E. SCHNEIDER.

SUSPENSION APPARATUS FOR GUN CARRIAGES AND THE LIKE.

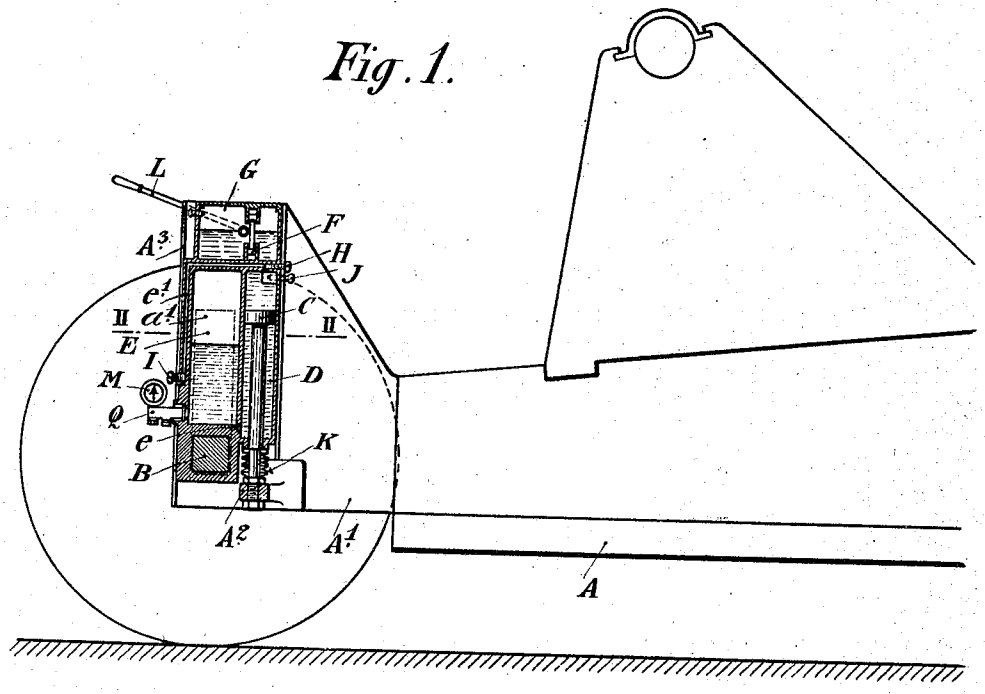
APPLICATION FILED AUG. 21, 1918.

1,310,146.

Patented July 15, 1919.

4 SHEETS—SHEET 1.

Fig. 1.



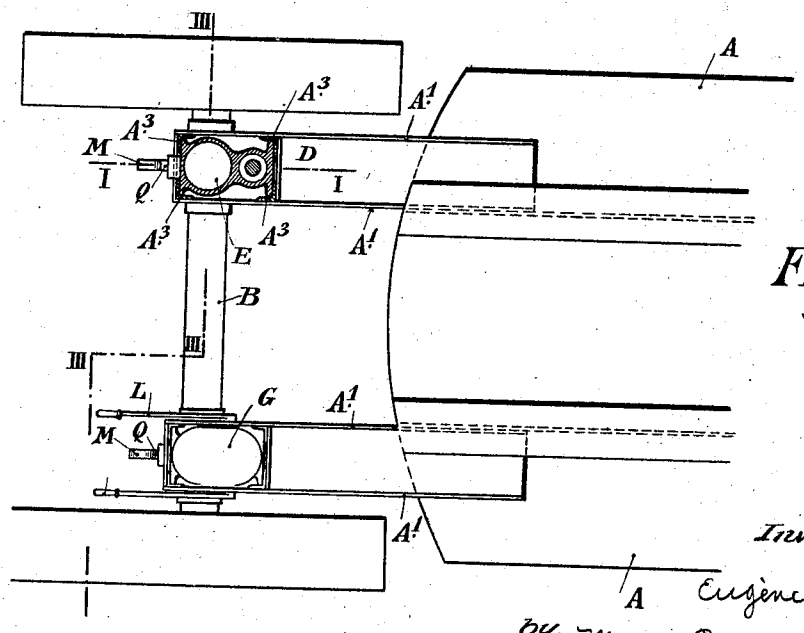


Fig. 2.

