C. J. COSTELLO & S. G. SKINNER.

AIR COMPRESSOR.

APPLICATION FILED JAN. 23, 1911.

1,005,940.

Patented Oct. 17, 1911.

3 SHEETS—SHEET 1.

Fig. 1.

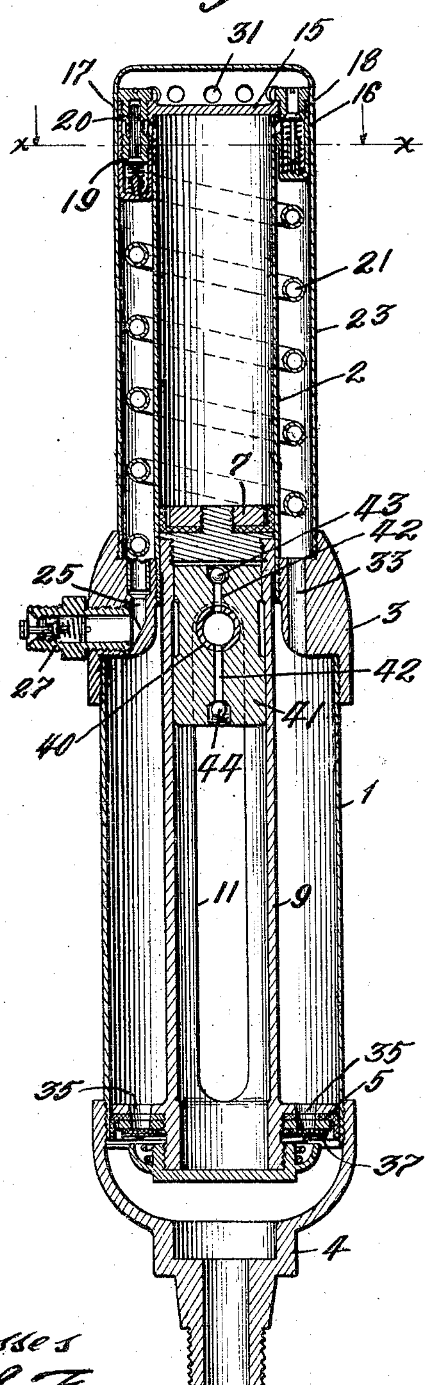

Fig. 2.

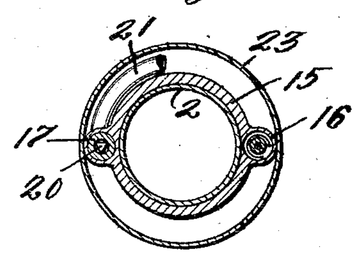

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Fig. 3.

