I. COWLES.

PNEUMATIC CUSHIONING MEANS.

APPLICATION FILED NOV. 16, 1910.

1,002,823.

Patented Sept. 12, 1911.

2 SHEETS—SHEET 1.

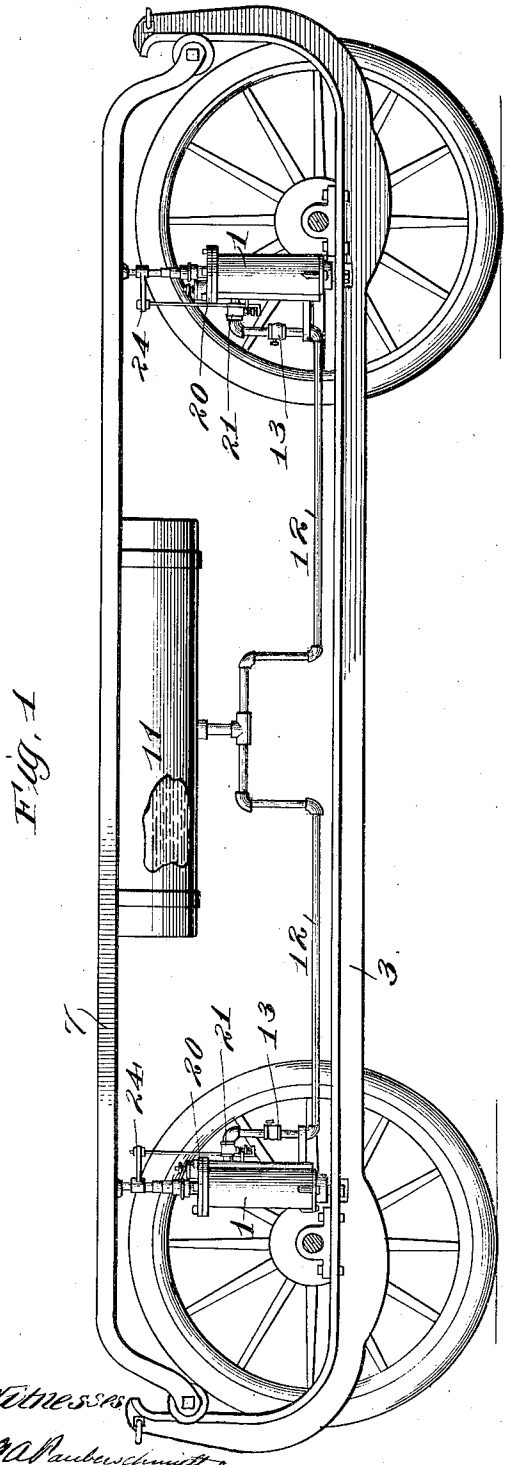

Fig. 1.

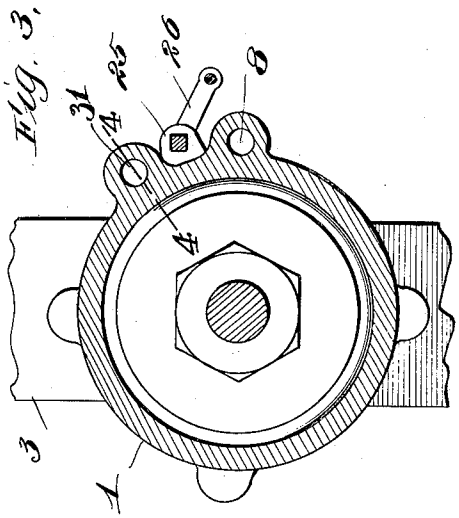

Fig. 3.

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2 SHEETS—SHEET 2.

Fig. 2.

