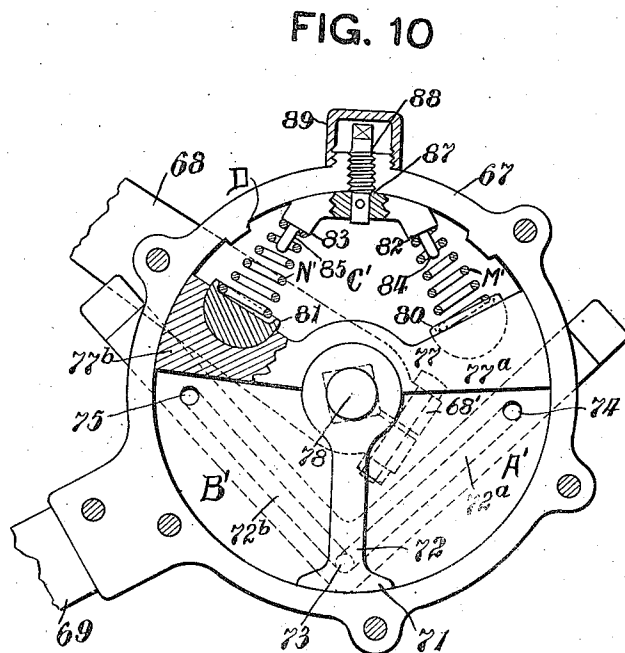


FIG. 10

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UNITED STATES PATENT OFFICE.

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SHOCK-ABSORBER.

1,066,255.

Specification of Letters Patent.

Patented July 1, 1913.

Application filed August 15, 1911. Serial No. 644,150.

To all whom it may concern:

Be it known that we, PAUL J. CUBBISON and ROBERT G. McFARLAND, citizens of the United States, and residents of New Castle, in the county of Lawrence and State of Pennsylvania, have invented a new and useful Improvement in Shock-Absorbers; and we do hereby declare the following to be a full, clear, and exact description thereof.

Our invention relates to shock absorbers. Its object is to provide an improved shock absorbing device to be used in conjunction with the ordinary or any vehicle body spring of a vehicle such as an automobile, which will enhance the smooth running or freedom from bumps or shocks of the vehicle body, and prevent excessive vibrations of the vehicle spring when a heavy jolt to the wheels or axles is encountered in traffic while permitting the free play of the spring in running on a road surface of moderate smoothness.

It is well known to persons skilled in the art that springs of sufficient flexibility to maintain smooth running and freedom from continual up and down motion of a motor vehicle body running at high speeds over ordinary good roads are in general not adequate to resist sudden jolts due to heavy obstacles or dips in the roadway, or the continuous irregularity of rough roads even when the vehicle is running at slow speed. Shock absorbing means such as the commercial types of shock absorbers heretofore in use, so far as we are informed, are in general therefore employed to afford a frictional resistance to the motion of the spring or axle relative to the vehicle body, either in reaction or back lash of the spring, or both its original compression and reaction; the said devices depending either on metallic friction or the frictional resistance to travel of a liquid or air through restricted passages or openings. As, however, such devices are brought into play at the instant of motion of the spring, where such motion is at a relatively high rate due to a heavy impact to the wheels in traffic, the resistance of the shock absorbing device being relatively greater to quick displacements of these elements, a heavy jolt is still felt by persons riding in the vehicle on account of the communication

of the axle or spring motion to the vehicle body under such circumstances, whether the shock absorbing device offers its highest resistance during both compression and reaction of the vehicle spring or only during reaction thereof.

The particular object of our invention therefore is to provide means for decreasing the resistance to motion of the spring for a short interval beginning at the instant of a heavy impact which causes rapid movement of the vehicle spring and to bring such resistance progressively into play so that the motion of the spring is dampened or its energy absorbed gradually in the shock absorbing device, while at the same time permitting the free slow movement or vibration of the vehicle spring during ordinary traffic when such obstacles or impacts are not encountered.

A further particular object of our invention is to provide means extrinsically operated, such as manually controlled valves for respectively varying or controlling the sizes of the restricted passages through which the liquid employed as a resistance agent passes on the up and down stroke or compression and reaction of the vehicle spring; so that the size of the passage through which the said liquid must pass on the up stroke may be arranged, for instance, the desired amount larger than the more restricted passage of controllable size through which the liquid must pass on the down stroke. It will be understood that it is generally desirable to absorb the motion of the vehicle spring, or the energy of the impact, on the reaction of the spring; as, except during very violent shocks, it is the sudden reaction of the spring which causes a bump or jar in the vehicle body.