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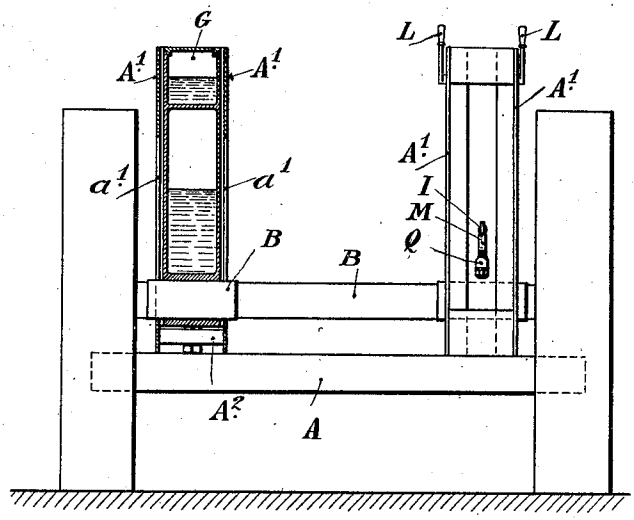
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4 SHEETS—SHEET 2.

Fig. 3.



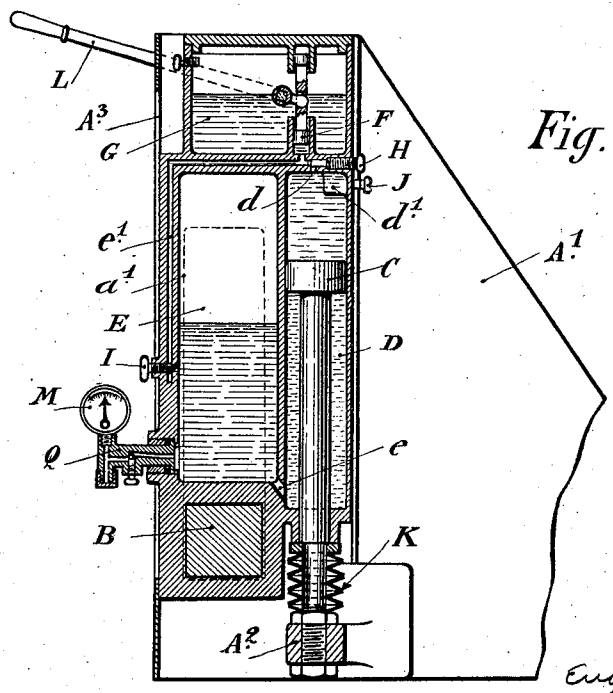


Fig. 4.

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4 SHEETS—SHEET 3.

Fig. 5.