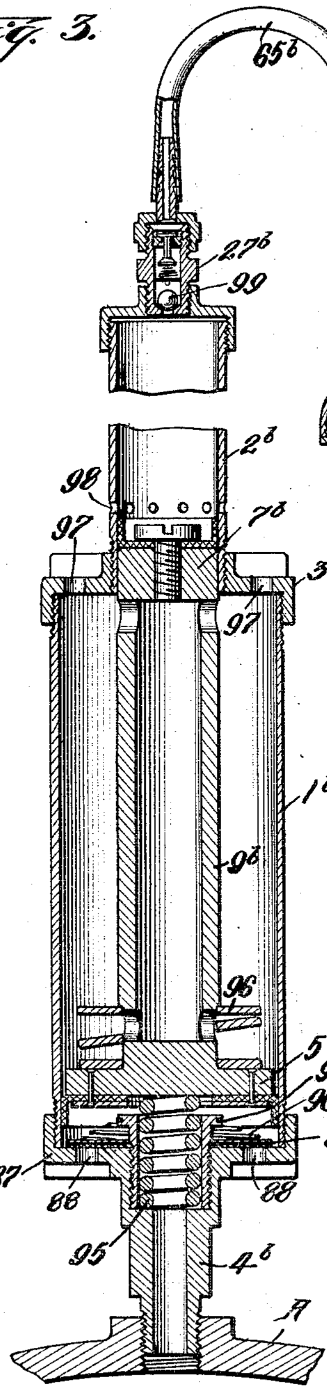
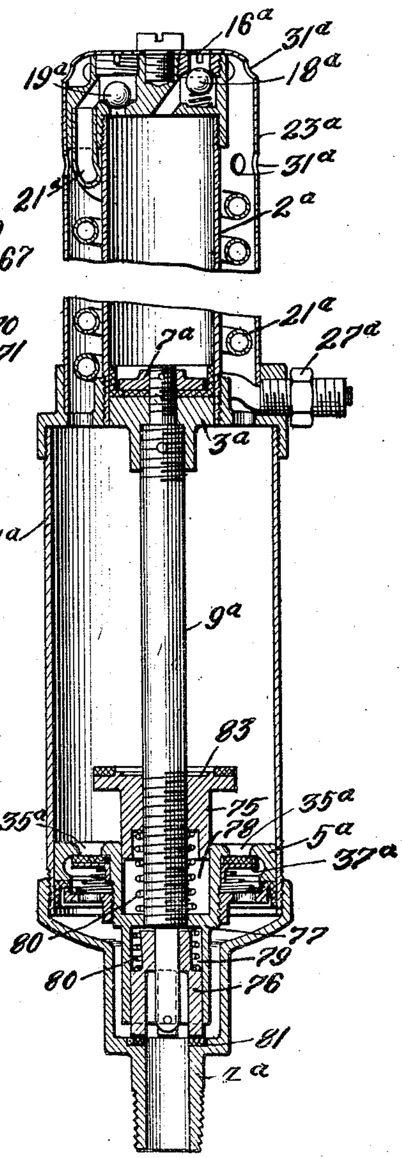


Fig. 4.



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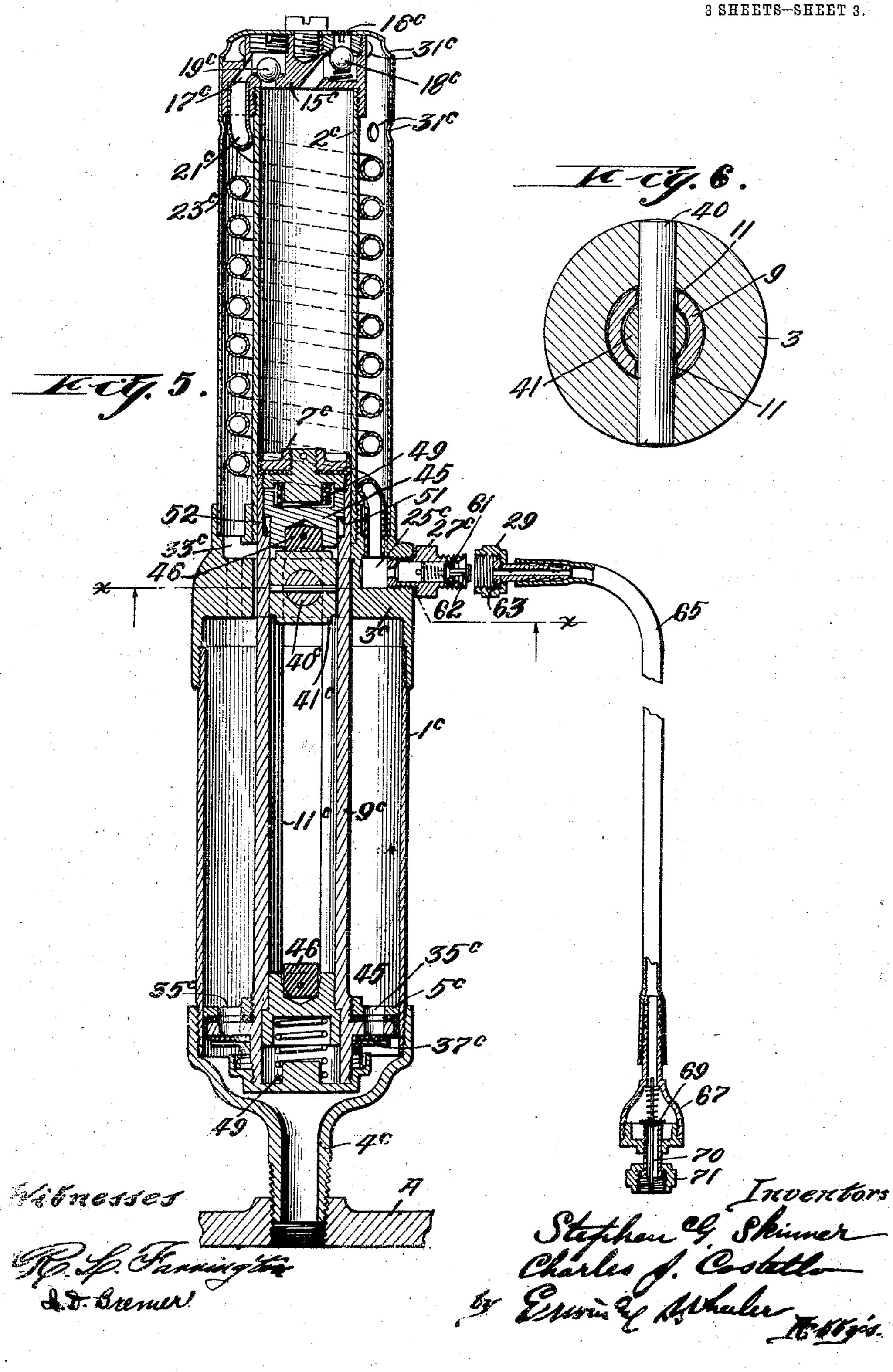

