W. PRELLWITZ.

UNLOADER FOR FLUID COMPRESSORS.

APPLICATION FILED MAY 31, 1907.

1,019,359.

Patented Mar. 5, 1912.

5 SHEETS—SHEET 1.

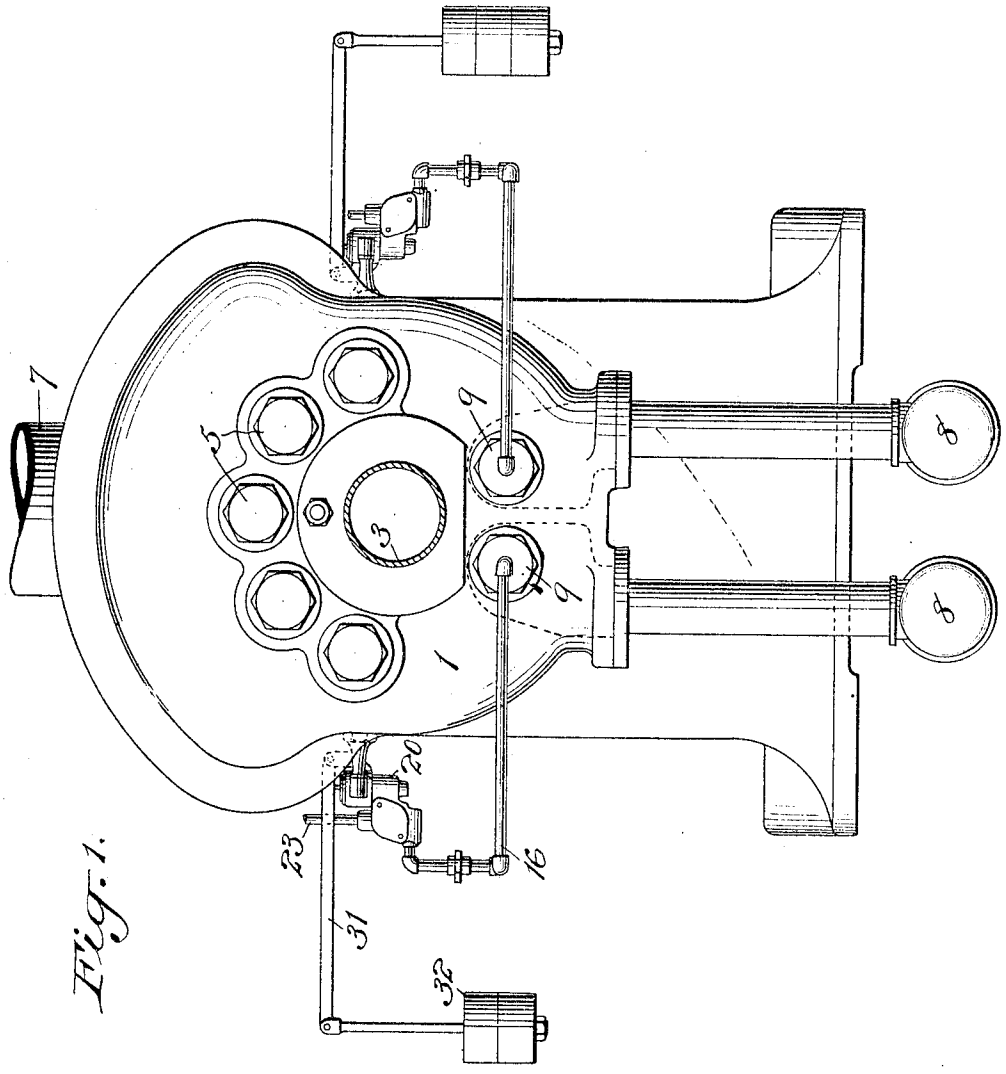

Fig. 1.

Witnesses:-
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Henry Thiemann.

