Feb. 23, 1932. C. S. BRAGG ET AL 1,846,022

POWER ACTUATOR

Original Filed Sept. 17, 1927 2 Sheets-Sheet 1

Fig. 1.

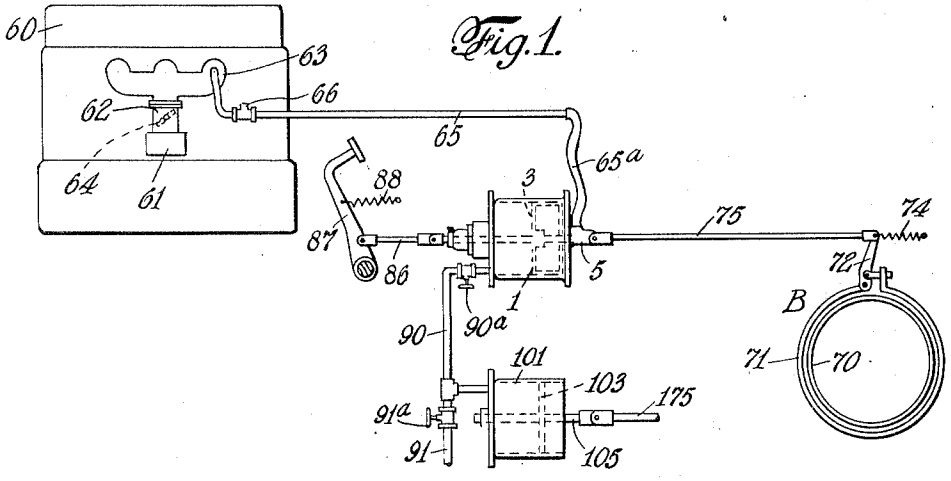
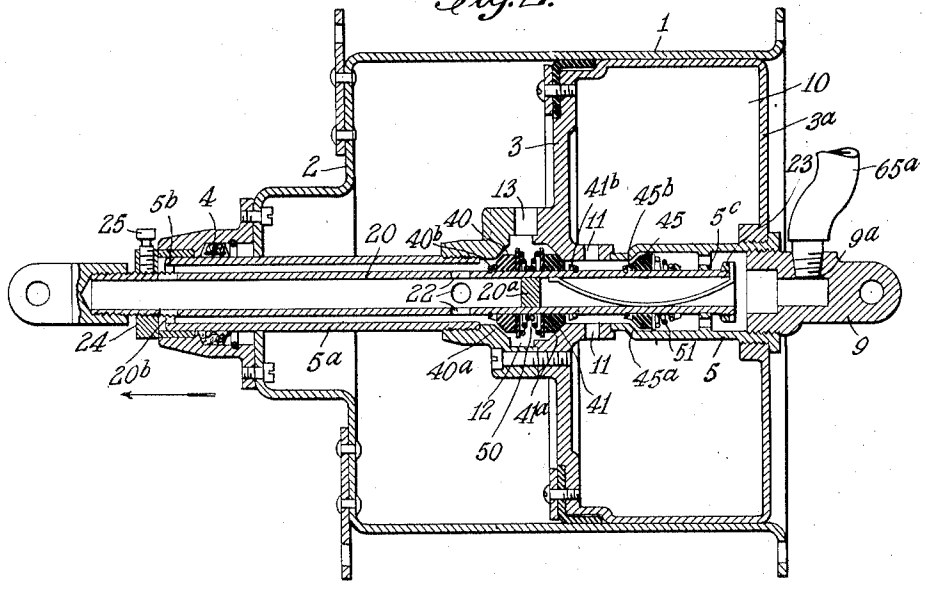


Fig. 2.



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Fig. 3.

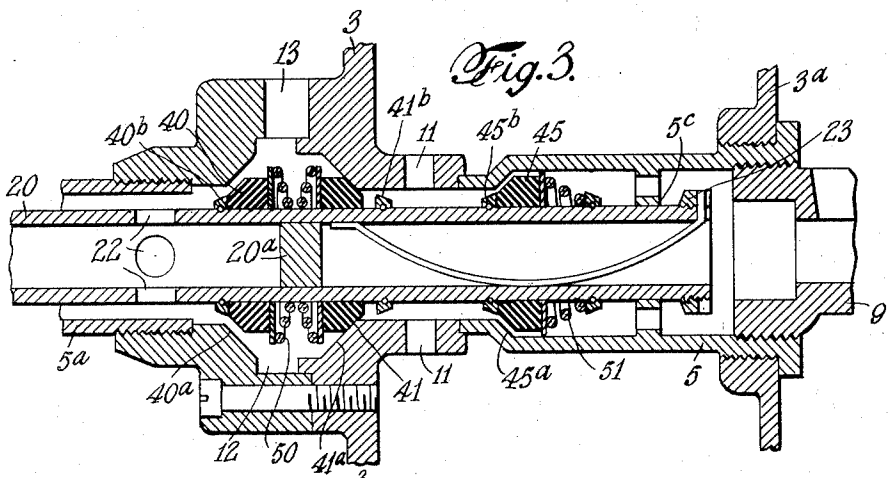


Fig. 4.