UNITED STATES PATENT OFFICE.

CHARLES JEROME COSTELLO AND STEPHEN GUION SKINNER, OF CHICAGO, ILLINOIS, ASSIGNORS TO SKINNER & SKINNER CO., OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

AIR-COMPRESSOR.

1,005,940. Specification of Letters Patent. Patented Oct. 17, 1911.

Application filed January 23, 1911. Serial No. 604,940.

To all whom it may concern:

Be it known that we, CHARLES JEROME COSTELLO and STEPHEN GUION SKINNER, citizens of the United States, residing at Chicago, county of Cook, and State of Illinois, have invented new and useful Improvements in Air-Compressors, of which the following is a specification.

Our invention relates to improvements in air compressors, with especial reference to that type of compressors which are designed to be used in connection with multiple cylinder engines, and in which air or vapor from one of the cylinders is utilized to actuate the compressor, either for pumping air to inflate a tire or for any other purpose.

The objects of our invention are to provide a pump of this class wherein the cylinder which drives the compressor, may be run at full capacity, that is, may receive a full charge of air or vapor, although the engine, as such, may be throttled so that the other cylinders receive only a portion of a full charge of motive fluid, such as steam, hot air or explosive gases; also to provide means whereby the compressed air delivered to the tire or other place of use, may consist of pure air which has not entered the engine cylinder, and in which the heat evolved by compression has been abstracted to such an extent as to avoid injurious effects; also to provide means whereby destructive movements of the compressor pistons may be avoided, by proper cushioning, both when pumping against a tire pressure and when pumping without connecting the pump outlet to any form of receiver, as, for example, when the delivery hose is uncoupled without stopping the engine.

In the following description, reference is had to the accompanying drawings, in which—

Figure 1 is a vertical sectional view of an air compressor embodying our invention. Fig. 2 is a cross sectional view drawn on line $x—x$ of Fig. 1. Fig. 3 is also a vertical sectional view showing a modified form of construction. Fig. 4 is a similar view, showing a third modification. Fig. 5 is a vertical sectional view of a pump embodying our invention, showing one wall, or head of an engine cylinder, to which the same may be applied. Fig. 6 is a sectional view drawn on line $x—x$ of Fig. 5.

Like parts are identified by the same reference characters throughout the several views.