Inventor:-
William Prellwitz
by attorneys
Brown & Durand

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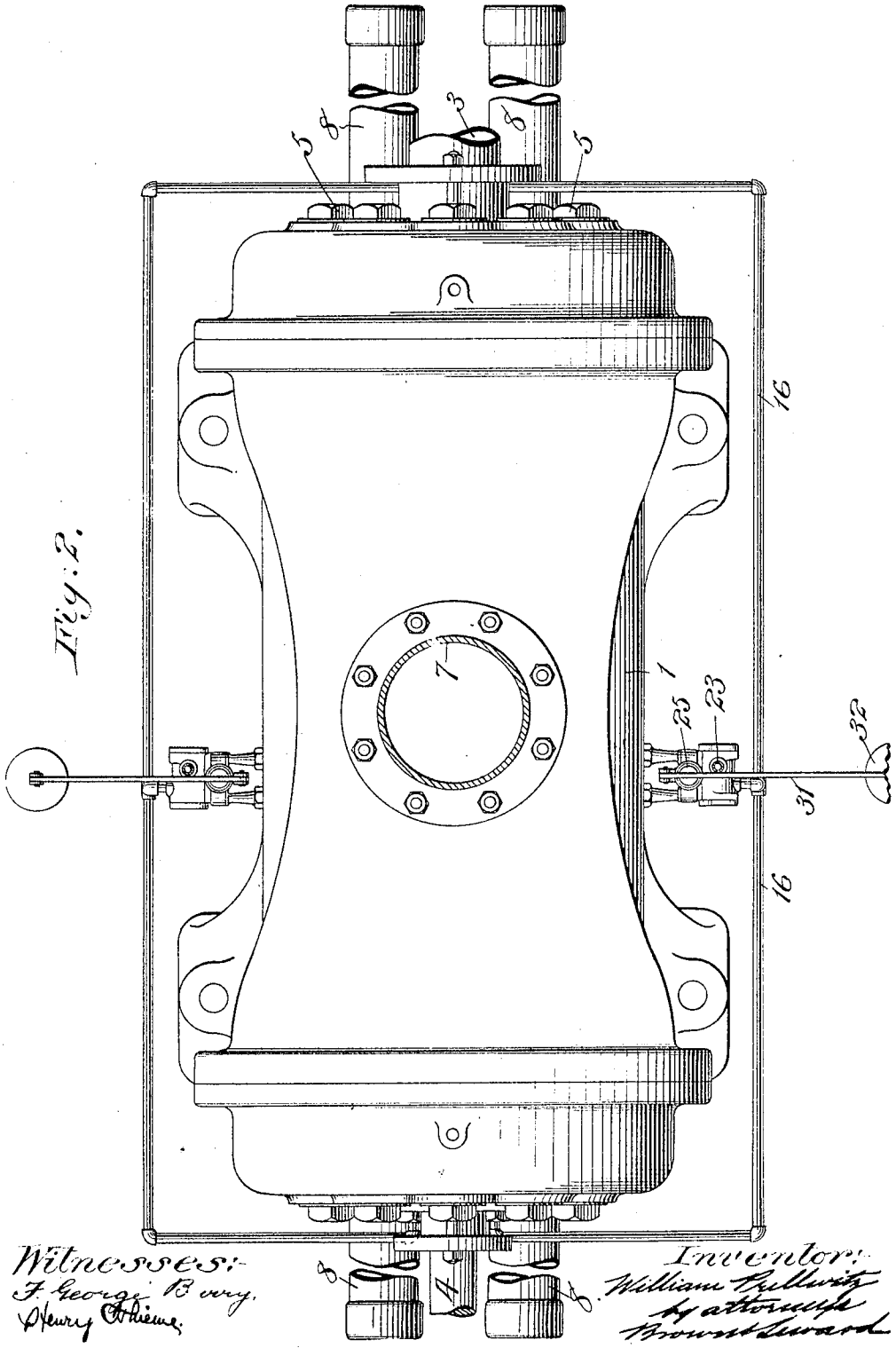

Fig. 2.

Witnesses:
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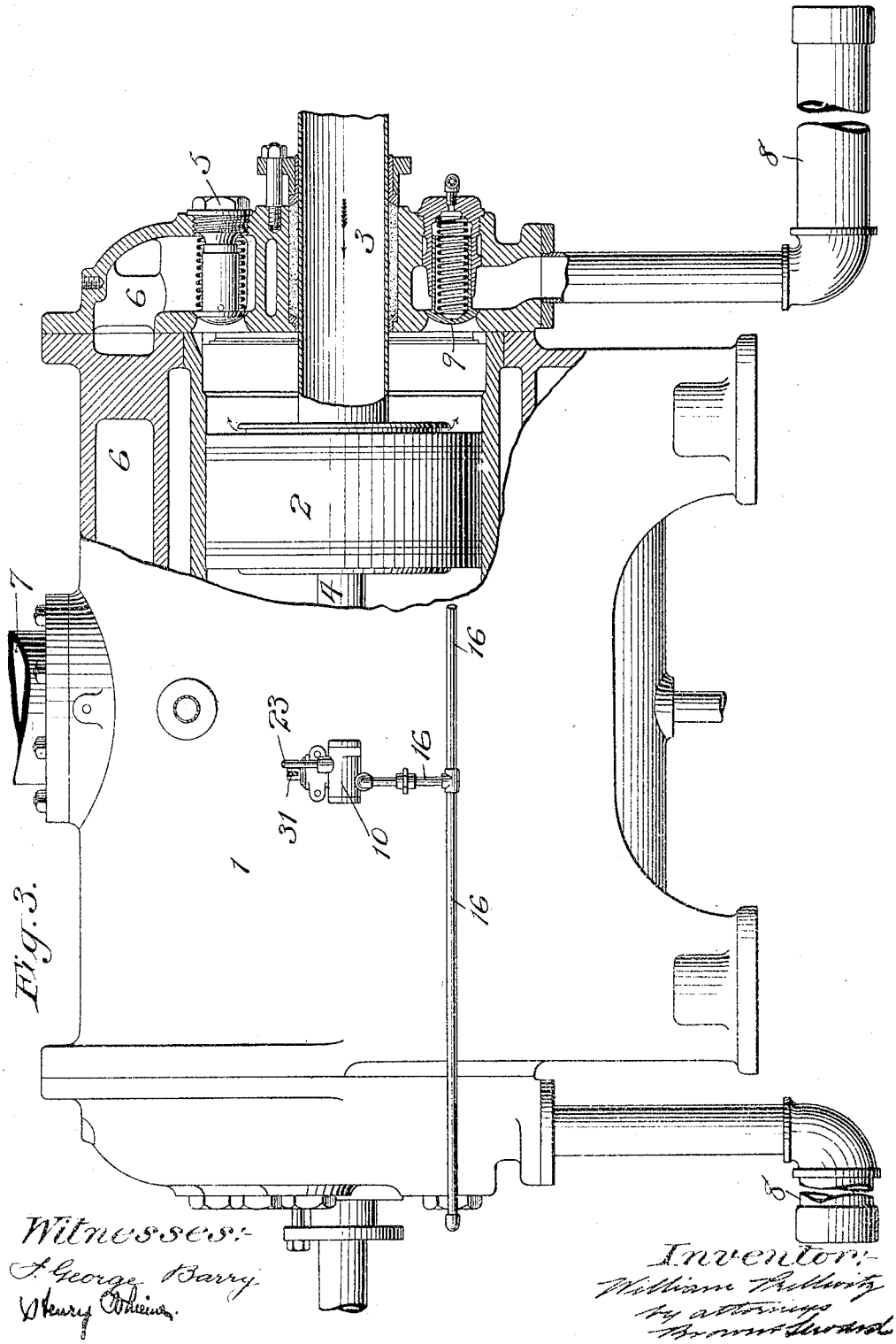