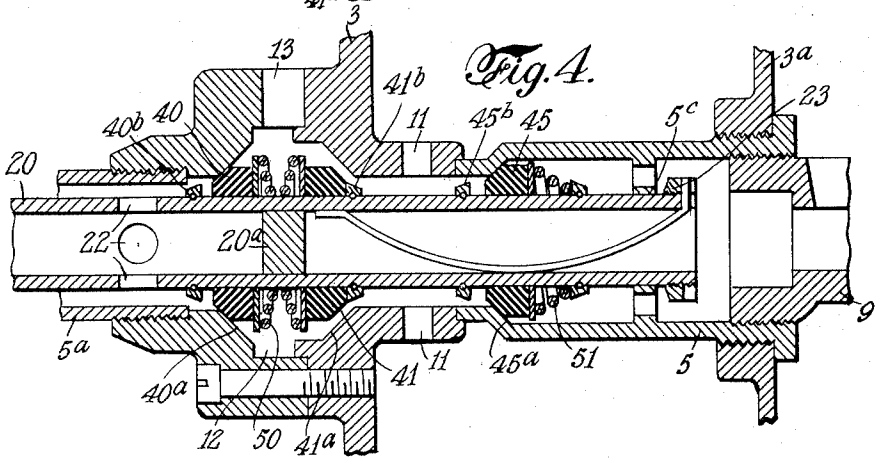
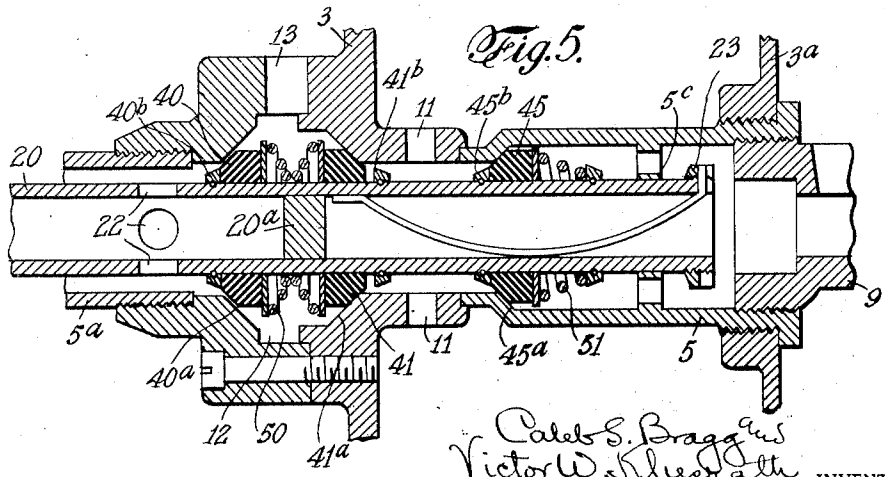


Fig. 5.



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UNITED STATES PATENT OFFICE

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POWER ACTUATOR

Application filed September 17, 1927, Serial No. 220,102. Renewed January 22, 1930.

Our invention consists in the novel features hereinafter described, reference being had to the accompanying drawings, which illustrate one embodiment of the same, selected by us for purposes of illustration, and the said invention is fully disclosed in the following description and claims.

In the operation of vacuum brakes for automobiles or other vacuum operated devices, comprising ordinarily a cylinder and piston, and being operated by differential pressures obtained by a connection with the suction passage of an internal combustion engine between the throttle valve and the cylinders of the engine, as the source of lower pressure, and a connection with the atmosphere as the source of higher pressure, it is necessary to place the suction actuated device in communication with the suction passage of the engine when a suction actuated device normally subjected to atmospheric pressure on both sides of the piston is operated to apply the brakes, or operate the part to be operated, thus discharging a considerable volume of air into the suction passage, which is liable to interfere with the operation of the engine and to stall it if idling, thus reducing the efficiency of, or eliminating altogether, the source of suction upon which the operation of the power actuator and the brake mechanism connected therewith, depends. It has been the practice to interpose a vacuum tank in the suction line, between the suction passage and the actuator connected at all times with the suction passage, and by suitable valve mechanism with the power actuator, and it has been found that the air withdrawn from the suction actuator device during the operation of the brakes tends to pass directly through such a storage tank to the suction passage of the engine as rapidly as the tubular connections will permit.

Our invention has for its object the elimination of this difficulty by closing off all communication between the vacuum storage space or vacuum tank and the suction passage of the engine when the brakes are applied. The vacuum storage space may be a vacuum tank entirely separate from the power actuator, as will be readily understood, but in the preferred form of our invention herein shown and described, we form the said vacuum storage space, or vacuum tank, as a part of the piston of the actuator and enclosed within the cylinder thereof, which makes a very neat and desirable construction, obviating the necessity of the separate tank, and permitting of a more convenient arrangement of the controlling device, or valve mechanism, for the suction connection from the vacuum storage space to the suction passage of the engine.

Our invention also comprises certain novel features of construction and combination of parts hereinafter fully described and particularly pointed out in the claims.

Referring to the drawings,

Fig. 1 is a diagrammatic view of a installation of vacuum brake mechanism in an automotive vehicle embodying our invention.

Fig. 2 is an enlarged sectional view of the power actuator shown in Fig. 1.

Fig. 3 is an enlarged detail view of the valve mechanism, showing the positions of the valves in a normal or retracted position of the piston and brake mechanism.

Fig. 4 is a similar view showing the positions of the valves when operated to effect an application of the brake mechanism.