The air compressor comprises a power cylinder 1, and a compression cylinder 2 of less diameter, coupled end to end, preferably by a common head piece 3. The cylinder is provided with a connecting member 4 adapted to be screwed into the spark plug aperture of one cylinder of a multiple cylinder engine, the head piece of which is partly shown at A in Figs. 3 and 5.

The power cylinder 1 (Fig. 1) contains a piston 5, preferably of the cup leather type, and the compression cylinder 2 contains a piston 7 of the same type. The pistons 5 and 7 are connected with each other by a tubular rod 9 having slots 11 in opposite side walls. This rod extends through an aperture in head piece 3. The compression cylinder 2 carries a head piece 15 provided with inlet and outlet ports 16 and 17 respectively, the inlet port being normally closed by a spring seated check valve 18 and the outlet port by a similar check valve 19. A tube 21 is connected with the outlet port and is coiled about the cylinder 2, between it and an outer casing 23. The lower end of the tube 21 communicates with a cavity 25 in the intermediate head piece 3, and a valved nipple 27 serves as a means for delivering air from this cavity, said nipple being adapted to receive the hose coupling 29, as shown in Fig. 5.

The casing 23 is provided with apertures 31 at its upper end. The head piece 3 is provided with apertures 33, affording communication between the cylinder space of cylinder 1 and the casing space, that is, the space occupied in part by the tube 21. The upward movement of the driven piston 7 compresses air in cylinder 2 and delivers it through tube 21, and the simultaneous upward movement of the power piston 5 forces air from cylinder 1 through the apertures 33, the casing space, and apertures 31, thus cooling the air in tube 21 by heat absorption. During the down stroke of the pistons 7, 5, and that piston of the engine cylinder to which the pump is connected, the engine cylinder is refilled with air, derived in part through the apertures 31, the casing space, apertures 33, and the cylinder 1, from which it passes to the engine cylinder through ports 35 in the piston 5, which are normally closed underneath the piston, by a spring seated annular check valve 37. The air drawn by engine suction past this valve enters the engine cylinder through the tubular connecting member 4. The ends of the tubular connecting rod 9 are closed and the cylindrical ends of a plunger anvil 41 are adapted to socket in the respective connecting rod ends at the completion of the piston strokes, compressing the air in such sockets, and thus checking the piston movement. The plunger anvil is supported by cross pin 40, mounted in head piece 3.

The valve 19 is preferably provided with a triangular stem 20 (Fig. 2) to permit the delivery of air past the stem when the valve is open. The inlet valve 18 may have any form of stem, for this stem does not extend into the path of the air delivered through port 16.

The plunger anvil 41 is provided with ducts 42 leading from the interior of cross pin 40 to the upper and lower surfaces, respectively, of the anvil. These ducts have check valves 43 and 44 respectively, which allow the piston rod sockets to freely fill when the piston movement reverses.

Referring to Figs. 5 and 6, it will be observed that the general features of construction are the same as in Fig. 1 and are identified by the same reference numerals, with the letter "c" appended to the numerals. In this construction, the pistons are cushioned on the up and down strokes as follows. A cross pin 40^c, mounted in the intermediate head piece 3, extends through the slots 11^c of the connecting rod 9^c, and within the latter, this pin supports a stop block or anvil 41^c. Plungers 45, socketed in the respective end portions of the rod 9^c, are provided with yielding striker cushions 46 for contact with the anvil 41^c, and are also yieldingly mounted on springs 49, which permit the plungers to move toward the adjacent end of rod 9^c, and compress the air in the spring receiving space, thus affording an air cushion and to some extent a spring cushion, co-acting with the striker cushions, to check the piston movement on completion of a stroke. It will be understood that the striker cushion 46 on piston 5^c impinges on the under surface of the anvil and actuates the lower plunger 45 to compress its supporting spring and the air in the spring space. The upper plunger is shown in spring and air compressing relation in Fig. 1. The function of the springs 49 is principally to move the plungers outwardly to normal position preparatory to the next contact with the anvil. This outward movement of the plungers is limited by shoulders 51 and 52 on the plungers and piston rod respectively.