Fig. 3.

Witnesses:-
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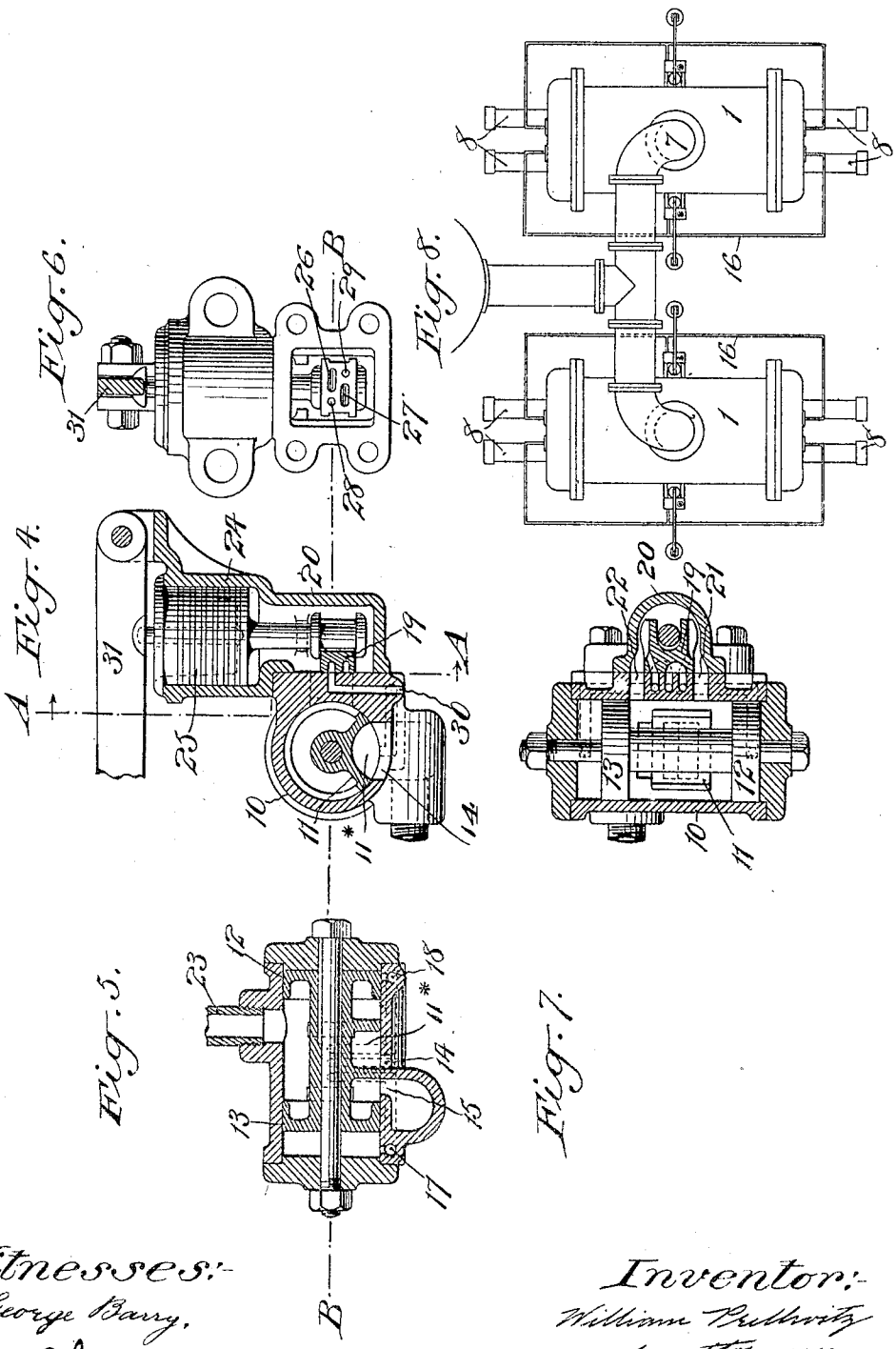
5 SHEETS—SHEET 4.



