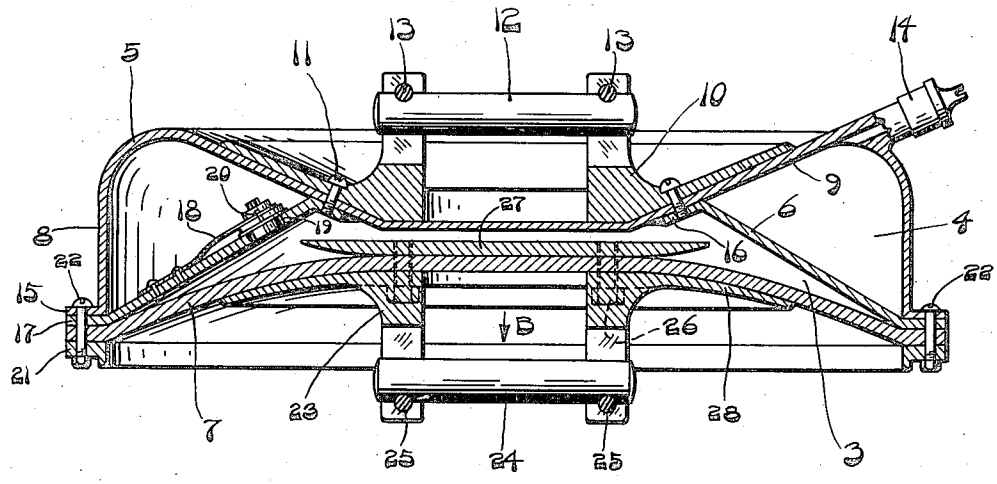
F. S. CHURCH.

AIR SPRING.

APPLICATION FILED APR. 6, 1921.

1,414,623. Patented May 2, 1922.

FIG. 1



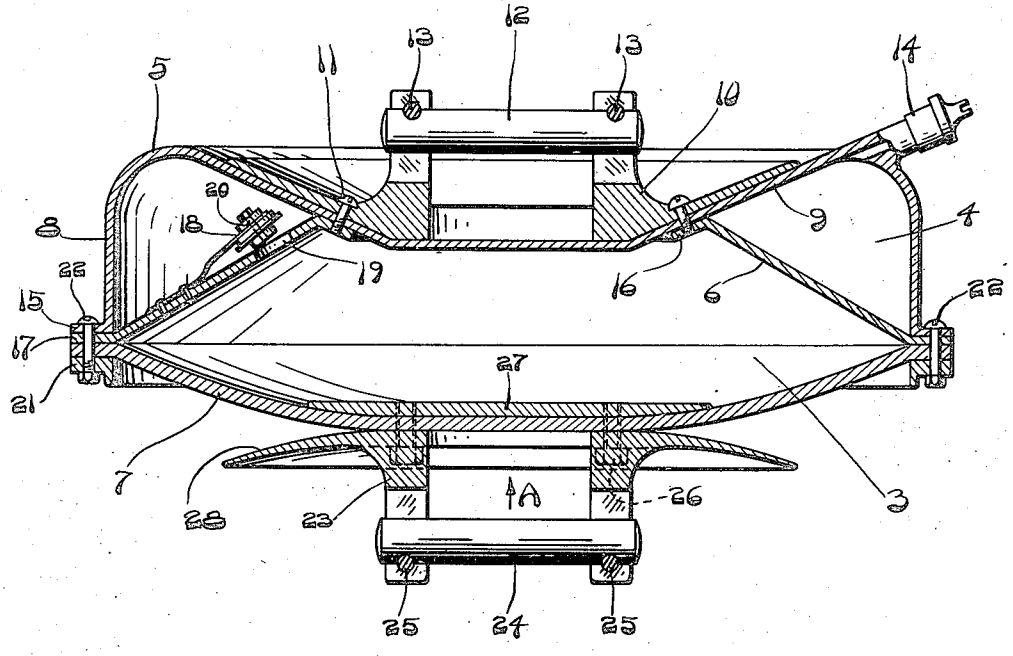


FIG. 2

INVENTOR

Frank S. Church

BY Thornton Bogert

ATTORNEY

UNITED STATES PATENT OFFICE.

FRANK S. CHURCH, OF CINCINNATI, OHIO, ASSIGNOR OF ONE-HALF TO THE THOS. J. CORCORAN LAMP COMPANY, OF CINCINNATI, OHIO, A CORPORATION OF OHIO.

AIR SPRING.

1,414,623. Specification of Letters Patent. Patented May 2, 1922.

Application filed April 6, 1921. Serial No. 458,984.

To all whom it may concern:

Be it known that I, FRANK S. CHURCH, a citizen of the United States, residing at Cincinnati, in the county of Hamilton and State of Ohio, have invented a new and useful Air Spring, of which the following is a specification.