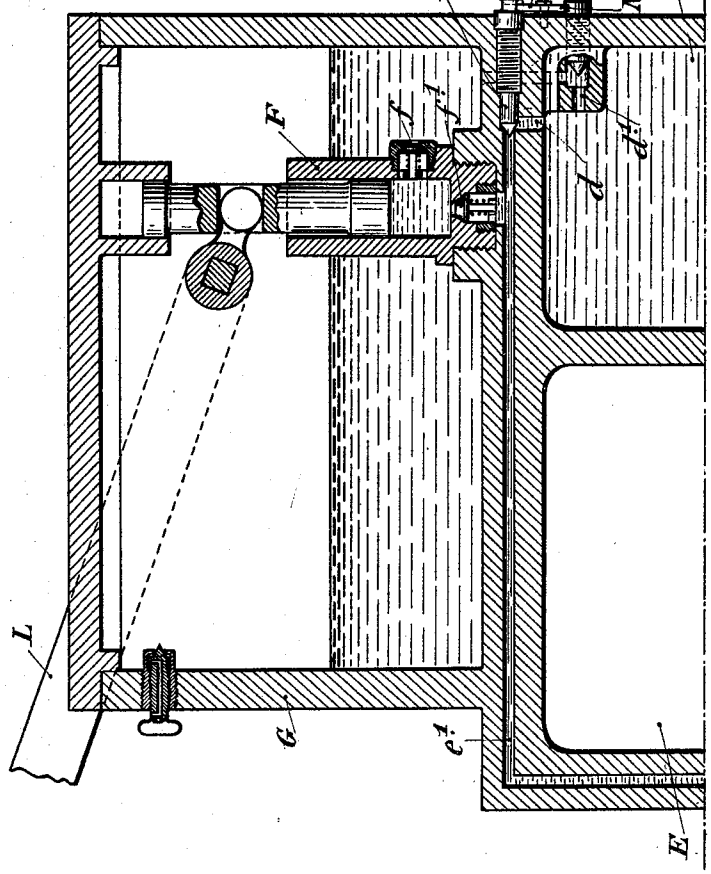


Fig. 7.

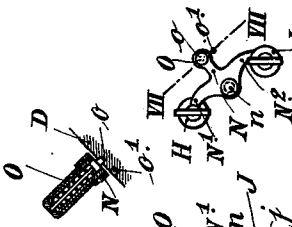


Fig. 6.

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SUSPENSION APPARATUS FOR GUN CARRIAGES AND THE LIKE.

APPLICATION FILED AUG. 21, 1918.

1,310,146. **Patented July 15, 1919.**

4 SHEETS—SHEET 4.

Fig. 8.

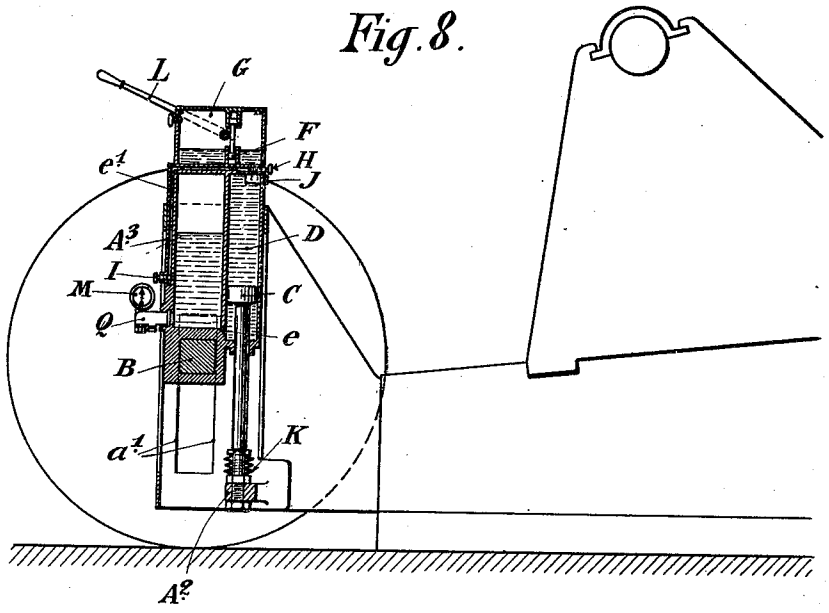
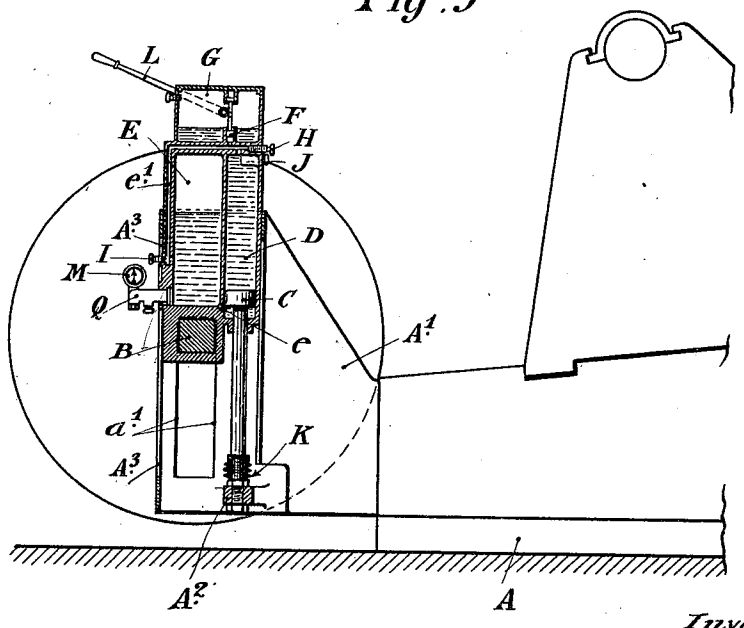