Fig. 5 is a similar view showing the position of the valves when partially moved in the reverse direction to permit the equalization of pressure on opposite faces of the actuator piston and the release of the valve mechanism.

In the drawings, 60, represents an internal combustion engine for propelling the vehicle, provided with the usual carburetor, 61, suction passage leading therefrom to the engine cylinders and comprising the vertical passage, 62, and intake manifold, 63, of the throttle valve, 64, for controlling the suction passage all of which may be of any usual or preferred construction. The brake mechanism of the vehicle may be of any desired type and may operate in connection with two or more wheels of the vehicle. It is diagrammatically indicated in Fig. 1 at B, and is shown in this instance as comprising the brake drum, 70, brake band, 71, brake operating lever, 72, provided with the usual retracting spring, or springs, indicated at 74.

The brake operating lever is shown in this instance as connected by a link, 75, with the piston rod, 5, of a power actuator, supported on the chassis of the vehicle, in any desired manner, and comprising a cylinder, 1, closed at one end, by the head, 2, and open at the opposite end, the head, 2, being provided with a stuffing box, 4, of any desired type, a piston, 3, movable in the cylinder, and controlling valve mechanism, in this instance located in the hub of the piston. The piston, 3, is shown provided with a hollow piston rod, 5*a*, extending through the stuffing box, 4, and the hollow piston rod, 5, to which the brake mechanism is connected extending in the opposite direction. The piston rod, 5*a*, serves to assist in guiding the piston, and also to provide for the admission of atmospheric air to the cylinder forward of the piston under the control of the air inlet valve, as hereinafter described. In this instance the piston is shown as provided with an annular chamber, 10, surrounding the hollow piston rod, 5, and forming the vacuum storage space, or vacuum tank, which communicates with the interior of the rollow piston rod, 5, by ports or passages, 11, and the outer end of the hollow piston rod, 5, is conveniently provided with a fitting, 9, having an aperture, 9*a*, therein, which is connected with the suction passage of the engine, by suction pipe, 65, a portion of which, as 65*a*, is made flexible to accommodate the movements of the piston, and the suction pipe is preferably provided with a check valve, indicated at 66, opening in a direction toward the suction passage. The suction pipe, 65, is conveniently connected to the intake manifold, 63, as shown.

The interior of the hollow piston rod, 5, is preferably provided with a valve seat, 45*a*, adapted to be engaged by a cut off valve, 45, for cutting off communication between the intake manifold and the vacuum storage chamber, or space, 10, as hereinafter described.

The hub of the piston is shown provided with a valve chamber, 12, communicating by a port, or ports, 13, with the cylinder forward of the piston. In this valve chamber are located oppositely disposed valves, 40 and 41, the valve, 41, being the suction valve, engaging a seat, 41*a*, and controlling communication between the cylinder forward of the piston and the vacuum storage chamber, 10. The valve, 40, is an air inlet valve, engaging a seat, 40*a*, and controlling communication between the cylinder forward of the piston and the atmosphere, through the hollow piston rod, 5*a*, which communicates with the atmosphere at its forward end. The valves, 40, 41 and 45, are preferably formed of molded rubber, cork or cork composition, or other suitable material, and have central apertures to engage a hollow valve actuating part, or sleeve, 20, so as to effect a sealing effect thereof, while permitting the longitudinal movement of the sleeve therethrough. The valve actuating sleeve passes through the hollow piston rods and the piston, and is supported concentrically thereof by guiding bearings, 5*b*, 5*c*, in the hollow piston rods, 5*a* and 5, respectively, which bearings are in the form of spiders, or otherwise constructed, to permit the passage of air past the same. The inlet valve, 40, and suction valve, 41, are pressed toward their seats by an interposed spring, or springs, indicated at 50, and the valve sleeve is also provided with collars, 40*b* and 41*b*, on opposite sides of the said valves, so that a movement of the valve sleeve in either direction will open one of said valves and permit the other to be seated by the action of the spring 50. The auxiliary suction valve or cut off valve, 45, is normally pressed toward its seat by a suitable spring, indicated at 51, and the valve actuating sleeve is provided with a collar, 45*b*, on the forward side of this valve, for opening the valve, 45, when the valve actuating sleeve is moved in a direction opposite to that indicated by the arrow in Fig. 2. The collars, 40*b*, 41*b* and 45*b*, are so located with respect to the valves operated thereby, that when the sleeve, 20, is moved in the direction of the arrow in Fig. 2, the auxiliary suction valve or cut off valve, 45, and the air inlet valve, 40, will be permitted to close before the suction valve, 41, is open, and when the valve actuating sleeve, 20, is moved in the opposite direction, the air inlet valve, 40, will be opened and the suction vave, 41, closed, before the auxiliary suction valve, or cut off valve, 45, is opened.