To these ends our invention consists, generally stated, in a shock absorber comprising a casing for liquid, a piston therein dividing said casing into compartments or chambers and movable relative to said casing on the relative movement of the vehicle axle or spring and vehicle body, the casing being preferably pivotally connected to one of said parts, such as the axle, and the piston being similarly connected to the body, the casing having a restricted passage con-

necting said opposite chambers, and means permitting an initial movement of the piston in the casing without the travel of liquids through said passage, the said means comprising preferably a yielding device, or piston and spring in a by-passage which is actuated by the incompressible liquid in the chamber of the casing decreased in size by the movement of the piston, so as to maintain temporarily the size of said chamber and obviate for an instant or short interval of time the very rapid flow of liquid through the restricted passage connecting the chambers. This maintaining temporarily of the size of the piston chamber we term for convenience "equalizing the fluid within the chamber," that is to say, causing the liquid or fluid on one side of the piston in the chamber to flow to the opposite side substantially freely, temporarily under heavy impact on the road.

Our invention consists further in the means or valves employed to control the size of the particular passage or section of the main passage connecting each chamber with the chamber on the opposite side of the piston after the movement of the piston has commenced; and our invention also contemplates certain other improvements and features of construction as hereinafter pointed out, such as an auxiliary by-pass opened by the yielding of the spring controlling the piston which provides for maintaining temporarily the size of each chamber after movement of the main piston.

In the accompanying drawing Figure 1 is a side view of a shock absorber embodying our invention illustrating diagrammatically the vehicle body member and spring or axle member to which it is operatively connected; Fig. 2 is an end elevation in vertical section through the body member or chassis and spring of the same; Fig. 3 is a detail side view looking at the interior of one of the two members of which the shock absorber illustrated in Figs. 1 and 2 is preferably constructed and Fig. 4 is a like view of the other of said members; Fig. 5 is a cross section on the line 5—5 Fig. 3, and Fig. 6 is a cross section on the line 6—6 Fig. 3; Fig. 7 is a fragmental detail longitudinal sectional view showing the valve controlling one of the restricted passages in the casing; Fig. 8 is a detail perspective view partly broken away of the valve plug and a portion of the valve stem illustrated in Fig. 7; Fig. 9 is a detail perspective view of the valve washer; Fig. 10 is a vertical sectional view of a shock absorber showing a modification of our invention.

In the drawings the vehicle body is represented by the member 1 which may be considered as the side member of the chassis of

an automobile, and the vehicle spring is shown at 2 and attached by the shackles 3 to the strip 4 encircling the automobile axle 5.

The shock absorber proper comprises the casing 7 shown in two parts 8 (Fig. 3) and 9 (Fig. 4). The casing members 8 and 9 are mutually attached as by the bolts 10 and nuts 11, and the member 8 is provided with the lug 12 to which is attached the arm 13 which is pivoted to the pin 14 fastened by the bolt 15 and nut 16 to the bracket 17 carried by the axle 5. The said bracket 17 may be conveniently attached to the said axle and spring 2 by the shackle bolts 18 and nuts 19, as illustrated.

The casing 7 is hollow, and within it is mounted the oscillating or pivoted piston 20 which has a stud 22 journaled in the casing member 9 and the arm 25 is rigidly connected to the shaft or journal 23, as by the strap portions 25' and strap bolt 27. The arm 25 is connected to the vehicle body member 1 in any preferred fashion, being illustrated as pivoted to a pin 24 on which it is held by a nut cap 26. It will be understood, however, that the particular means employed for mounting and connecting the casing 7 and oscillating piston 20 to the body and axle or spring may be varied as desired and form no part of the essential features of our invention.

The casing 7 is provided with a connecting passage, illustrated as cored within the casing member 8 and provided with terminal ports 29 and 30 opening in the chambers A and B on opposite sides of the piston 20, and near the ends or corners of said chambers, respectively. The said connecting passage or by-pass comprises two parts 28^a and 28^b which unite at 28', and are provided at their junction with the central port 31 also opening within the hollow casing 8 and opposite the normal or mid position of the piston 20, the said port 31 being therefore closed by said piston when at its exact mid position, or the position assumed when the vehicle spring 2 is under no compression of excessive load on the vehicle body 1 or is not in material motion due to the impacts of traffic.