Fig. 9



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UNITED STATES PATENT OFFICE.

EUGÈNE SCHNEIDER, OF PARIS, FRANCE, ASSIGNOR TO SCHNEIDER & CIE., OF PARIS, FRANCE, A LIMITED JOINT-STOCK COMPANY OF FRANCE.

SUSPENSION APPARATUS FOR GUN-CARRIAGES AND THE LIKE.

1,310,146. Specification of Letters Patent. Patented July 15, 1919.

Application filed August 21, 1918. Serial No. 250,863.

To all whom it may concern:

Be it known that I, EUGÈNE SCHNEIDER, a citizen of the French Republic, and a resident of 42 Rue d'Anjou, Paris, France, have invented a new and useful Improvement in Suspension Apparatus for Gun-Carriages and the like, which invention is fully set forth in the following specification.

This invention has for its object to provide an improved elastic suspension apparatus for gun carriage frames and the like.

According to this invention the gun carriage framing has connected to it a plurality of pistons each working in a cylinder of a hydro-pneumatic recuperator attached to the corresponding axle of the carriage. These recuperators are so constructed that their pneumatic pressure transmitted by the liquid to one of the faces of the pistons, normally balances, with a small suitably determined excess, the weight of the gun carriage framing and its load, whereby an elastic suspension is provided for the load during traveling and if desired also when at rest. The said recuperators are combined with a pump the operation of which allows of exerting upon the opposite faces of the pistons a pressure that is greater than the excess over the pressure balancing the load. Since the excess of balancing pressure may be made as small as desired, this operation can be effected without the expenditure of much power and will thus enable the carriage framing to be lowered relatively to its axles by its own weight, while the power consumed by the pump is conserved in the form of pneumatic pressure. This conserved pressure can then be utilized on the one hand for raising or lowering the axles relatively to the carriage framing when it is resting upon the ground, and on the other hand for raising the carriage framing when the wheels are resting on the ground.

A constructional form and manner of application of this invention are illustrated by way of example in the accompanying drawings in which:

Figure 1 is a part elevation of a gun carriage framing provided with a suspension apparatus according to this invention. This suspension apparatus is shown in vertical section on the line I—I of Fig. 2, that is to say, along the axis of the combined hydro-pneumatic recuperator and pump.

Fig. 2 is a corresponding part plan partly in section on the line II—II of Fig. 1.

Fig. 3 is a vertical section on the line III—III of Fig. 2.

Fig. 4 is a vertical section on a larger scale of the combined recuperator and pump.

Fig. 5 is a partial detail elevation on a larger scale of the combined pump and recuperator.

Fig. 6 is a partial side elevation corresponding to Fig. 5.

Fig. 7 is a section on a larger scale on the line VII—VII of Fig. 6.

Figs. 8 and 9 are elevations partly in vertical section similar to Fig. 1, showing different relative positions of the carriage framing and the wheel axles.