The valve actuating sleeve, 20, is provided with a partition, or plug, 20*a*, dividing its interior into two parts, the rear portion of which is in communication with the suction line, the forward portion being in communication with the atmosphere through the apertures, 20*b*, and the sleeve, 20, is also provided with air inlet apertures, 22, communicating with the interior of the hollow piston rod, and assisting in establishing communication with the atmosphere. The forward end of the sleeve, 20, is connected by a link, 86, with an operator operated part, in this instance a pedal lever, 87, provided with the usual retracting spring, 88, for operating the valves hereinbefore described. We also prefer to provide means for limiting the lost motion between the sleeve, 20, and the piston of the actuator, to permit the operator to add his physical force to that of the actuator, and also to operate the piston and apply the brakes by physical force alone in case of failure of power. In this instance we have shown the rear end of the sleeve, 20, provided with a collar, 23, which may be brought into engagement with the bearing, 5*c*, of the hollow piston rod, to limit the forward movement of the sleeve with respect to the piston, and the en-

gagement of said collar, 23, with the fitting, 9, at the outer end of the piston rod, 5, will limit the relative movement of the valve sleeve with respect to the piston in the opposite direction. The valve actuating sleeve is also shown provided with an adjustable stop collar, 24, threaded on the exterior of the sleeve, and provided with a set screw, 25, for engaging the end of the stuffing box of the cylinder, to normally maintain the valves in their normal position when the piston and brake mechanism are in the retracted position, and the piston may be provided with any suitable means for arresting it in its retracted position.

The normal position of the valve mechanism is indicated in Figs. 2 and 3, the valve, 45, being open to maintain communication between the suction storage space, 10, and the intake manifold, or suction passage of the engine, the suction valve, 41, being closed, and the air inlet valve, 40, being held in open position. The valves will be maintained in these positions by the retracting spring, 88, for the foot pedal, for example, or any other suitable retracting means. It will thus be seen that in the normal position of the valve mechanism, the forward face of the piston, 3, is exposed to amtospheric pressure, which is counterbalanced by the atmospheric pressure upon the rear end of the storage chamber, 10, which corresponds with the rear face of the piston in this form of the invention, and will be so referred to hereafter, the rear wall of said chamber being indicated at 3*a*. Assuming that the engine is running, when the throttle valve is closed, or partially closed, there will be a rarification within the suction passage of the engine and the air will be exhausted from the vacuum storage space, or chamber, 10, which, by reason of the check valve, 66, will be maintained at the highest degree of rarification which occurs in the intake manifold between operations of the brake mechanism. To operate the power actuator and effect an application of the brake mechanism, the operator will place his foot on the pedal lever, 87, and depress the same, thereby shifting the valve actuating sleeve, 20, forwardly with respect to the piston. in the direction of the arrow, Fig. 2. This causes the auxiliary suction or shut off valve, 45, to close under the action of spring 51, disconnecting the suction chamber, 10, from the suction passage of the engine, and also causes the air inlet valve, 40, to close under the action of spring 50, shutting off communication between the forward end of the cylinder and the atmosphere, after which the suction valve, 41, is opened by collar 41*b*, to establish communication between the forward end of the cylinder, 1, and the vacuum storage space, or chamber, 10, as shown in Fig. 4. An equalization of pressures immediately follows between the forward end of the cylinder and the vacuum chamber, withdrawing a large portion of the air from the forward end of the cylinder and the pressure of the atmosphere on the rear face of the piston, in this instance the rear face, 3*a*, of the vacuum storage chamber, thus moving the piston forward and applying the brakes. The piston will be moved forward as long as the operator's foot continues to move the valve sleeve, 20, forward, until the brakes are applied, to the desired extent, when the operator will stop the forward movement of the pedal, and a slight movement of the piston with respect to the valve sleeve, will permit the suction valve, 40, to close, without opening either of the other valves, thus holding the brakes as applied. If the operator desires to add his physical force to that of the actuator, he can further depress the foot pedal, so as to bring the collar, 23, on the sleeve, 20, into engagement with the bearing, 5*c*, on the piston rod, 5, as before indicated, and obviously he could, in like manner, operate the piston and apply the brake mechanism by physical force alone in case of failure of power.

It will be observed that during the application of the brake mechanism the actuator and the vacuum storage space are positively cut off from the suction passage of the engine by the closing of the valve, 45, so that no air can pass from the suction actuated device, or from the vacuum storage space to the suction passage of the engine, and the slowing down of the engine or the stalling of the engine if idling, during the application of the brake mechanism, is positively prevented, although air may be withdrawn from the cylinder as rapidly as desired.

To release the brake mechanism, it is only necessary for the operator to release his pressure on the foot pedal sufficiently to permit a reverse movement of the sleeve, 20, under the action of its retracting means, as the spring, 88, to open the air inlet valve, 40, without opening the suction valve, 41, and auxiliary suction or cut off valve, 45, as shown in Fig. 5, which will permit atmospheric air to enter the forward end of the cylinder and again equalize pressures on opposite faces of the piston, permitting an almost instantaneous release of the brakes under the action of their retracting means and permitting the piston and brakes to be restored by said retracting means to their normal or retracted position, without admitting any air from the actuator or vacuum storage space to the suction passage of the engine. When the operator removes his foot from the pedal, the retracting spring will effect the opening of the auxiliary suction or cut off valve, 45, and re-establish communication between the intake manifold and the vacuum storage space, or reservoir, 10. and withdraw such air as has been admitted to the vacuum storage reservoir, by the use

of the brakes through the restricted opening of valve, 45, or other restricted passage in such quantities as will not stall the engine if idling.

As previously stated, it is obvious that the vacuum storage chamber, or reservoir, 10, could be located exterior to the piston and cylinder of the actuator, if desired, but obviously it is distinctly advantageous to locate it as shown herein, as a part of the piston and within the cylinder, as this greatly simplifies the construction and installation of the apparatus in an automotive vehicle.