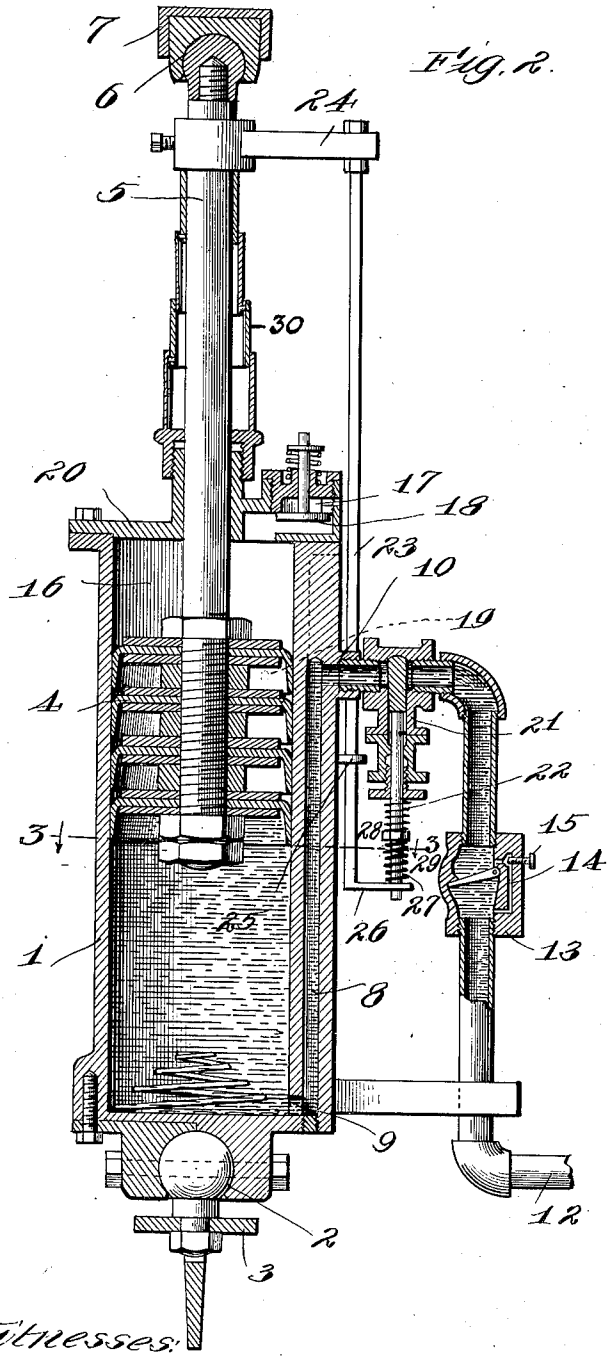
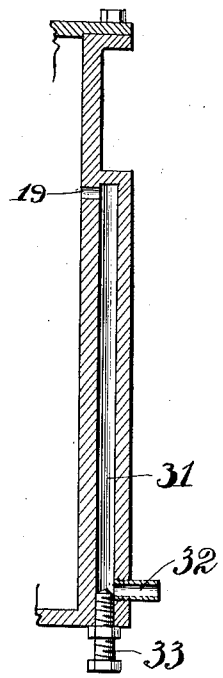


Fig. 4.



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UNITED STATES PATENT OFFICE.

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PNEUMATIC CUSHIONING MEANS.

1,002,823. Specification of Letters Patent. Patented Sept. 12, 1911.

Application filed November 16, 1910. Serial No. 592,680.

To all whom it may concern:

Be it known that I, IRVING COWLES, citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Pneumatic Cushioning Means; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to new and useful improvements in pneumatic cushions of the type illustrated and described in Letters Patent No. 891,328 issued to myself and E. H. MacDowell and further illustrated and described in our joint applications for patents Serial Nos. 311532, 517492 and 524283.

The object of the present invention is to provide means whereby the upward movement of the piston in a cylinder is automatically limited so that in the event that a greater load is imposed upon one portion of a vehicle body supported on said cushions than upon another part, the lighter parts will not be raised and the heavier part become depressed.

The invention consists in the features of construction and combinations of parts hereinafter fully described and claimed.

In the accompanying drawings illustrating a suitable embodiment of the invention: Figure —1— is a vertical longitudinal section of a vehicle equipped with pneumatic cushioning means constructed in accordance with my invention. Fig. —2— is a central vertical longitudinal section through one of the cylinders employed. Fig. —3— is a horizontal section on the line 3—3 of Fig. —2—, certain parts being omitted from same. Fig. —4— is a fragmentary detail longitudinal section on the line 4—4 of Fig. —3—.

In the aforesaid patent and several applications there is described a pneumatic cushioning means in which the vehicle body is supported upon the running gear frame by means of a plurality of cylinders and pistons in the latter, one chamber of each cylinder being connected with a central pressure tank containing air under pressure; the said pressure being transmitted to the said chambers of said cylinders by means of a liquid vehicle such as oil. The pistons of said cylinders preferably are supported by the pressure and in turn carry the vehicle body. The connection between each cylinder and the central pressure tank is so made that upon a downward stroke of the piston the oil may freely pass into said pressure tank but the return of said oil to the cylinder is retarded by means of a check valve and a by-pass around the same so that the upward stroke of the piston is rendered relatively slow compared to the downward stroke thereof.