A is a gun carriage framing or other supporting structure, adapted to be guided on the wheel axles B by means of side plates A^1 which are formed for this purpose with openings a^1. The carriage framing A has fixed to it a plurality of pistons C which for this purpose may be attached by means of the ends of their piston rods to cross-heads A^2 provided between the side plates A^1.

Each piston C works in one of the cylinders D of a hydro-pneumatic recuperator D—E combined with a pump F. The combined pump and recuperator D—E—F is fixed to the wheel axle B and is guided in guides A^3 provided between the side plates A^1 of the carriage framing. The cylinder E of the recuperator communicates at its lower end by means of a duct e with the cylinder D. This cylinder D may on the other hand be placed in communication at its upper end by means of a duct d with a duct e^1 delivering into the liquid contained in the cylinder E. The pump F delivers into this duct e^1, the pump itself being located in a liquid tank G. The cylinder D may also be placed in communication by means of a duct d^1 with the tank G. The ducts d, e^1 and d^1 may be opened or closed by means of the needle valves H, I, J, respectively.

The recuperators constructed as hereinbefore described, and provided in any desired number (for instance: two on the hind axle and one on the front axle), are charged in such a manner that normally, when the car-

riage framing is in position for traveling, the cylinder D will be full of liquid; the cylinder E containing a charge of air or gas under pressure above a partial charge of liquid. The upper face of the piston is then subjected only to the action of the liquid confined above it which is at atmospheric pressure. The needle valves H, J and I occupy the positions shown in Figs. 1, 4 and 5, that is to say, H and I are closed, whereas J is open. The pressure of the gas in the cylinders E is such that its action upon the lower face of the pistons will balance in its totality, with an excess p^1, the weight p of the carriage framing with its load, so that if P is the total pressure exerted upon the lower faces of the pistons C, then

$$P=p+p^1.$$

The small excess of pressure p^1 is exerted upon the lower face of the pistons for the purpose of avoiding any accidental disturbance of equilibrium and of preventing excessive oscillation during transport. Belleville washers K may be located around the lower end of each piston rod between the point of attachment of the latter and the lower end of the cylinder D.

With the parts arranged as just described, it will be clear that the carriage framing with its load is suspended elastically upon the wheel axles; the charge of gas under pressure contained in the cylinders E serving as a damping cushion. In the case where the wheels meet a raised portion of the ground or any other obstacle, the entirety of the recuperators with the wheel axle will rise relatively to the pistons; the liquid forced underneath the lower face of the pistons having a tendency to flow back into the cylinders E. When, on the contrary, the wheels meet a depression in the ground, the descent of the cylinders D, E, tends to cause the liquid confined in the cylinders D above the pistons, to flow back into the tanks G. At the same time the Belleville washers K are compressed; their presence preventing any sudden descent of the cylinders D relatively to the points of the attachment A^2 of the piston rods. When the liquid has flowed from E back toward D, the pressure of the gas in the recuperators diminishes and balances the load only to a partial extent. The load therefore tends to descend in its turn until the parts resume their position of equilibrium shown in Fig. 1.