This invention relates to an improved air spring of a disc-shaped diaphragm type as distinguished from the annular-tube diaphragm type disclosed in my copending application serially numbered 414,376 filed Oct. 2, 1920. In the present application, as in the application to which reference has just been made, the construction is shown as designed to be used either as a substitute for the usual vehicle spring or as a supplemental spring or shock absorber.

The particular object in the present invention, however, has been to provide in an air spring primary and secondary pressure chambers which cooperate for vastly improved action and reaction during the initial and rebound shock impelled movements of the running gear of a vehicle with relation to its chassis.

In addition to this important feature of the invention herein described, I have had as a further object to produce an air spring construction of materially decreased size and improved shape, in which greatly increased efficiency of operation is attained than in the construction of my above mentioned copending application, all of which renders it better adapted to vehicles having certain types of spring suspension.

Another object I have had in the production of the present invention is to produce a construction, the parts of which may be much more simply and consequently much more easily and cheaply manufactured, with a resultant reduction in the total cost of production and in the sale price to the purchaser.

These and other objects which have not been specifically set forth, are attained in the air spring construction described in the following specification and illustrated in the accompanying drawing in which:

Fig 1 is a sectional elevation of my improved air spring with the elements thereof in the positions they assume immediately upon the completion of an initial shock-impelled movement of the vehicle running gear relatively to the chassis.

Fig. 2 is a view similar to Fig. 1, but showing the parts in the positions they assume after completion of a rebound shock-impelled movement of the running gear relatively to the chassis and immediately upon the introduction of an initial shock-impelled movement thereof.

In the form which I have chosen as an embodiment of my present invention, I have provided a primary or main air chamber 3 and a secondary or auxilliary air chamber 4, the latter being formed by the space between the air spring body 5 and an inner division wall 6, and the former being formed by the space between the division wall 6 and a flexible diaphragm 7. The body 5 is preferably formed of sheet metal with its outer walls 8 of cylindrical shape and having a depressed top 9 closing the cylinder at its upper end. A shackle bolt bracket 10 is secured to the top by any suitable means as for example the spaced screws 11 and mounted in the split ends of the bracket is the shackle bolt or pin 12 which is locked therein by pins or bolts 13, further illustration and description of which is not essential to the invention. At a suitable point, preferably at or adjacent to the juncture of the side and top of the body an air valve 14 is provided for inflation of the spring, as will be hereinafter explained. The lower edge of the cylindrical body wall is outturned to form an annular flange 15. The inner division wall 6 is preferably of sheet metal and has a shape which is substantially frusto-conical. The upper edge of the inner wall is provided with a slightly downturned flange 16 to fit the depressed top 9 of the body and may be so located as to permit of being fastened by the screws 11 to the body, thus securing the bracket 10, body 5, and inner wall 6 together at this point. The lower edge of the inner wall meets the bottom edge of the cylindrical wall 8 of the body and is provided with an outturned flange 17 which lies against the flange 15 of the body. In the inner wall and located to open upwardly is a clack valve 18 which closes an opening 19 in the wall, the opening 19 affording communication between the chambers 3 and 4 when the valve is open and a small opening or bleeder passage 20 in the valve affording communication between the chambers when the valve is closed. The flexible diaphragm 7 is preferably of a rubber impregnated fab-

ric such as the usual pneumatic tire material, and being of disc shape having a dished formation, is secured to the under face of inner wall flange 17 by a ribbed clamping ring 21, which with the diaphragm, and flanges 15 and 17, are held together securely by bolts 22 spaced at intervals. At the center of diaphragm 7 and in axial alignment with shackle bolt bracket 10 is the lower shackle bolt bracket 23 carrying the shackle bolt or pin 24 which is held in the split ends of the bracket by lock bolts 25 as in the upper bracket. This lower bracket is held to the diaphragm by bolts or screws 26 which clamp the material thereof between the bracket and an inner clamping plate 27, the bracket having a disc-like plate extension 28 which is curved downwardly to its outer edge to take the opposite curvature of the diaphragm when depressed as shown in Fig. 1, and the plate 27 has its lower face similarly curved to take the curvature of the diaphragm when it is extended as shown in Fig. 2. Such curvatures as are provided by plates 27 and 28 therefore prevent deteriorating bending action of the diaphragm in its flexing during the operation of the spring.