The chambers or compartments A, B, are connected respectively to the by-passes *a* and *b* which lead to the auxiliary spring compartment C. These by-passes *a* and *b* are formed in the parts 8 and 9 of the casing and converge toward each other as indicated in dotted lines Fig. 3. The compartment or spring chamber C contains a piston 33 longitudinally movable on a piston guide rod 39 which is seated at its opposite ends in the seat 40 of the casing 8 and the seat 41 in a screw plug 42 which is threaded at 43 into

the hole in the casing 8 forming the spring chamber C. The compression springs M and N are confined between the piston 33 and the spring plates 44 and 45 attached by the nuts 46 and 47 to the guide rod 39, as illustrated.

The passages 28^a and 28^b are controlled respectively by the valves 50 and 51 which are preferably identical in construction and their parts represented by the same reference numerals. Each valve has a valve head 52 provided with an aperture 53 of equivalent size preferably to each of the ports 29 and 30. The valve head 52 is inserted in an enlargement 54 near the end of the passage 28^a or 28^b, and is provided with the valve stem 55 having a threaded end 55' and longitudinal key way 56, as illustrated in Figs. 7 and 8. The threaded plug 57 is screwed into a threaded slot in the casing member 8 after the valve head 52 is inserted in the enlargement or seat 54, and said plug has its outer end 57' of serrated form (Fig. 8). The washer 59 is provided with a key 60 movable within the slot 56 of the stem 55 and a tapered key 61 adapted to engage one of the serrations of the end 57' of the plug 57. The jam nut 55'' is threaded on the end 55' of the valve stem 55 and when tightened acts to hold the said stem and hence the valve stem 52 in adjusted position. The hollow cap 57^a is also screwed onto the threaded plug 57, and serves to protect the valve parts. In order to change the degree of opening of the valve, it is necessary merely to remove the cap 57^a and jam nut 55'', after which the valve stem 55 may be turned within the plug 57 until the proper degree of closure of the port 29 (or 30, as the case may be) is obtained. The washer 59, the tapered key 61 of which is engaged with one of the serrations 57' of the plug 57 is then fastened in such engaged position by screwing on the jam nut 55'', the key 60 of the washer holding the valve stem 55 and valve head 52 in desired position.

In operation, assuming that severe irregularities are not being encountered on the road by the vehicle wheels, and assuming also that the controlling valves 50 and 51 are so adjusted as to restrict the openings through the passages 28^a and 28^b the desired amount, the passage 28^b being in general more restricted than the passage 28^a, the shock absorber will act to dampen or absorb the vibrations of the spring 2, so that its upward movement is gradually retarded by the moderate resistance to flow of liquid through the port 29 of the passage 28^a, and through said passage and the passage 28^b and port 30, or directly out of the central port 31 from the passage 28^a, on the upward movement of the piston 20 in the casing 8.

This movement, which is caused as much (in the device illustrated) by the rotation 65 of the casing as by the rotation of the piston 20, decreases the size of the chamber A on one side of or above the piston 20, thus forcing the liquid through the port 29 into passage 28^a, the port 31 being uncovered by the movement of the piston 20, after which the said liquid passes out through the port 31 into the enlarging chamber B. On the down stroke or reaction of the spring 2, the said liquid, such as oil, passes in reverse direction 75 through the port 31 until the piston 20 uncovers port 31. The liquid then has to pass through the restricted port 30 into the passage and out of ports 29 and 31 into the chamber A, as all of the incompressible liquid must be forced through the restricted opening in the port 30 when the piston passes the port 31, and as said opening is in general of smaller size or more restricted than that of the port 29, the shock absorber 85 will in general be so adjusted as to absorb the sudden reaction of the spring on account of the high frictional resistance to travel of the liquid, and jolts in the vehicle body will be thereby prevented.

The above description applies to the operation of our improved shock absorber when the impacts to the vehicle spring 2 from the jolts of traffic are not so heavy as to cause very rapid compression or movement of the said spring. If, however, a sudden bump or rut or like depression is encountered on the road, and the vehicle is traveling at a considerable rate, the initial movement of impact of the vehicle spring is much more rapid. This would result in forcing the liquid at a much higher rate through the connecting passages, or rather an ineffectual tendency to force said liquid at the required higher rate, and hence a jar to the vehicle body; except for the improved means to prevent such result which we provide. This means consists, as illustrated in Figs. 1 to 9, in the springs M, N, and piston 33 seated in the spring chamber C. When a sudden shock is imparted to the axle 5 and the spring 2 due to the vehicle encountering an abrupt rut or depression, the piston will be moved upward as indicated in dotted lines Fig. 3, and this shock coming so suddenly will direct a pressure against the piston 33 which will be moved down and spring M compressed. This movement of the piston 33 will put the two chambers A and B in communication with each other through the auxiliary by-pass formed by the passages a and b and thereby the fluid is equalized within the chambers A and B during the initial movement of the piston 20. This sudden movement of the piston 20 does not