In order to bring the platform A from the position for traveling into the firing position, that is to say, to bring it to a position in which it rests upon the ground, the improved suspension apparatus may be employed as lifting jacks. For this purpose it will be sufficient to operate the pistons of the pumps F, after having first moved the valves H, J, into the proper positions, that is to say, after having closed J and opened H. The movements of these valves may be coordinated by means of a device hereinafter described. If, now, the levers L are actuated, liquid will be drawn through the clacks f in the tanks G, and will be delivered by the next stroke through the clacks f^1 and the ducts d (Fig. 5) into the cylinders D. The delivery pressure produced by the pumps acts upon the whole of the upper surface of the pistons C, and it is sufficient for it to attain a value p^2, greater than p^1, to enable the carriage framing with its load to descend as a whole with the pistons C, the side plates A^1 sliding in this movement on the wheel axles B. The platform A can then be brought into contact with the ground, Fig. 8, quickly and with a minimum consumption of power. In this movement the pistons C have forced the liquid under their lower faces back through the ducts e, into the cylinders E, thereby compressing the gas charge in these cylinders. Apart from the loss of pressure due to friction, the power consumed in forcing back the pistons is thus conserved in the form of pneumatic pressure in the cylinders E. The result is that as soon as the platform A has come into contact with the ground, the energy which has been conserved in the cylinders E now becomes available. If it is desired to return the carriage framing into its initial position (Fig. 1) it is sufficient to move the valves H and J back into the positions shown in Fig. 5. From that moment, the liquid confined above the pistons C can flow back into the tanks G by the action of the expansion of the gas in the recuperator cylinders E.

If, for the purpose of relieving the wheels of all strain during firing, or for any other reason, it is desired to remove these wheels from all contact with the ground, this maneuver may also be effected by utilizing the energy conserved in the cylinders E. For this purpose the valves H and J are left in the positions they occupied during the descent of the carriage framing, that is to say, H is open and J is closed; and the valve I is opened. The liquid in the cylinders E is thus placed in communication with the liquid in the cylinders D, thereby balancing the pressure per unit of surface upon the pistons C. The total pressure upon the upper faces of the pistons consequently exceeds the pressure upon the lower faces by an amount which is sufficient to raise the wheeled axles relatively to the pistons C that are fixed to the carriage framing A. The parts thus resume the positions shown in Fig. 9. The rise of the wheel axles is limited by their striking against the upper end of the openings a^1.

If, starting from the position shown in Fig. 9, it is desired to return the carriage

framing into the traveling position (Fig. 1), it is merely necessary to close the valves I and H and to open the valves J.

By the action of the pressure of the gas in the cylinders E and of the weight of the wheel axles, the latter will descend relatively to the carriage framing, the lower faces of the pistons constituting an abutment. The liquid which is forced back by the descent of the cylinders D, flows into the tanks G. As soon as the wheels are resting upon the ground, the pressure of the gases in E which was previously acting upon the ends of the cylinders D, is taken by the resistance of the ground, so that the pistons C will then rise and carry up with them the carriage framing with its load.

It is to be understood that this operation causes a quantity of liquid to flow from the cylinders D back into the tanks G, so that the quantity of liquid in the recuperator cylinders E is diminished by the small amount that is discharged from D during the descent of the wheels until they come in contact with the ground. In order to reëstablish the initial pressure in the recuperators E, it is necessary therefore to reëstablish the level of the liquid and this is easily done by operating the pumps F after having opened the valves I. A pressure gage M fixed on each cylinder E, allows of ascertaining that the pressure in the recuperators has been duly restored to the desired value.

Figs. 5, 6 and 7 illustrate the device for coördinating the valves H and J. On the wall of the cylinder D or at any other suitable point, there is fulcrumed on an axle pin n, a rocking beam N bearing with the end of its arm N^1 upon the stem of the actuating knob of the valve H, while the end of its other arm N^2 bears upon the body of the valve J when the latter is open. The rocking beam N also carries a handle O formed as a spring bolt. The nose of the bolt is adapted to engage in one or the other of two sockets o, o^1, formed in the wall of the cylinder D. It will be perceived that when the bolt O is engaged in the socket o, as shown in Figs. 5, 6 and 7, it is impossible for the valve H to open. On the other hand, the valve J is able to close. This closing is necessary in order to allow of the movement of the rocking beam the arm N^2 of which can then engage in the groove j formed between the body of the valve J and the operating knob of the latter. If, then, the rocking beam be caused to rock in such a manner as to cause its bolt O to engage in the socket o^1, the valve J will then be locked, and can open only after the valve H has been previously closed.

In these various figures, Q is a known device for enabling the recuperator cylinders E to be charged with gas under pressure.