Witnesses:-
A. George Barry,
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APPLICATION FILED MAY 31, 1907.

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5 SHEETS—SHEET 5.

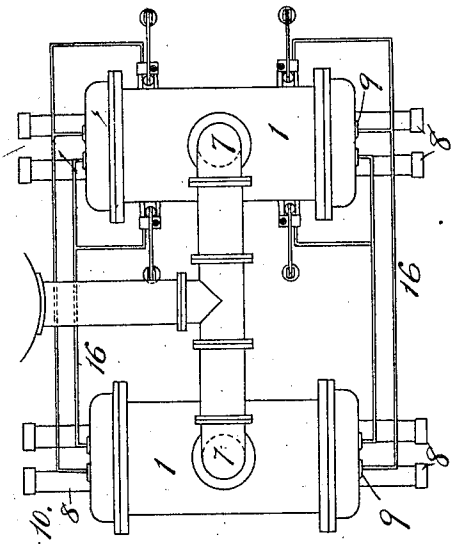

Fig. 10.

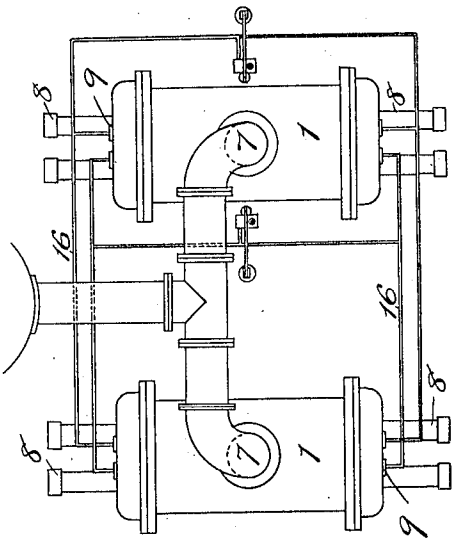

Fig. 12.

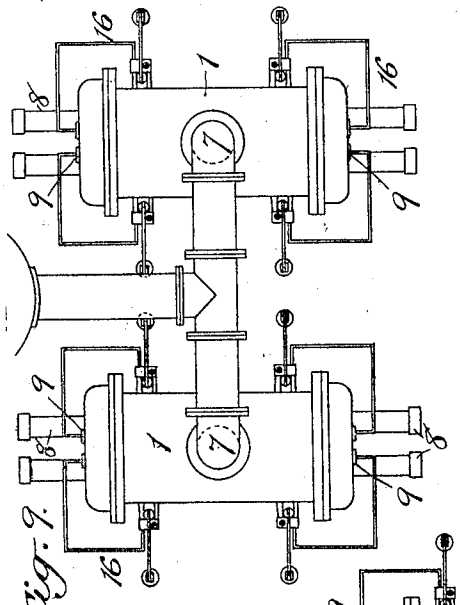

Fig. 9.

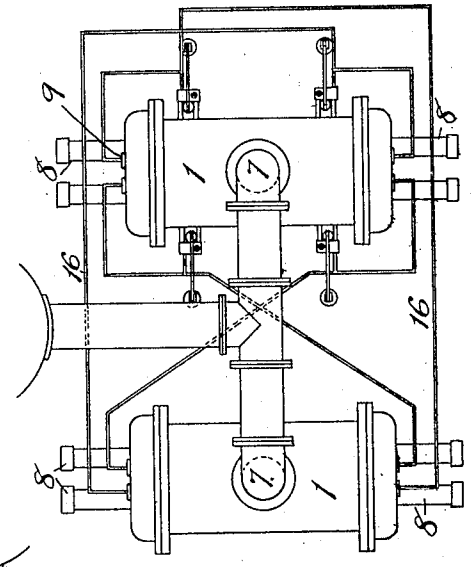

Fig. 11.

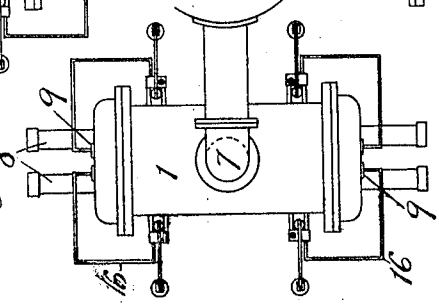

Fig. 13.

Witnesses:-
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Brown & Howard

UNITED STATES PATENT OFFICE.

WILLIAM PRELLWITZ, OF EASTON, PENNSYLVANIA, ASSIGNOR TO INGERSOLL-RAND COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW JERSEY.

UNLOADER FOR FLUID-COMPRESSORS.

1,019,359. Specification of Letters Patent. Patented Mar. 5, 1912.

Application filed May 31, 1907. Serial No. 376,702.