It is to be noted that when it is desired to start the internal combustion engine, if the brake pedal is depressed sufficiently to permit the cut off valve, 45, to close, before attempting to start the engine, communication between the intake manifold and the vacuum storage reservoir is completely cut off so that no air from the storage reservoir can be discharged into the manifold, thus materially facilitating the starting of the engine.

It is also obvious that the valve mechanism could be located outside of the cylinder of the actuator, for example as illustrated in our former application filed March 13, 1926, and given Serial No. 94,412, by providing suitable pipe connections between the valve mechanism and the suction passage of the engine, the vacuum storage reservoir and the cylinder of the actuator, and it is also obvious that a single valve mechanism, whether located within an actuator piston as herein shown, or exterior to the actuator, can be operatively connected with the cylinders of a plurality of power actuators to simultaneously control the pistons thereof. For example in Fig. 1, we have illustrated a second power actuator cylinder, 101, the piston rod, 105, of which may be connected by a link, 175, to other brake mechanism of the vehicle, or brake mechanism of a separate vehicle, the closed ends of the cylinders, 1 and 101, being connected by a pipe, 90, provided with a cut off cock, 90*a*, in case it is not desired to use the cylinder, 101. We have also shown the pipe, 90, provided with an extension, 91, provided with a cut off cock, 91*a*, and the pipe, 91, may be connected with another actuator cylinder or cylinders, if desired. It will be obvious that the valve mechanism illustrated in Figs. 2, 3, and 4 will control all of the power actuators simultaneously, and that during the simultaneous power strokes of the actuator pistons controlled by the valve mechanism, communication between the vacuum storage reservoir and the suction passage of the engine will be cut off as hereinbefore described.

What we claim and desire to secure by Letters Patent is:—

1. The combination with an internal combustion engine, provided with a carburetor, a suction passage and a throttle valve controlling the same, of a suction actuated device connected with said suction passage, a vacuum storage reservoir interposed between said suction actuated device and said suction passage of the engine and normally in communication with said suction passage, said suction actuated device being provided with valve mechanism for connecting it with said reservoir, to effect an operation of the suction actuated device, and means for disconnecting said vacuum storage reservoir from the suction passage of the engine when the suction actuated device is operated to prevent interference with the operation of the engine or stalling of the engine if idling during the operation of the suction actuated device.

2. The combination with an internal combustion engine, provided with a carburetor a suction passage and a throttle valve controlling the same, of a suction actuated device comprising a cylinder, a piston therein provided with means for connecting it to a part to be operated, and controlling valve mechanism, a vacuum storage reservoir normally in communication with the suction passage of the engine, said valve mechanism being constructed to connect said cylinder on one side of the piston thereof, with said reservoir, to effect a power stroke of the piston, and means for disconnecting said reservoir from the suction passage of the engine during said power stroke, whereby the stalling of the engine if idling by the operation of a suction actuated device is prevented.

3. The combination with an internal combustion engine, provided with a carburetor, a suction passage and a throttle valve controlling the same, of a suction actuated device comprising a cylinder, a piston therein provided with means for connecting it to a part to be operated, and controlling valve mechanism, a vacuum storage reservoir normally in communication with the suction passage of the engine, said valve mechanism being constructed to connect said cylinder on one side of the piston thereof alternately with said reservoir and with the atmosphere, and a valve for disconnecting said reservoir from the suction passage of the engine whenever said portion of the cylinder is in communication with the reservoir, whereby the delivery of air from said reservoir to the suction passage of the engine during the operation of the suction actuated device, is prevented.

4. The combination with an internal combustion engine, provided with a carburetor a suction passage and a throttle valve controlling the same, of a suction actuated device comprising a cylinder closed at one end, a piston therein provided with means for connecting it to a part to be operated, and controlling valve mechanism, said cylinder having the closed portion on one side of the piston normally in communication with the

atmosphere when the valve mechanism is in released position, a vacuum storage reservoir provided with means for normally connecting it with the suction passage of the engine when the piston is in retracted position, said controlling valve mechanism being constructed to close the communication between the said portion of the cylinder and the atmosphere, and establish communication between said portion of the cylinder and said vacuum storage reservoir, and means for disconnecting said vacuum storage reservoir from said suction passage when the valve mechanism is operated, to establish communication between the said reservoir and said portion of the cylinder.

5. The combination with an internal combustion engine provided with a carburetor a suction passage and a throttle valve controlling the same, of a suction actuated device comprising a cylinder closed at one end and a piston movable therein, and provided with means for connecting it with a part to be operated, a vacuum storage reservoir, a suction connection therefrom to the suction passage of the engine between the throttle valve and the engine cylinders, means for connecting the closed portion of the cylinder on one side of the piston thereof with the atmosphere, and with said reservoir, inlet and suction valves for controlling said connections, an auxiliary valve for cutting off the connection between said reservoir and the suction passage of the engine, a valve actuating part for normally holding said air inlet valve and auxiliary suction valve in open position when the piston is in retracted position, and an operator operated part connected with said valve actuating part, said valve actuating part being constructed to effect the closing of the air inlet valve and the auxiliary suction valve when the main suction valve is open, to effect a working stroke of the piston, to disconnect said reservoir from the suction passage of the engine during said working stroke.