The cylinders preferably correspond in number with the number of wheels supporting the vehicle and each thereof is located contiguous to the hub of one of said wheels so that vertical movements of the latter relatively to the vehicle body are transmitted to the said cylinders and pistons and the resultant shocks absorbed without imparting movement to the vehicle body to an appreciable extent.

The specific means for accomplishing the aforesaid results are described in the prior patent and pending applications aforesaid, the present invention being limited more particularly to means for preventing those portions of the vehicle body which are less heavily loaded than others from being raised to a higher elevation than the more heavily loaded parts thereof. This is accomplished to some extent in the constructions shown and described in the said prior patent and applications by providing means for producing an air cushion between the cylinder head and the upper end of the piston but in the event of the slightest leakage of said air cushion the latter would not become operative to prevent the aforesaid condition.

The main object of the present invention is to provide means whereby the upward movement of the piston is limited by automatically interrupting its communication with the pressure tank when said piston reaches a given point in its upward movement so that the further transmission of pressure and movement to said piston is prevented.

In the accompanying drawings illustrating a suitable embodiment of the invention, the cylinder 1 is mounted by means of a universal joint 2 upon the running gear frame 3. In each of said cylinders a piston 4 is reciprocally movable; the piston rod 5 being connected by means of a universal joint 6 with the body frame 7. A passage 8 in the cylinder wall communicates through

the port 9 at the lower end of said cylinder with the lower chamber of the latter, and through the port 10 said passage 8 communicates with the pressure tank 11 by means of the pipe 12 having valves interposed therein as will be hereinafter more fully described. In said pipe 12 there is interposed a check valve 13 which serves to permit free flow from the cylinder 1 to the pressure tank 11 but prevents flow from said tank 11 to said cylinder 1. Around said check valve 13 and preferably in a wall of the casing thereof is a small by-pass duct 14 which is controlled by means of a pin valve 15 which enables said by-pass to be more or less choked in order to control the rapidity of upward movement of the piston after a downward stroke thereof.

The upper chamber 16 of the cylinder is supplied with air through an inlet port 17 in the cylinder head 20 which is controlled by a normally closed valve 18; the latter serving to permit air to pass into said chamber 16 but preventing egress thereof. In the cylinder wall there is a small opening 19 which is closed by the piston 4 as the latter approaches the upper limit of its movement but which is open to enable air to be admitted and discharged when said piston moves downwardly and returns again to the upper limit of its movement. Upward movement of said piston 4 beyond the elevation of said port 19 serves to compress the air contained in the chamber 16 and such compression resists further upward movement of the piston as will be obvious.

In the event that the pressure in the tank 11 is relatively high as for example to support a relatively heavy load on the vehicle body the said piston 4 will, of course, move upwardly until the air in the chamber 16 is compressed to a point equal to the pressure in said tank 11. This may cause said piston 4 to very closely approach or even come in contact with the head 20 of the cylinder, and this it is desired to avoid. To prevent this contingency there is interposed in the pipe 12, preferably between the check valve 13 and the connection of said pipe with the cylinder 1, a valve 21 of any suitable construction. The said valve 21 is maintained normally open by means of a compression spring 22 and is closed against the action of said spring by means of a rod 23 rigidly connected by means of an arm 24 with the piston rod 5, said rod passing between its ends through a guide 25 on the cylinder. At the lower end of said rod is a horizontal arm 26 having an opening therein through which the stem 27 of the valve 21 is adapted to pass. On said stem 27 is a collar 28 against which the spring 22 bears at one end to maintain said valve normally open and to the other or lower face of which a compression spring 29 is secured, the latter serving to permit further upward movement of the rod 23 after said valve 21 is closed. The said rod 23 and its arm 26 are relatively so located and disposed as to cause said valve 21 to be closed when the piston 4 reaches a point in its upward stroke at which the port 19 is closed thereby and sufficient space is still left above the same to permit enough upward movement of said piston to compress the air contained in the chamber 16. It will be obvious, of course, that as soon as said valve 21 is closed the transmission of further pressure from the tank 11 to the lower chamber of the cylinder is prevented and that further upward movement of the piston must thereafter be accomplished against the resistance offered by compression of the air in the chamber 16 and by the formation of a partial vacuum in the lower chamber of the cylinder, these two factors coacting to effectually prevent the piston rising high enough in the cylinder to strike the head 20 thereof.