To all whom it may concern:

Be it known that I, WILLIAM PRELLWITZ, a citizen of the United States, and resident of Easton, in the county of Northampton and State of Pennsylvania, have invented a new and useful Improvement in Unloaders for Fluid-Compressors, of which the following is a specification.

My invention relates to means for unloading fluid compressors and consists broadly in novel means arranged to automatically unload the compressor when the pressure rises to a predetermined point and load the compressor when the pressure falls to a predetermined point, said means comprising an auxiliary receiver, a valve for opening and closing communication between the compressor and auxiliary receiver and a regulating device, such as a fluid pressure governed regulator, connected to the back of the auxiliary receiver valve.

My invention further consists in means for unloading and loading the compressor step by step as the pressure rises and falls to predetermined points, said means comprising a plurality of auxiliary receivers, valves arranged to open and close communication between the compressor and the auxiliary receivers and a plurality of regulating devices, such as fluid pressure governed regulators, connected to the backs of the auxiliary receiver valves for unloading the valves successively as different high pressures are reached.

The present invention is also directed to the novel means above set forth, applied to the cylinder or duplex cylinder of a single-stage fluid compressor.

Practical embodiments of my invention are represented in the accompanying drawings in which—

Figure 1 represents an end view of a one cylinder single stage fluid compressor with my novel unloading means applied thereto, Fig. 2 is a top plan view of the same, Fig. 3 is a side view partially in longitudinal central section, Fig. 4 is a central vertical section through the fluid pressure governed regulator which is used in connection with my unloading means, Fig. 5 represents a central vertical section of the regulating valve, Fig. 6 is a view taken in the plane of the line A—A of Fig. 4, looking in the direction of the arrows, Fig. 7 is a horizontal section taken in the plane of the line B—B of Figs. 4, 5, 6. Figs. 8, 9, 10, 11, 12 are diagrammatic plan views showing different arrangements of the unloading means as applied to single stage duplex fluid compressors, and Fig. 13 is a diagrammatic plan view showing another arrangement of the unloading means as applied to a one cylinder single stage compressor.

Proceeding to describe the form shown in Figs. 1 to 7 inclusive; the cylinder of the piston inlet fluid compressor shown herein is denoted by 1, the piston by 2, its inlet by 3 and its rod through which the piston derives its motion, by 4. It is to be understood that this piston is driven from any suitable source of power, not shown herein.

The main discharge valves are denoted by 5, the air passages by 6 and the pipe leading to the receiver by 7, one or more auxiliary receivers 8 are provided which are arranged to be opened and closed to the interior of the cylinder by one or more auxiliary valves 9. In the present instance four of these receivers are shown, two being shown in communication with one end of the cylinder and two being shown in communication with the other end of the cylinder. The backs of the auxiliary receiver valves 9 are brought into communication with regulating devices, such as fluid pressure governed regulators of the form disclosed in United States Letters Patent No. 514,839 dated February 13, 1894, a general description of the construction, arrangement and operation of which follows.

10 is a cylindrical valve box containing the main slide valve 11 having piston heads 12, 13 and a bridge port 11*. This valve box is provided with a port 14 open to atmosphere and a port 15 which is in communication with the backs of the two auxiliary receiver valves 9 at opposite ends of the cylinder 1 through a pipe 16. The main valve 11 is operated by pressure upon one or the other of its piston heads 12, 13, by fluid admitted at the ends of the valve box through ports 17, 18, under the control of an auxiliary slide valve 19 in the box 20 which is always open to the valve box 10 between the piston heads 12, 13, through the passages 21, 22. A pipe 23 leads from

the receiver to the space between the main valve piston heads 12, 13 so that this space and the interior of the box 20 are always open to receiver pressure. On the top of the auxiliary valve box 20 is a cylinder 24 which is open at the bottom to the interior of the said box. A piston 25 is fitted to slide in the cylinder 24, which piston is arranged to move the auxiliary valve 19 under the influence of receiver pressure. This auxiliary valve 19 is provided with upper and lower bridge ports 26, 27, and upper and lower through ports 28, 29. The main valve box 10 is provided with a port 30 intermediate the ports 17, 18. These several ports are so arranged that the movement of the auxiliary valve will control the movement of the main valve for opening the pressure from the receiver to the backs of the auxiliary receiver valves 9 through port 15, and pipe 16, when the main valve is in one position or open the backs of the said auxiliary receiver valves to atmosphere through pipe 16, port 15, bridge port 11* and port 14, when the main valve is in its other position. The piston 25 for operating the auxiliary valve 19 of the regulator is weighted to hold the auxiliary valve in position to keep the load on the auxiliary receiver valve until a predetermined high pressure has been reached, by means of a weighted arm 31, the weights 32 on which may be so regulated that the backs of the auxiliary receiver valves 9 will be unloaded by the movement of the main valve under the control of the movement of the auxiliary valve when said predetermined high pressure has been reached.