6. The combination with an internal combustion engine provided with a carburetor, a suction passage and a throttle valve controlling the same, of a suction actuated device comprising a cylinder and a piston movable therein, and provided with means for connecting it with a part to be operated, a vacuum storage reservoir, a suction connection therefrom to the suction passage of the engine between the throttle valve and the engine cylinders, means for connecting the closed portion of the cylinder on one side of the piston thereof with the atmosphere and with said reservoir, inlet and suction valves for controlling said connections, an auxiliary valve for cutting off the connection between said reservoir and the suction passage of the engine, a valve actuating part for said valve, means for normally holding said air inlet valve and auxiliary suction valve in open position when the piston is in retracted position, and an operator operated part connected with said valve actuating part, said valve actuating part being constructed to effect the closing of the air inlet valve and the auxiliary suction valve when the main suction valve is open, to effect a working stroke of the piston, to disconnect said reservoir from the suction passage of the engine during said working stroke, and to effect the closing of the main suction valve and the opening of the air inlet valve before effecting the opening of the auxiliary suction valve, to permit an equalization of pressures on opposite faces of the piston, and enable the piston to be retracted without admitting air to the suction passage.

7. The combination with an internal combustion engine, provided with a carburetor, a suction passage and a throttle valve controlling the same, of a suction actuated device comprising a cylinder open at one end, and closed at the other end, and a piston in said cylinder, a vacuum storage reservoir, a suction connection therefrom to the suction passage of the engine, means for connecting the portion of the cylinder between the piston and the closed end thereof with said reservoir and with the atmosphere, a main suction valve and an air inlet valve controlling said connections, an auxiliary suction valve for closing the connection between said reservoir and the suction passage, a valve actuating part for said valve normally holding the air inlet valve and auxiliary suction valve in open position when the piston is in retracted position, and constructed to close the same and open the suction valve when moved in one direction, to connect said portion of the cylinder with said reservoir and effect a power stroke of the piston, without admitting air from said reservoir to the suction passage of the engine, and an operator operated part connected with said valve actuating part.

8. The combination with an internal combustion engine, provided with a carburetor, a suction passage and a throttle valve controlling the same, of a suction actuated device comprising a cylinder open at one end, and closed at the other end, and a piston in said cylinder, a vacuum storage reservoir, a suction connection therefrom to the suction passage of the engine, means for connecting the portion of the cylinder between the piston and the closed end thereof with said reservoir and with the atmosphere, a main suction valve and an air inlet valve controlling said connections, an auxiliary suction valve for closing the connection between the reservoir and the suction passage, a valve actuating part for said valve normally holding the air inlet valve and auxiliary suction valve in open position when the piston is in retracted position, and constructed to close the same and open the suction valve when moved in one

direction, to connect said portion of the cylinder with said reservoir and effect a power stroke of the piston, without admitting air from said reservoir to the suction passage of the engine, and an operator operated part connected with said valve actuating part, said valve actuating part being constructed to effect the closing of the suction valve and the opening of the air inlet valve before the auxiliary suction valve is opened, to permit an equalization of pressures on opposite faces of the piston and enable the piston to be returned to retracted position without admitting air from said reservoir to the suction passage of the engine.

9. The combination with an internal combustion engine provided with a carburetor a suction passage and a throttle valve controlling the same, of a suction actuated device comprising a cylinder, and a piston movable therein, said piston being provided with a vacuum storage reservoir connected with and movable therewith, means for connecting said reservoir with the suction passage of the engine, controlling valve mechanism for connecting a portion of the cylinder on one side of the piston alternately with the atmosphere and with said reservoir, and means for disconnecting said reservoir from the suction passage of the engine when said valve mechanism is operated to connect the said portion of the cylinder with the said reservoir to prevent the passage of air from said reservoir to the suction passage of the engine during the operation of the suction actuated device.

10. The combination with an internal combustion engine provided with a carburetor, a suction passage and a throttle valve controlling the same, of a suction actuated device comprising a cylinder open at one end and closed at the other, and a piston in said cylinder provided with a vacuum storage reservoir connected therewith and contained within the cylinder, a suction connection from said vacuum storage reservoir to the suction passage of the engine, controlling valve mechanism for alternately connecting the portion of the cylinder between the piston and the closed end of the cylinder with the atmosphere and with said reservoir, and means for disconnecting said reservoir from the suction passage of the engine when the valve mechanism is operated, to connect said reservoir with said portion of the cylinder.

11. The combination with an internal combustion engine provided with a carburetor, a suction passage and a throttle valve controlling the same, of a suction actuated device comprising a cylinder closed at one end and open at the other, a piston in said cylinder, a vacuum storage reservoir connected with and movable with the piston and contained within a portion of the cylinder, a suction connection from said reservoir to the suction passage of the engine, connections from the cylinder between the piston and the closed end of the cylinder to the said reservoir and to the atmosphere, a main suction valve, and an air inlet valve controlling said connection, an auxiliary suction valve controlling the connection between the reservoir and the suction passage, a valve actuating part normally holding said air inlet valve and auxiliary suction valve in open position when the piston is in retracted position, and constructed to close said inlet valve and auxiliary suction valve and open the main suction valve when moved in one direction, to effect a power stroke of the piston without admitting air to the suction passage through said suction connection, the connections between said valve actuating part and said valves permitting the closing of the main suction valve and the opening of the air inlet valve before the auxiliary suction valve is opened, to effect an equalization of pressures on opposite faces of the piston and the return movement of the piston without admitting air from said reservoir to the suction passage of the engine, and an operator operated part connected with said valve actuating part.