Having now described my invention what I claim as new and desire to secure by Letters Patent is:—

1. In suspension apparatus for gun carriage frames and the like, the combination with the carriage frame and a wheel axle thereof, of a plurality of hydro-pneumatic recuperators each comprising a cylinder and a piston working therein, connections between one of said recuperator elements and said frame, and connections between the other of said recuperator elements and said axle.

2. In suspension apparatus for gun-carriage frames and the like, the combination with the carriage frame and a wheel axle thereof, of a plurality of hydro-pneumatic recuperators each comprising a cylinder and a piston working therein, connections between said pistons and said frame, and connections between said cylinders and said axle, the pressure of the fluid in said recuperators on the supporting faces of said pistons over-balancing by a small excess the weight of said frame and its load.

3. In suspension apparatus for gun-carriage frames and the like, the combination with the carriage frame and a wheel axle thereof, of a plurality of hydro-pneumatic recuperators each comprising a cylinder and a piston working therein, connections between said recuperator elements and said frame and axle, the normal operative pressure in said recuperators over-balancing by a small amount the weight of said frame and its load, and means for overcoming said excess of pressure to lower said frame with respect to said axle.

4. In suspension apparatus for gun-carriage frames and the like, the combination with the carriage frame and a wheel axle thereof, of a plurality of hydro-pneumatic recuperators each comprising a cylinder and a piston working therein, connections between said recuperator elements and said frame and axle, the normal operative pressure in said recuperators over-balancing by a small amount the weight of said frame and its load, and means to pump fluid into said recuperators to overcome said excess of pressure and lower said frame with respect to said axle.

5. In suspension apparatus for gun-carriage frames and the like, the combination with the carriage frame and a wheel axle thereof, of a hydro-pneumatic recuperator comprising a cylinder and a piston working therein, connections between said recuperator elements and said frame and axle, the normal operative pressure in said recuperator being in excess, by a small amount, of that necessary to balance said frame and its load, and a pump for building up an opposing pressure to lower said frame with respect to said axle.

6. In suspension apparatus for gun-carriage frames and the like, the combination with the carriage frame and a wheel axle thereof, of a hydro-pneumatic recuperator comprising a cylinder and a piston working therein, connections between said recuperator elements and said frame and axle, the normal operative pressure in said recuperator being in excess, by a small amount, of that necessary to balance said frame and its load, and a pump for building up an opposing pressure to lower said frame with respect to said axle and increase the pressure in said recuperator, and means to release said opposing pressure whereby said increased pressure in the recuperator will be operative to raise said frame with respect to said axle.

7. In suspension apparatus for gun carriage frames and the like, the combination with the carriage frame and a wheel axle thereof, of a hydro-pneumatic recuperator comprising a cylinder and a piston working therein, connections between said recuperator elements and said frame and axle, the normal operative pressure in said recuperator being in excess, by a small amount, of that necessary to balance said frame and its load, a pump for building up an opposing pressure to lower said frame with respect to said axle and increase the pressure in said recuperator, and means whereby said increased pressure in the recuperator is made effective to raise said axle with respect to said frame.

8. In suspension apparatus for gun-carriage frames and the like, the combination with the carriage frame and a wheel axle thereof, of a hydro-pneumatic recuperator comprising a cylinder and a piston working therein, connections between said recuperator elements and said frame and axle, the normal operative pressure in said recuperator being in excess, by a small amount, of that necessary to balance said frame and its load, a pump for building up an opposing pressure to lower said frame with respect to said axle and increase the pressure in said recuperator, and means whereby said increased pressure in the recuperator is made effective to raise said axle with respect to said frame, or said frame with respect to said axle.

9. In suspension apparatus for gun-carriage frames and the like, the combination with the carriage frame and a wheel axle thereof, of a hydro-pneumatic recuperator comprising a pressure vessel, a cylinder communicating therewith and a piston working in said cylinder, connections between said recuperator elements and said frame and axle, a pump for building up pressure in said cylinder in opposition to the hydro-pneumatic pressure in said vessel, a tank containing a fluid from which said pump draws, ducts through which said tank may communicate with said pressure vessel and said cylinder, and valves controlling said ducts.