give the fluid time to pass in any appreciable quantity through the port 29 and consequently the sudden shock is absorbed by the spring M. In this manner means other than the restricted opening 29 is provided for retarding the movement of the piston as the spring M affords resistance to the movement of the piston, but such resistance is less than that afforded by the restricted opening 29, and as a consequence the piston 33 is moved so as to equalize the fluid within the chambers A and B. When this initial movement of the piston is over, the spring M brings the piston 33 back to its normal position and the further movement of the piston 20 forces the liquid through the restricted opening 29 and the full effect of the absorber is then obtained. This results in permitting an initial preliminary movement of the vehicle spring without encountering the full resistance of the shock absorber; but on the further movement of the piston 20 the resistance of the absorber is then brought into play by the ordinary action of forcing the liquid through the passage 28, as described above. In Figs. 1 to 6 a by-passage for liquid is also opened through the by-passes *a* and *b* by the movement of the piston 33, so that in this construction the liquid may pass around the piston 20 until the shock is sufficiently absorbed by the vehicle spring resistance and by the travel of liquid through the passage 28 and the said passages *a*, *b*, to permit the expansion of the spring M. The expansion of the spring further increases the resistance of the shock absorber, and by closing the by-passage *a*, *b*, provides for an additional increased resistance on account of the necessary travel of liquid through the passage 28 in the other direction described above. This results in adding an additional resistance to absorb the energy of vibration of the vehicle spring after its first yielding to the heavy or sudden impact. We therefore obtain a shock absorbing effect which is less at the moment of impact when heavy obstacles are encountered by the wheels than during ordinary running over slight unevennesses in the road. The energy stored up in the springs M or N is, however, added to the resistance of the shock absorber subsequently so that its shock absorbing effect in preventing excessive vibration of the spring is increased rather than diminished. By our invention we therefore provide means for permitting an initial movement of the piston in the casing without the travel of liquid through the restricted passage or fixed area of escapement when heavy road shocks are encountered.

The operation is similar to that of a

vehicle spring acting as an ordinary spring not stiffened by a shock absorber at the instant of impact, so as to prevent a heavy initial shock to the vehicle body, but as a stiffer spring in absorbing such a shock to the axle.

In Fig. 10 we have illustrated a modification in which the casing 67 and pivoted piston 71 are mutually moved through the lever rods 68 and 69 by the relative movement of the vehicle body and spring in the same manner as that just described. The connecting passage 72 in the casing 67 also comprises two parts or sections 72^a and 72^b having a central port 73 at their junction and the terminal ports 74 and 75 arranged respectively in the chambers A' and B' on opposite sides of the piston 71. The chambers A' and B', however, have yielding walls formed by a pivoted head 77 journaled on the piston shaft 78 which is fastened to the arm 68 as by the strap 68'. The movable head 77 comprises the chamber heads 77^a and 77^b, the faces of which are normally adjacent to the terminal ports 74 and 75 within the casing 67. The springs M' and N' are arranged in contact with the heads 77^a and 77^b respectively, being held in position by the spring caps 80 and 81 respectively and the heads 82 and 83 provided with the pins 84 and 85 respectively or in any desired fashion. The said heads 82 and 83 are illustrated as integral parts of the plug 87 closing the spring chamber C', and adjustably mounted by means of the threaded stem 88 covered by the screw cap 89.

The operation of the modified device illustrated in Fig. 10 is analogous to that of the construction illustrated in Figs. 1 to 9, and differs therefrom principally by the omission of the by-pass *a*, *b*, in the aforesaid construction. When, on sudden heavy impacts, the liquid in the chamber A' is forced at a very high rate through the port 74 and passage 72, the pivoted head 77 oscillates by pressure of liquid on the chamber head portion 77^a against the resistance of the spring M' so as to permit an initial rapid compression of the vehicle spring before the liquid is forced through the resistance passage 72. The pivoted head 77 engages the stops D and retards the compression of the springs M', N'. The oscillating head portion 77^b in this case is given an opposite angular movement relative to the piston 71 by the movement of the pivoted head 77, and the said head 77 is returned to normal position by the mutual balancing action of the springs M' N' when the rate of movement of the vehicle spring is reduced, the shock absorbing device then acting with increased resistance to absorb further vibratory movement of the spring and hence pre-

vent shocks to the vehicle body as described above.