The above described cushioning devices are sufficiently effective when the pump is operated to deliver air against a pre-existing pressure, such as ordinarily exists in a tire. But when disconnected from one tire, and preparatory to coupling up with another, the engine meanwhile continuing in operation, injury might result, (at least to the cushioning devices shown in Figs. 3, 4, and 5) if the pump cylinder 2 were permitted to discharge to the open air without resistance. We therefore provide the nipple 27, 27^a, 27^b, or 27^c, with a spring seated check valve 61, seating with the pressure, and having a stem 62 projecting outwardly in a position to be actuated by a member 63 in the hose coupling 29 when the latter is in coupling relation to the nipple 27. The other end of the hose 65 is provided with a member 67 having a similar check valve 69, the stem 70 of which projects into a coupling member 71 in a position to be actuated to open this valve, by an actuating member on any receiving nipple connected with a tire or other air receiving member. As both the valves 61 and 69 close with the pressure as developed by the pump, it follows that if the hose is uncoupled at either end while the pump is in operation, a delivery of air from cylinder 2 will be prevented and the piston will therefore be effectively cushioned.

It will be understood that when the above described device is used, it is screwed into a spark plug aperture of one of the cylinders of a multiple cylinder engine. The air and vapor compressed in said cylinder (A in Figs. 1 and 5), passes upward through the connecting member 4 and actuates the lower piston 5 to drive the upper piston 7 upwardly in the cylinder 2. The lower piston 5 meets with substantially no resistance from the air in cylinder 1, since said air passes outwardly through the holes 33 and upwardly between the cylinder 2 and the casing 23. During this stroke of the pistons, air is compressed in cylinder 2 and delivered past the check valve 19 through the pipe 21 past check valve 6 and hose 65, (Fig. 5) to the point of use, check valves 61 and 69 being open and hose 65 being connected at both ends. On the down stroke of the pistons, air enters cylinder 2 through check valve 18 and air also passes downwardly through the holes 31, the space between cylinder 2 and casing 23, and holes 33, into cylinder 1, and from said cylinder to the engine cylinder, as above explained. When changing the hose 65 from one point of delivery to another, the engine need not be stopped, since the uncoupling of the hose member 71 will permit valve 69 to close until the hose is again coupled up in its new relation.

Referring to Fig. 4, it will be observed that cylinders 1^a and 2^a, connecting member 4^a, casing 23^a, inlet and outlet check valves 18^a and 19^a, delivery tube 21^a and outlet nipple 27^a are substantially the same as in Fig. 1. A piston 5^a is employed in cylinder 1^a, which is provided with ports 35^a, permitting passage of air from above the piston downwardly to the engine cylinder, the return of such air through said ports being prevented by an annular spring seated check valve 37^a carried between the upper and lower metallic portions of the piston, said metallic portions serving also to hold the cup leather in position. In this construction, plungers 75 and 76 respectively are socketed in a central member 77 carried by the piston, the upper plunger 75 seating downwardly in an upper socket 78 and the lower plunger seating upwardly in a socket 79. These plungers are normally pushed toward the outer ends of the sockets by springs 80, the lower plunger 76 is actuated inwardly in its socket when the downward movement of the piston brings said plunger into contact with a seat 81, which is preferably non metallic, and when this plunger moves inwardly, it compresses the corresponding spring 80 and also compresses the air in the spring receiving space. On the up-stroke of the pistons, the head 83 of the plunger 75 contacts with the intermediate cylinder head 3^a and this plunger is then forced inwardly into the socket 78, compressing the air in said socket. It is therefore obvious that in this construction, a spring and air compressing device is provided, which operates upon the same principle as that employed in Fig. 1, although differing to some extent structurally.