10. In suspension apparatus for gun-carriage frames and the like, the combination with the carriage frame and a wheel axle thereof, of a hydro-pneumatic recuperator comprising a pressure vessel, a cylinder communicating therewith and a piston working in said cylinder, connections between said recuperator elements and said frame and axle, a pump for building up pressure in said cylinder in opposition to the hydro-pneumatic pressure in said vessel, a tank containing a fluid from which said pump draws, a duct between said tank and said cylinder, a duct between said cylinder and said vessel, and coördinated valves controlling said ducts.

11. In suspension apparatus for gun-carriage frames and the like, the combination with the carriage frame and a wheel axle thereof, of a hydro-pneumatic recuperator comprising a pressure vessel, a cylinder communicating therewith and a piston working in said cylinder, connections between said recuperator elements and said frame and axle, a pump for building up pressure in said cylinder in opposition to the hydro-pneumatic pressure in said vessel, a tank containing a fluid from which said pump draws, a duct between said tank and said cylinder, a duct between said cylinder and said vessel, valves in said ducts, and means whereby only one of said valves may be open at a time.

12. In suspension apparatus for gun-carriage frames and the like, the combination with the carriage frame and a wheel axle thereof, of a hydro-pneumatic recuperator comprising a pressure vessel, a cylinder communicating therewith and a piston working in said cylinder, connections between said recuperator elements and said frame and axle, a pump for building up pressure in said cylinder in opposition to the hydro-pneumatic pressure in said vessel, a tank containing a fluid from which said pump draws, a duct between said tank and said cylinder, a duct between said cylinder and said vessel, valves in said ducts having stems provided with grooves, and a rocking beam adapted to engage in either of said grooves.

13. In suspension apparatus for gun-carriage frames and the like, the combination with the carriage frame and a wheel axle thereof, of a hydro-pneumatic recuperator comprising a pressure vessel, a cylinder communicating therewith and a piston working in said cylinder, connections between said recuperator elements and said frame and axle, a pump for building up pressure in said cylinder in opposition to the hydro-pneumatic pressure in said vessel, a tank containing a fluid from which said pump draws,

ducts through which said pump may deliver into either said cylinder or said vessel, a second duct between said tank and said cylinder, and valves controlling each of said ducts.

14. In suspension apparatus for gun-carriage frames and the like, the combination with the carriage frame and a wheel axle thereof, of a hydro-pneumatic recuperator comprising a cylinder and a piston working therein, a piston rod connecting said piston to the carriage frame, a connection between said cylinder and said axle, and a spring between said frame and said cylinder for cushioning downward movement of the cylinder with respect to the frame.

15. In suspension apparatus for gun carriage frames and the like, the combination with the carriage frame and a wheel axle thereof, of a hydro-pneumatic recuperator comprising a cylinder and a piston working therein, and connections between said recuperator elements and said frame and axle, the operative supporting pressure in said recuperator being in excess by a small amount of that necessary to balance said frame and its load.

16. In suspension apparatus for gun-carriage frames and the like, the combination with the carriage frame and a wheel axle thereof, of a hydro-pneumatic recuperator comprising a cylinder and a piston working therein, connections between said recuperator elements and said frame and axle, and means for overcoming the pressure in said recuperator to lower said frame with respect to said axle.

17. In suspension apparatus for gun carriage frames and the like, the combination with the carriage frame and a wheel axle thereof, of a hydro-pneumatic recuperator comprising a cylinder and a piston working therein, and connections between said recuperator elements and said frame and axle.

In testimony whereof I have signed this specification.

EUGÈNE SCHNEIDER.

Witnesses:
ANDRÉ MOSTICKER,
JOHN F. SIMONS.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."