In the form shown in Fig. 13, each of the four auxiliary receivers is provided with a fluid pressure governed regulator. In Fig. 9 a single stage duplex fluid compressor is shown in which each cylinder is shown as being provided with two auxiliary receivers at each end and a fluid pressure governed regulator is provided for the valve of each auxiliary receiver. In Fig. 10 four fluid pressure governed regulators are shown, each regulator being shown as controlling the valves of two auxiliary receivers on corresponding ends of the two cylinders. In Fig. 11 four fluid pressure governed regulators are shown, each regulator being arranged to control the operation of the valves of two auxiliary receivers upon opposite ends of the two cylinders. In Fig. 12 two fluid pressure governed regulators are shown, each being arranged to control the operation of the valves of two auxiliary receivers upon opposite ends of each of the two cylinders. The several forms shown are for the purpose of illustrating the point that any number of auxiliary receivers may be employed and any number of regulating devices, such as fluid pressure governed regulators, may be employed to suit different requirements.

The operation of the simplest form of my invention would be as follows. An auxiliary receiver of a predetermined size is connected to the compressor and a valve is provided for opening and closing communication between said receiver and the interior of the compressor cylinder. When the compressor starts, the pressure is raised in the auxiliary receiver corresponding to the rise of pressure in the system. After the pressure has been raised to its regular working condition, the auxiliary receiver valve tends to remain closed because of the pressure from the receiver on the back of the valve. When the pressure has been raised to a predetermined high point, the regulator which is controlled by receiver pressure will automatically unload the back of the auxiliary receiver valve, thus allowing the fluid under pressure to be forced from the cylinder into the auxiliary receiver on the forward stroke of the piston and to pass back from the auxiliary receiver into the cylinder on the return stroke of the piston, the unloaded valve remaining open so long as the power of the valve spring, which is made very light, is less than the pressure on the valve of the fluid within the cylinder, thus automatically reducing the power of the compressor to a predetermined extent fixed by the relative capacities of the compressor cylinder and auxiliary receiver. As the fluid pressure falls in the receiver, the regulator will automatically load the auxiliary receiver valve by opening the back of the same to receiver pressure, thus closing the valve and permitting the compressor to again operate under full load.

It is obvious that by varying the size of the auxiliary receiver, the compressor can be entirely unloaded or only partially unloaded, depending upon the capacity of the auxiliary receiver. An auxiliary receiver may be connected to both ends of the cylinder and a single regulating device, such as a fluid pressure governed regulator, may be provided for the valves on both auxiliary receivers, or a regulator may be provided for each auxiliary receiver.

If it is desired to unload the compressor step by step, an additional set of auxiliary receivers may be provided for the ends of the cylinder, the valves of the said additional set of auxiliary receivers being controlled by a second regulating device, such as the fluid pressure governed regulator above described, which is set by means of its weights to further unload the compressor after the first set of auxiliary receivers have been used for partially unloading the compressor. If it is desired to unload the compressor in four steps, as for

instance in the form shown in Fig. 13, one way of accomplishing this result would be to first unload the auxiliary receiver valve at the front end of the cylinder, then unload the auxiliary receiver valve at the back end; then unload the other auxiliary receiver valve at the front end, and finally unload the other auxiliary receiver valve at the back end. It will also be seen that as the fluid pressure falls in the receiver the load will be automatically thrown on to the compressor step by step, this gradual increase in the load being a valuable feature of my invention, especially when used in connection with large machines.

It is obvious that by making different combinations of auxiliary receivers and regulators, the unloading of the compressor can be accomplished either at one time or in successive steps as the fluid in the receiver reaches different predetermined high pressures.

When the auxiliary receiver valves are unloaded they will stay open as long as the fluid pressure on the valves overbalances the power of the valve springs and therefore the amount of work required for filling the auxiliary receivers will be again given back to the machine on the return stroke as the volume of fluid is expanded. If the unloaded valves should close at the end of the piston stroke away from said valves due to the reduction of pressure below the power of their springs, they will be opened again as soon as the piston starts toward the said valves and will remain open until the pressure in the auxiliary receivers is reduced to a point below the power of said springs.

When the compressor is working with the auxiliary receiver valves closed, it will be seen that the auxiliary receivers remain full of fluid at maximum pressure, the valves preventing the fluid from passing back into the cylinder.

It is to be understood that by the term "regulating device," I wish to include any mechanical, electrical or fluid means which can be employed for carrying out the objects of my invention; hence I do not wish to limit myself to the particular regulating device herein shown and described, but

What I claim is:

1. The combination with the cylinder of a fluid compressor, of auxiliary receivers therefor, and means for opening or closing communication between the cylinder and its auxiliary receivers at successively attained pressures.

2. The combination with the cylinder of a fluid compressor, of auxiliary receivers therefor, and fluid pressure controlled means for opening or closing communication between the cylinder and its auxiliary receivers at successively attained pressures.

3. The combination with the cylinders of a duplex single-stage fluid compressor, of auxiliary receivers therefor, and means for opening or closing communication between the cylinders and their auxiliary receivers at successively attained pressures.

4. The combination with the cylinders of a duplex single-stage fluid compressor, of auxiliary receivers therefor, and fluid pressure controlled means for opening or closing communication between the cylinders and their auxiliary receivers at successively attained pressures.

5. The combination with the cylinder of a fluid compressor, of auxiliary receivers therefor, and fluid pressure controlled valves for opening or closing communication between the cylinder and its auxiliary receivers at successively attained pressures.