It will be understood, moreover, that our invention permits of various modifications and considerable changes without departing from its spirit as defined in the accompanying claims.

What we claim is:

1. A shock absorber for vehicles comprising a casing for fluid, a piston therein dividing said casing into two chambers and movable relative to said casing on the relative movement of the vehicle spring and body, means movable in response to variations in pressure thereon for equalizing the pressure within said chambers during the initial movement of said piston in either direction, and said casing having a restricted passage connecting said chambers for by-passing the fluid on further movement of said piston.

2. A shock absorber for vehicles comprising a casing for fluid, a piston therein dividing said casing into two chambers and movable relative to said casing on the relative movement of the vehicle spring and body, said casing having a pressure operable by-pass for equalizing the fluid within the chambers during the initial movement of the piston in either direction, and provided with a restricted passage connecting the chambers for by-passing the fluid on further movement of said piston.

3. A shock absorber for vehicles comprising a casing for fluid, a piston therein dividing said casing into two chambers, and movable relative to said casing on the relative movement of the vehicle spring and body, and having a by-pass for equalizing the fluid within the chambers on the initial movement of the piston in either direction, spring actuated means retarding said movement, and said casing provided with a restricted by-pass forming communication for travel of the fluid between said chambers after the initial movement of the piston.

4. In shock absorbers, the combination of a casing for liquid, a piston movable therein dividing said casing into two chambers, said casing and piston being operatively connected to the vehicle body and spring, said casing having a restricted passage connecting the chambers on opposite sides of the piston, an auxiliary passage communicating with each chamber, a piston therein, and a spring movable by said piston to permit the temporary equalization of liquid in the chambers during the initial movement of said first piston in either direction.

5. In shock absorbers, the combination of a casing for liquid, a piston movable therein dividing the casing into two chambers, said casing and piston being operatively connected to the vehicle body and spring, said

casing having a restricted passage connecting the chambers on opposite sides of the piston, an auxiliary by-pass connecting said chambers, means normally closing said auxiliary by-pass and opened by the initial movement of said piston in either direction whereby the equalizing of said liquid within the chambers takes place during the initial movement of said piston.

6. In shock absorbers, the combination of a casing for liquid, a piston movable therein dividing the casing into two chambers, said casing and piston being operatively connected to the vehicle body and spring, said casing having a restricted passage connecting the chambers on opposite sides of the piston, an auxiliary by-pass also connecting said chambers, a piston normally closing said by-pass and springs engaging said last named piston whereby said last named piston is moved by the initial movement of the first named piston in either direction to open said auxiliary by-pass and equalize the liquid within the chamber by the initial movement of said first named piston.

7. A shock absorber comprising a casing for liquid, an oscillating piston dividing said casing into chambers and movable relative thereto on the movement of the vehicle spring, a restricted passage having terminal ports opening in said chambers, and a central fixed port in said casing, said port affording a connection between either of said terminal ports and the opposite chamber on the movement of said piston, and means for varying the size of said restricted passage between said central port and each of said terminal ports.

8. A shock absorber comprising a casing for liquid, an oscillating piston dividing said casing into compartments and movable to universally vary the size of said compartments on the movement of the vehicle spring, a central port in said casing closed, or partly so, by said piston when in mid-position, terminal ports opening in each of said chambers, a passage connecting each terminal port with said central port, and a valve controlling each passage and arranged to provide a restricted opening therein of constant size when in use.

9. A shock absorber comprising a member connected with the vehicle body, a second member connected with the axle and movable relatively to the first, a resistance medium adapted to oppose such relative movement, means constructed and arranged to cause said medium to offer slight proportionate resistance to light impact on the vehicle spring, and means constructed and arranged to cause said medium to offer decreased proportionate resistance to heavy impacts during the initial period of com-

pression movement of the vehicle springs under said heavy impact.

10. A shock absorber comprising a member connected with the vehicle body, a second member connected with the axle and movable relatively to the first, a resistance medium interposed between said members, means constructed and arranged to cause said medium to offer slight proportionate resistance to light impact on the vehicle spring, means constructed and arranged to cause said medium to offer decreased proportionate resistance to heavy impacts during the initial period of compression

movement of the vehicle springs under said heavy impact, and means to cause said medium to offer the full resistance of the device during the latter part of compression movements under heavy impacts. 15

In testimony whereof, we, the said PAUL J. CUBBISON and ROBERT G. McFARLAND, have hereunto set our hands. 20

PAUL J. CUBBISON.
ROBERT G. McFARLAND.

Witnesses:

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