12. In brake mechanism for automotive vehicles, provided with an internal combustion engine having a carburetor, a suction passage and a throttle valve controlling the same, of a power actuator comprising a cylinder, a piston therein provided with means for connecting it with brake mechanism of the vehicle, and controlling valve mechanism for the actuator, a vacuum storage reservoir, interposed between said actuator and the suction passage of the engine, and normally in communication with said suction passage, said valve mechanism being constructed to connect said actuator with said reservoir to effect the operation of the actuator to apply the brake mechanism, and means for disconnecting said reservoir from the suction passage of the engine when the brake mechanism is operated, to prevent interference with the operation of the engine or stalling of the engine if idling by the operation of the brake mechanism.

13. In brake mechanism for automotive vehicles provided with an internal combustion engine having a carburetor, a suction passage and a throttle valve controlling the same, of a power actuator comprising a cylinder, a piston therein provided with means for connecting it with brake mechanism of the vehicle, and controlling valve mechanism for the actuator, a vacuum storage reservoir, means for connecting said reservoir with the suction passage of the engine when the piston and brake mechanism are in retracted position, said valve mechanism being constructed to connect said cylinder on one side of the piston thereof with said reservoir to effect a power stroke of the piston in a direction to apply the brake mechanism, and means for disconnecting said reservoir from the suc-

tion passage of the engine during said power stroke, whereby interference with the operation of the engine or stalling it if idling is prevented during the application of the brake mechanism.

14. In brake mechanism for automotive vehicles provided with an internal combustion engine having a carburetor, a suction passage and a throttle valve controlling the same, of a power actuator comprising a cylinder, a piston therein provided with means for connecting it with brake mechanism of the vehicle, and controlling valve mechanism for the actuator, a vacuum storage reservoir, means for normally connecting said reservoir with the suction passage of the engine when the piston and brake mechanism are in retracted position, said valve mechanism being constructed to connect said cylinder on one side of the piston thereof alternately with said reservoir and with the atmosphere, and a valve for disconnecting said reservoir from the suction passage of the engine whenever said portion of the cylinder is in communication with said reservoir, whereby the delivery of air from said reservoir to the suction passage during the operation of the brake mechanism is prevented.

15. In brake mechanism for automotive vehicles provided with an internal combustion engine having a carburetor, a suction passage and a throttle valve controlling the same, of a power actuator comprising a cylinder, a piston therein provided with means for connecting it with brake mechanism of the vehicle, and controlling valve mechanism for the actuator, a vacuum storage reservoir, a suction connection from said reservoir to the suction passage of the engine, means for connecting the portion of the cylinder on one side of the piston with said reservoir and with the atmosphere, said controlling valve mechanism, including a main suction valve and an air inlet valve controlling said connections, a normally open auxiliary suction valve controlling the connection between said reservoir and the suction passage, and means for closing said auxiliary suction valve when the said controlling valve is operated, to effect a power stroke of the piston to apply the brake mechanism, whereby air is prevented from passing from said reservoir and from said actuator to the suction passage during the application of the brake mechanism and interference with the engine or stalling it if idling by the operation of the brake mechanism, is prevented.

16. In brake mechanism for an automotive vehicle provided with an internal combustion engine having a carburetor, a suction passage and a throttle valve controlling the same, of a power actuator comprising a cylinder open at one end and closed at the other, a piston in said cylinder, means for connecting the piston with the brake mechanism, retracting means for said brake mechanism and piston, a vacuum storage reservoir, a suction connection therefrom to the suction passage of the engine, means for connecting a portion of the cylinder between the piston and the closed end of the cylinder with said reservoir and with the atmosphere, controlling valves for said connections including a main suction valve, an air inlet valve, and an auxiliary suction valve for controlling the connection between said reservoir and the suction passage of the engine, and valve actuating means constructed to normally maintain the air inlet valve and auxiliary suction valve open, and the main suction valve closed when the piston is in retracted position, and to effect the closing of the air inlet valve, the opening of the suction valve, and the closing of the auxiliary suction valve when operated in one direction to effect a power stroke of piston to apply the brake mechanism, whereby the admission of air through said reservoir to the suction passage of the engine is prevented during the application of the brake mechanism.

17. In brake mechanism for an automotive vehicle provided with an internal combustion engine having a carburetor, a suction passage and a throttle valve controlling the same, of a power actuator comprising a cylinder open at one end and closed at the other, a piston in said cylinder, means for connecting the piston with the brake mechanism, retracting means for said brake mechanism and piston, a vacuum storage reservoir, a suction connection therefrom to the suction passage of the engine, means for connecting a portion of the cylinder between the piston and the closed end of the cylinder with said reservoir and with the atmosphere, controlling valves for said connections including a main suction valve, an air inlet valve, and an auxiliary suction valve for controlling the connection between said reservoir and the suction passage of the engine, and valve actuating means constructed to normally maintain the air inlet valve and auxiliary suction valve open, and the main suction valve closed when the piston is in retracted position, and to effect the closing of the air inlet valve, the opening of the suction valve, and the closing of the auxiliary suction valve when operated in one direction to effect a power stroke of the piston to apply the brake mechanism, whereby the admission of air through said reservoir to the suction passage of the engine is prevented during the application of the brake mechanism, said valve actuating means being constructed to effect the closing of the suction valve and the opening of the auxiliary suction valve when moved in the opposite direction, to permit equalization of pressures on opposite faces of the piston, and the release of the brake mechanism and retraction of the piston by the said retracting means

without admitting any air from said reservoir to the suction passage of the engine.