In the operation of my improved air spring which is first inflated to the desired extent through the valve 14, which is preferably one of the usual Schrader type, the vehicle chassis is supported by the upper shackle bolt 12 of each spring attached thereto and the running gear receives the weight of the chassis and its attached parts through the lower shackle bolt 24, one of my improved air springs being preferably located at each point where the vehicle springs and chassis are connected. Upon the passage of the vehicle wheels over any unevenness or obstruction in the roadway upon which the vehicle is travelling, the first action will be to lift the wheel which encounters the obstruction, with relation to the chassis. This causes the shackle bolt 24 to be moved toward shackle bolt 12 by indenting diaphragm 7 to flex it over plate 28. This movement of the diaphragm, tending to collapse it, is resisted yieldingly by the pressure in chamber 3 which is increased by reason of this action. The result of such an increase of pressure within chamber 3 is to overbalance the pressure in chamber 4 by lifting valve 18, thus equalizing the pressures in both chambers and giving the air spring greater resiliency by thus automatically increasing the volume of air to be acted upon. An extremely collapsed position of the diaphragm, after having been moved from the position shown in Fig. 2, is shown in Fig. 1, and the valve, which is shown open in Fig. 2 during the upward movement of diaphragm 7 as indicated by arrow A, in order to show the communication between the chambers during the main shock absorbing movement of the air spring, is shown closed in Fig. 1 upon completion of the collapsing movement and resumption of the extended position by movement of the diaphragm downward as indicated by arrow B. In the condition shown in Fig 1, the air in chamber 4 has been materially increased in density and the bleeder passage in the valve will allow of gradual resumption of normal pressure within chamber 3 from chamber 4, thus acting to cause the air spring to snub and resist with yielding force the reaction or rebound shock occasioned by the primary or main shock movement, so that the spring will be caused to act in the combined capacity of shock absorber and snubber as these terms are ordinarily understood by those skilled in the art. Although I have described the operation of the parts under extreme action and reaction conditions, it will be understood that normally the spring will be operating under greatly modified vibratory movements which bring about a series of rapid collapsing and restoring actions of the diaphragm, the valve, and the air in the two cooperating chambers, serving to maintain a relative smooth passage of the vehicle over the roadway.

A feature of my invention is that the air spring body and diaphragm being relatively large in diameter as compared to the thickness of the spring over the body and diaphragm, will support a much greater load and react in like degree as compared with air spring constructions having much greater length from top to bottom and a considerably decreased area exposed to air pressure. Another feature is that because of the thin construction of my improved spring, the substitution thereof between the chassis and vehicle spring in place of the usual shackle, is rendered possible without in any way changing the height of the chassis above the vehicle spring or otherwise altering the positions, conditions, construction, or operation of the vehicle parts with relation to one another. A feature which should not be overlooked lies also in the fact that in as much as the plate 28 beneath the diaphragm is curved away from the diaphragm and does not contact therewith except at the center under normal conditions, any increase in load will bring an increased amount of plate surface into contact with the diaphragm to afford greater support thereto, thus reinforcing it to a greater extent as well as subjecting an increased area to the air pressure to support an increased load.

These and other advantages are attained in my improved air spring the novelties of which are set forth in the appended construction claims as follows:

1. An air spring consisting of a substantially cylindrical metal body having the

upper end thereof closed, an inner wall located therein and secured at its lower edge to the lower edge of the body and at its upper edge to the top thereof adjacent to the center thereof to form a substantially annular air chamber between the body and inner wall, a disc shaped flexible diaphragm closing the lower end of the body to form an air chamber between it and the inner wall, and means for attaching the chassis and running gear of a vehicle to the body and diaphragm respectively.

2. In an air spring the combination of a cylindrical metal body having a closed top, a relatively flexible diaphragm closing the bottom, a wall within the body dividing the space therein into chambers, one between the top and the wall and one between the wall and the diaphragm, and means attaching the body and diaphragm respectively to the chassis and running gear of a vehicle.

3. In combination in an air spring a body having a closed top, a diaphragm closing the bottom, a wall dividing the space between the top and diaphragm into two chambers, a valve in the wall adapted to open and close to afford communication between the chambers during relative movements of the diaphragm and body, and means adapted to connect the air spring to a vehicle whereby relative movement of the body and diaphragm will occur during movement between the vehicle chassis and running gear.

4. An air spring comprising a body having a closed top, a diaphragm closing the bottom and relatively movable with relation to the body, and a plate having a reversely curved surface in engagement with the diaphragm, adapted to present a surface of increasing area to the diaphragm as the plate is moved to flex the diaphragm toward the body, and means in the body dividing the space between the top and the diaphragm into two chambers, and adapted to permit easy passage of air from the chamber below the means to the chamber above the means and restricted passage of air from the chamber above the means to the chamber below the means.

5. In an air spring the combination of a body having one end closed, a diaphragm closing the opposite end of the body, a wall dividing the space within the body into chambers, a valve within the wall adapted to open when the diaphragm is depressed to afford communication between the chambers, and having a bleeder passage therein to afford a restricted communication between the chambers when the valve is closed, means for connecting the body to one relatively movable portion of a vehicle, and a second means for connecting the diaphragm to another relatively movable portion of a vehicle.

6. In combination in an air spring a metal body having a closed top, a flexible diaphragm closing the bottom and relatively movable with relation to the body, a wall dividing the space between the top and diaphragm into two chambers, a valve in the wall adapted to open and close to afford communication between the chambers, a plate having a reversely curved surface in engagement with the diaphragm, adapted to present a surface of increasing area to the diaphragm as the plate is moved to flex the diaphragm toward the body, means for connecting the body to the chassis of a vehicle, and a separate means for connecting the diaphragm to the running gear of a vehicle.

FRANK S. CHURCH.