6. The combination with the cylinders of a duplex single-stage fluid compressor, of auxiliary receivers therefor, and fluid pressure controlled valves for opening or closing communication between the cylinders and their auxiliary receivers at successively attained pressures.

7. The combination with the cylinder of a fluid compressor, of auxiliary receivers therefor, valves for opening or closing communication between the cylinder and its auxiliary receivers at successively attained pressures and unloading devices for the said valves.

8. The combination with the cylinder of a fluid compressor, of auxiliary receivers therefor, valves for opening or closing communication between the cylinder and its auxiliary receivers at successively attained pressures and fluid pressure controlled unloading devices for the said valves.

9. The combination with the cylinders of a duplex single-stage fluid compressor, of auxiliary receivers therefor, valves for opening or closing communication between the cylinders and their auxiliary receivers at successively attained pressures and unloading devices for the said valves.

10. The combination with the cylinders of a duplex single-stage fluid compressor, of auxiliary receivers therefor, valves for opening or closing communication between the cylinders and their auxiliary receivers at successively attained pressures and fluid pressure controlled unloading devices for the said valves.

11. In a fluid compressor, the combination with pumping mechanism, of means independent of the valves of the pumping mechanism for unloading it in successive well defined steps.

12. In a fluid compressor, the combination with pumping mechanism, of fluid pressure controlled means independent of the valves of the pumping mechanism for unloading it in successive well defined steps.

13. In a fluid compressor, the combination with pumping mechanism, of means independent of the valves of the pumping mechanism for loading or unloading it in successive well defined steps.

14. In a fluid compressor, the combination with pumping mechanism, of fluid pressure controlled means independent of the valves of the pumping mechanism for loading or unloading it in successive well defined steps.

15. In a fluid compressor, the combination with pumping mechanism, of unloading devices independent of the valves of the pumping mechanism fitted to operate at different successively attained pressures.

16. In a fluid compressor, the combination with pumping mechanism, of fluid pressure controlled unloading devices independent of the valves of the pumping mechanism fitted to operate at different successively attained pressures.

17. In a duplex single-stage fluid compressor, the combination with pumping mechanism, of means independent of the valves of the pumping mechanism for unloading it in successive well defined steps.

18. In a duplex single-stage fluid compressor, the combination with pumping mechanism, of fluid pressure controlled means independent of the valves of the pumping mechanism for unloading it in successive well defined steps.

19. In a duplex single-stage fluid compressor, the combination with pumping mechanism, of means independent of the valves of the pumping mechanism for unloading or loading it in successive well defined steps.

20. In a duplex single-stage fluid compressor, the combination with pumping mechanism, of fluid pressure controlled means independent of the valves of the pumping mechanism for unloading or loading it in successive well defined steps.

21. The combination with the cylinder of a fluid compressor, of auxiliary receivers, valves for opening and closing communication between the cylinder and the auxiliary receivers and regulators connected to the backs of the valves for successively unloading them as different predetermined high pressures are reached, for unloading the compressor step by step.

22. The combination with the cylinder of a fluid compressor, of auxiliary receivers, valves for opening and closing communication between the cylinder and the auxiliary receivers and fluid pressure governed regulators connected to the backs of the valves for successively unloading them as different predetermined high pressures are reached, for unloading the compressor step by step.

23. The combination with the cylinder of a fluid compressor, of auxiliary receivers, valves for opening and closing communication between the cylinder and auxiliary receivers and regulators for successively unloading the valves as the pressure rises to predetermined points and for successively loading the valves as the pressure falls to predetermined points, for automatically unloading and loading the compressor step by step.

24. The combination with the cylinder of a fluid compressor, of auxiliary receivers, valves for opening and closing communication between the cylinder and the auxiliary receivers and fluid pressure governed regulators for successively unloading the valves as the pressure rises to predetermined points and for successively loading the valves as the pressure falls to predetermined points, for automatically unloading and loading the compressor step by step.

25. The combination with the cylinders of a fluid compressor, of auxiliary receivers, valves for opening and closing communication between the cylinders and auxiliary receivers and regulators connected to the backs of the valves for successively unloading them as different predetermined high pressures are reached, for unloading the compressor step by step.

26. The combination with the cylinders of a fluid compressor, of auxiliary receivers, valves for opening and closing communication between the cylinders and auxiliary receivers and fluid pressure governed regulators connected to the backs of the valves for successively unloading them as different predetermined high pressures are reached, for unloading the compressor step by step.

27. The combination with the cylinders of a fluid compressor, of auxiliary receivers, valves for opening and closing communication between the cylinders and auxiliary receivers and regulators for successively unloading the valves as the pressure rises to predetermined high points and for successively loading the valves as the pressure falls to predetermined points, for automatically unloading and loading the compressor step by step.

28. The combination with the cylinders of a fluid compressor, of auxiliary receivers, valves for opening and closing communication between the cylinders and auxiliary receivers and fluid pressure governed regulators for successively unloading the valves as the pressure rises to predetermined high points and for successively loading the valves as the pressure falls to predetermined points, for automatically unloading and loading the compressor step by step.