The pressure in the tank 11 is normally maintained sufficiently high to support the vehicle body at the upper limit of its movement which in the present instance is determined by closure of the valves 21. Preferably said pressure is also sufficiently high to maintain the vehicle body in this position when loaded to a normal extent. However, overloading of the vehicle body at one or more points is not infrequent and in some instances a very heavy load may be disposed directly over or contiguous to one of said cylinders so that the tendency would be to depress the piston in the said cylinder. Such depression of one piston will cause a slight increase in the pressure in the tank 11 and this would in turn be communicated to the other cylinders and thus serve to raise the pistons in the other cylinders to a height greater than that determined by said openings 19, and, thus, as one part of the vehicle body is depressed the other parts would necessarily become more elevated. By means of my present invention this is prevented and at the same time the increase in pressure due to greater load at one point of the vehicle body than at the other points is communicated only to the particular cylinder bearing the greater load which is obviously very advantageous. Said increased pressure due to overloading the vehicle body at one point will, of course, act to correspondingly increase the resistance to downward movement of the remaining pistons but would not materially interfere with absorption of shocks.

Suitable means may be provided for protecting the exposed portions of the operating parts from dust and grit, as for example, the telescoping jacket 30 surrounding the exposed end portion of the piston 5 and which is secured at one end to the

cap of the stuffing box of the cylinder head 20 and at its other end to the hub of the arm 24.

In order to limit the volume of air at any time contained in the chamber 16, a passage 31 is provided in the wall of the cylinder 1 which communicates through an opening 19 with the latter and at its other end with the outer air at 32, said passage being adapted to be partially choked by means of the valve 33. The said opening 19 is adapted to be closed by the piston when approximately the latter approaches the upward limit of movement determined by the closure of the valve 21, so that at no time can there be a greater volume of air contained in the chamber 16 than, at atmospheric pressure, equals the volume of space above the level of said opening 19. This will prevent the retention of a larger volume of air drawn into the chamber 16 during the downward movement of the piston and which would necessarily become compressed during the return stroke of the piston to its normal position and thus partially counterbalance the tank pressure.

I claim as my invention:

1. In a pneumatic cushioning device, the combination with a cylinder, a piston therein and a fluid pressure tank connected with said cylinder at one end, of a valve in the connection between said cylinder and said tank, a spring maintaining said valve normally open, and means rigid with said piston operatively engaging said valve to close the same against the action of said spring as said piston reaches a given point in its movement.

2. In a pneumatic cushioning device, the combination with a cylinder, a pressure tank, and a pipe connecting the latter with said cylinder at one end, of a piston in said cylinder, a valve in said pipe, a spring maintaining said valve normally open, and a member rigid with said piston adapted to yieldingly engage said valve to close the same as said piston approaches one limit of its movement relatively to said cylinder whereby said piston is capable of further movement in the same direction after said valve is closed.

3. In a pneumatic cushioning device, the combination with a cylinder, a pressure tank, and a pipe connecting the latter with said cylinder at one end, of a piston in said cylinder, a valve in said pipe, a spring maintaining said valve normally open, an arm on the piston rod, a rod secured at one end to said arm and disposed parallel with said piston rod, a projection on the free end of said rod and a spring interposed in the path of said projection and engaging the same valve, said projection adapted to bear upon said last-named spring as said piston approaches one limit of its movement relatively to said cylinder and compress the same, thereby overcoming the resistance of said first-named spring and closing said valve against the action thereof.

4. A pneumatic cushioning device comprising a cylinder, a piston operating therein, a fluid pressure tank, connections between the cylinder and said tank, an incompressible liquid solely within the lower portion of the cylinder and in the said connections and constituting means for transmitting pressure from said tank to the piston, means whereby the supply of liquid to the cylinder is discontinued when the piston reaches its normal position, the said piston being yieldingly suspended and capable of further upward movement when the supply of liquid to the cylinder is discontinued.

In testimony whereof I have signed my name in presence of two subscribing witnesses.

IRVING COWLES.

Witnesses:
RUDOLPH WM. LOTZ,
M. M. BOYLE.