Referring to Fig. 3, it will be observed that we employ cylinders 1^b and 2^b, and a connecting member 4^b, similar in form to the corresponding parts shown in Fig. 1. Pistons 5^b and 7^b are employed and correspond in position and function with the pistons 5 and 7 in Fig. 1, but instead of admitting air to the engine cylinder through the piston 5^b, we admit it through the lower cylinder head 87, which is provided with ports 88, normally closed by an annular spring seated check valve 89, the spring 90 being held in position to close said valve by a tubular member 91, threaded into a suitable socket in the connecting member 4^b. Said member 91 contains a cushioning spring 95, which is seated upon a shoulder in the member 4^b and projects upwardly through the member 91 into a position to be struck by the piston 5^b on its downward stroke. A flat spring 96, coiled as illustrated, about the connecting rod 9^b, is employed to cushion the pistons on their up stroke by striking the intermediate head piece 3^b. In this construction, air is admitted to the cylinder 1 above the piston 5^b through holes 97, the purpose of this air admission being merely to prevent resistance to the piston movement. Air is admitted to the upper cylinder 2^b through holes 98, which are uncovered on the completion of the down strokes of the pistons. It is delivered through a gravity ball check valve 99 and through a valved nipple 27^b into a hose connection 65^b, the nipple 27^b and hose connection 65^b being the same as illustrated in Fig. 1.

It will of course be understood that the coiled tube 21 may be employed or omitted in any one of the constructions illustrated, and that the specific features of the cushioning devices are not essential in any of the views, but may be employed indiscriminately in any of the structures illustrated.

In Fig. 4, we have illustrated a connecting rod 9^a, which is solid instead of tubular, as illustrated in the other views. This is merely a matter of convenience in construction.

With any one of the pumps illustrated, air from the engine cylinder is never delivered through the compression cylinder 2, 2^a, or 2^b, pure air only being received and expelled from said cylinder. By supplying air through this pumping apparatus to the engine cylinder which furnishes the power fluid to drive the pump, a complete charge and full compression is secured in the engine cylinder, regardless of the condition of the admission valves normally used when said cylinder is employed as a prime mover.

Having thus described our invention, what we claim as new, and desire to secure by Letters Patent, is—

1. In an air compressor of the described class, the combination of a set of cylinders of different diameters, disposed end to end, pistons in said cylinders connected with each other, a casing encircling the smaller cylinder and arranged to permit the passage of air therethrough to and from the larger cylinder, and a duct therein for the air discharge from the smaller cylinder.

2. In an air compressor of the described class, the combination of a power cylinder, a pumping cylinder, pistons in said cylinders connected with each other, a casing inclosing the pumping cylinder and forming an air passage leading to the power cylinder, said air passage being provided with a duct constituting an outlet for the pumping cylinder, valves at the respective ends of said duct, and an inlet valve for the pumping cylinder; said duct valves being each arranged to seat with the pressure in the duct.

3. In an air compressor, the combination of a power cylinder, a pumping cylinder of less diameter connected therewith, an outlet duct for the pumping cylinder, extending spirally about said cylinder, an automatically closing valve controlling the outlet of said duct, a casing inclosing said duct and the pumping cylinder, and forming an air passage leading to the power cylinder, a valved inlet for the pumping cylinder, and

a connecting member adapted to deliver power fluid to the power cylinder.

4. In an air compressor, the combination of a power cylinder a pumping cylinder of less diameter connected therewith, an outlet duct for the pumping cylinder, extending spirally about said cylinder, an automatically closing valve controlling the outlet of said duct, a casing inclosing said duct and pumping cylinder, and forming an air passage leading to the power cylinder, a valved inlet for the pumping cylinder, and a connecting member adapted to deliver power fluid to the power cylinder,—said power cylinder pistons being provided with a valved passage adapted for the delivery of fluid through the connecting member to the source of power supply when the pressure upon said pistons is less on the side of the connecting member than it is upon the other side.

5. In an air compressor, the combination of a power cylinder provided at one end with a connecting member adapted to deliver a fluid thereto, an axially disposed pumping cylinder at the other end of the power cylinder, pistons in said cylinders connected with each other, means for permitting the passage of fluid past the power cylinder piston in the direction of the connecting member, said pumping cylinder being provided with inlet and outlet ports, and said power cylinder being provided with an inlet on the opposite side of its piston from that occupied by the connecting member.