18. In brake mechanism for an automotive vehicle provided with an internal combustion engine having a carburetor, a suction passage, the combination with a power actuator, comprising a cylinder, and a piston therein provided with means for connecting it with brake mechanism of the vehicle, a vacuum storage reservoir connected and movable with said piston, a suction connection from said reservoir to the suction passage of the engine, means for connecting a portion of the cylinder on one side of the piston with said reservoir and with the atmosphere, a main suction and an air inlet valve controlling said connections, and means for disconnecting said reservoir from the suction passage of the engine when said valve mechanism is operated to disconnect said portion of said cylinder from the atmosphere and connect it with said reservoir, whereby the brakes may be applied and released without admitting air from said reservoir to the suction passage of the engine.

19. The combination with an internal combustion engine provided with a carburetor, a suction passage and a throttle valve controlling the same, of a suction actuated device comprising a cylinder, a piston therein provided with means for connecting it to a part to be operated, and controlling valve mechanism, said cylinder being provided with a vacuum storage reservoir normally in communication with the suction passage of the engine, and means for disconnecting said vacuum storage reservoir from the suction passage of the engine when the controlling valve mechanism is operated to effect a power stroke of the piston, whereby no air can be admitted to the suction passage of the engine from the suction actuated device during said power stroke of the piston.

20. In brake mechanism for an automotive vehicle provided with an internal combustion engine having a carburetor, a suction passage and a throttle valve controlling the same, the combination of a suction actuated device comprising a cylinder, a piston therein, operatively connected with brake mechanism for the vehicle, and controlling valve mechanism for the actuator, said cylinder being provided with a vacuum storage reservoir, a tubular connection from said reservoir to the suction passage of the engine, connected to the latter between the throttle valve and the engine cylinders, said reservoir being normally in communication with the suction passage when the brakes are in off or released position, and means for disconnecting said reservoir from the suction passage of the engine when the valve mechanism is operated to effect a power stroke of the piston to apply the brake mechanism, whereby no air from the suction actuated device can be admitted to the suction passage of the engine during the application of the brakes.

21. The combination with an internal combustion engine provided with a carburetor, a suction passage and a throttle valve controlling the same, of a plurality of suction actuated devices each comprising a cylinder and a piston therein provided with means for connecting it to a part to be operated, a vacuum storage reservoir, a suction connection therefrom to the suction passage of the engine between the throttle valve and the engine cylinders, means for connecting a portion of each actuator cylinder on one side of the piston thereof with the atmosphere and with said reservoir, controlling valve mechanism for said connections, a cut off valve for disconnecting the reservoir from the suction passage of the engine, an operator operated part, and means for connecting it with said valve mechanism and said cut off valve to effect the closing of the cut off valve by the operation of the controlling valve mechanism to effect simultaneous power strokes of said power actuator pistons.

22. The combination with an internal combustion engine provided with a carburetor, a suction passage and a throttle valve controlling the same, of a plurality of suction actuated devices each comprising a cylinder closed at one end and a piston movable therein, and provided with means for connecting it with a part to be operated, a vacuum storage reservoir, a suction connection therefrom to the suction passage of the engine between the throttle valve and the engine cylinders, means for connecting each of said cylinders between the piston and the closed end thereof with the atmosphere and with said reservoir, a single controlling valve mechanism comprising inlet and suction valve for controlling said connections, a cut off valve for closing the connection between said reservoir and the suction passage of the engine, an operator operated part, means for connecting the operator operated part with said inlet, suction and cut off valves, constructed to close the cut off valve when the inlet valve is closed and the suction valve is open, and means for normally holding the inlet valve and cut off valve in open position and the suction valve in closed position when the piston is in retracted position, whereby said vacuum storage reservoir will be disconnected from the suction passage of the engine when the valve mechanism is operated to effect the simultaneous power strokes of the actuator pistons controlled thereby.

23. In an automotive vehicle, the combination with an internal combustion engine having a carburetor, a suction passage and a throttle valve controlling the same, of a suction actuated device comprising a cylinder closed at one end and a piston movable therein, and provided with means for connecting

it with brake mechanism of the vehicle, a vacuum storage reservoir, a suction connection therefrom to the suction passage of the engine between the throttle valve and the engine cylinders, means for connecting the portion of the actuator cylinder on one side of the piston thereof with the atmosphere and said reservoir, controlling valve mechanism for said connections, a cut off valve for closing the connections between said reservoir and the suction passage of the engine, an operator operated part, means for connecting it with said controlling valve mechanism and said cut off valve, constructed to effect the closing of the cut off valve when the controlling valve mechanism is operated to effect a power stroke of the actuator piston, whereby by operating the operator operated part sufficiently to close the cut off valve the starting of the engine will be facilitated.

In testimony whereof we affix our signatures.

CALEB S. BRAGG.
VICTOR W. KLIESRATH.