6. In an air compressor, the combination of a power cylinder provided at one end with a connecting member adapted to deliver a fluid thereto, an axially disposed pumping cylinder at the other end of the power cylinder, pistons in said cylinders connected with each other, means for permitting the passage of fluid past the power cylinder piston in the direction of the connecting member, said pumping cylinder being provided with inlet and outlet ports, and said power cylinder being provided with an inlet on the opposite side of its piston from that occupied by the connecting member, together with means for cushioning said pistons at the extremity of their stroke in either direction.

7. The combination of a power cylinder provided with a connecting member at one end, constituting a fluid admitting means, and a pumping cylinder at the other end provided with inlet and outlet ports, pistons in said cylinder connected with each other, a valved passage arranged to admit air from the exterior to the connecting member, and an opening adapted to admit air to the power cylinder on the other side of the power cylinder piston from that occupied by the connecting member, together with means for cushioning said pistons at the extremity of their stroke in either direction.

8. The combination of a power cylinder provided with a connecting member at one end, constituting a fluid admitting means, and a pumping cylinder at the other end provided with inlet and outlet ports, pistons in said cylinder connected with each other, a valved passage arranged to admit air from the exterior to the connecting member, and an opening adapted to admit air to the power cylinder on the other side of the power cylinder piston from that occupied by the connecting member, a fluid conveying duct adapted to receive compressed fluid from the pumping cylinder, and a plurality of valves in said duct, one seating in the direction of fluid movement, and the other seating in the opposite direction and closing the outlet of the power cylinder.

9. In an air compressor, the combination of a power cylinder, a connecting member adapted to admit power fluid thereto, a pumping cylinder axially disposed at the other end of the power cylinder, pistons in said cylinders connected with each other, said pumping cylinder being provided with valved inlet and outlet ports adapted for the admission and discharge of fluid, and a duct formed in sections and connected with the outlet ports of the pumping cylinder, each section of said duct being provided with a valve adjacent to its outer end, seating in the direction of fluid delivery and adapted to be opened automatically when a coupling member is applied to such end of the duct section.

10. In an air compressor, the combination of a power cylinder, a connecting member adapted to admit power fluid thereto, a pumping cylinder axially disposed at the other end of the power cylinder, pistons in said cylinders connected with each other, said pumping cylinder being provided with valved inlet and outlet ports adapted for the admission and discharge of fluid, and a duct formed in sections and connected with the outlet ports of the pumping cylinder, each section of said duct being provided with a valve adjacent to its outer end, seating in the direction of fluid delivery and adapted to be opened automatically when a coupling member is applied to such end of the duct section, together with means for cushioning said pistons on the completion of their stroke in either direction.

11. In an air compressor, the combination of a power cylinder, a connecting member adapted to admit power fluid thereto, a pumping cylinder axially disposed at the other end of the power cylinder, pistons in said cylinders connected with each other, said pumping cylinder being provided with valved inlet and outlet ports adapted for the admission and discharge of fluid, and a

duct formed in sections and connected with the outlet ports of the pumping cylinder, each section of said duct being provided with a valve adjacent to its outer end, seating in the direction of fluid delivery and adapted to be opened automatically when a coupling member is applied to such end of the duct section, together with means for cushioning said pistons on the completion of their stroke in either direction, and each of said cushioning means comprising socketing plungers arranged for air compression on the completion of piston stroke in either direction.

12. The combination with the cylinder of an internal combustion engine, of a power cylinder and a pumping cylinder connected end to end and constituting an air pump, a tubular rod connecting said pistons slotted intermediate of its end portions, a stop extending into said rod between the pistons and, a motion stopping member on said stop, adapted to compress air in the unslotted end portions of the rod.

In testimony whereof we affix our signatures in the presence of two witnesses.

CHARLES JEROME COSTELLO.
STEPHEN GUION SKINNER.

Witnesses:
WALTON N. JACOBSON,
CHAS. T. PLASTOW.