29. In a variable volume fluid compressor, the combination with the fluid compressor cylinder and the receiver for the compressed fluid generated by said compressor, of a plurality of compartments

and means for successively placing the compartments in communication with the clearance space in said cylinder as the pressure in the receiver rises to different predetermined points.

30. In a variable volume fluid compressor, the combination with the fluid compressor cylinder and the receiver for the compressed fluid generated by said compressor, of a plurality of compartments and means for successively placing the compartments in communication with the clearance space in said cylinder as the pressure in the receiver rises to different predetermined points and to successively close communication between the said compartments and clearance space in said cylinder as the pressure in the receiver falls to different predetermined points.

31. In a variable volume fluid compressor, the combination with the fluid compressor cylinder and the receiver for the compressed fluid generated by said compressor, of a plurality of compartments and automatic means for successively placing the compartments in communication with the clearance space in said cylinder as the pressure in the receiver rises to different predetermined points.

32. In a variable volume fluid compressor, the combination with the fluid compressor cylinder and the receiver for the compressed fluid generated by said compressor, of a plurality of compartments and automatic means for successively placing the compartments in communication with the clearance space in said cylinder as the pressure in the receiver rises to different predetermined points and to successively close communication between the said compartments and clearance space in said cylinder as the pressure in the receiver falls to different predetermined points.

33. In a variable volume fluid compressor, the combination with the fluid compressor cylinder and the receiver for the compressed fluid generated by said compressor, of a plurality of compartments and fluid pressure controlled means for successively placing the compartments in communication with the clearance space in said cylinder as the pressure in the receiver rises to different predetermined points.

34. In a variable volume fluid compressor, the combination with the fluid compressor cylinder and the receiver for the compressed fluid generated by said compressor, of a plurality of compartments and fluid pressure controlled means for successively placing the compartments in communication with the clearance space in said cylinder as the pressure in the receiver rises to different predetermined points and to successively close communication between the said compartments and clearance space in said cylinder as the pressure in the receiver falls to different predetermined points.

35. In a variable volume fluid compressor, the combination with fluid compressor cylinders and the receiver for the compressed fluid generated by said compressor, of a plurality of compartments and means for successively placing the compartments in communication with the clearance spaces in said cylinders as the pressure in the receiver rises to different predetermined points.

36. In a variable volume fluid compressor, the combination with fluid compressor cylinders and the receiver for the compressed fluid generated by said compressor, of a plurality of compartments and means for successively placing the compartments in communication with the clearance spaces in said cylinders as the pressure in the receiver rises to different predetermined points and to successively close communication between the said compartments and the clearance spaces in said cylinders as the pressure in the receiver falls to different predetermined points.

37. In a variable volume fluid compressor, the combination with fluid compressor cylinders and the receiver for the compressed fluid generated by said compressor, of a plurality of compartments and automatic means for successively placing the compartments in communication with the clearance spaces in said cylinders as the pressure in the receiver rises to different predetermined points.

38. In a variable volume fluid compressor, the combination with fluid compressor cylinders and the receiver for the compressed fluid generated by said compressor, of a plurality of compartments and automatic means for successively placing the compartments in communication with the clearance spaces in said cylinders as the pressure in the receiver rises to different points and to successively close communication between the said compartments and the clearance spaces in said cylinders as the pressure in the receiver falls to different predetermined points.

39. In a variable volume fluid compressor, the combination with fluid compressor cylinders and the receiver for the compressed fluid generated by said compressor, of a plurality of compartments and fluid pressure controlled means for successively placing the compartments in communication with the clearance spaces in said cylinders as the pressure in the receiver rises to different predetermined points.

40. In a variable volume fluid compressor, the combination with fluid compressor cylinders and the receiver for the compressed fluid generated by said compressor, of a plu-

rality of compartments and fluid pressure controlled means for successively placing the compartments in communication with the clearance spaces in said cylinders as the pressure in the receiver rises to different predetermined points and to successively close communication between the said compartments and the clearance spaces in said cylinders as the pressure in the receiver falls to different predetermined points.

41. In a variable volume fluid compressor, the combination with a fluid compressor cylinder and the receiver for the compressed fluid generated by said compressor, of a plurality of compartments and automatic means for placing one of said compartments in communication with the clearance space in said cylinder when the pressure in said receivers reaches a predetermined point and for successively placing the remainder of said compartments in communication with said clearance space when the pressure in said receivers continues to rise.

42. In a variable volume fluid compressor, the combination with a fluid compressor cylinder and the receiver for the compressed fluid generated by said compressor, of a plurality of compartments and automatic means for placing one of said compartments in communication with the clearance space in said cylinder when the pressure in said receivers reaches a predetermined point and for successively placing the remainder of said compartments in communication with said clearance space when the pressure in said receivers continues to rise and for successively closing communication between said compartments and clearance space in said cylinder as the pressure in the receiver falls.

43. In a fluid compressor, the combination with single acting pumping mechanism, of means for unloading it in successive well defined steps.

44. In a fluid compressor, the combination with single acting pumping mechanism, of fluid pressure controlled means for unloading it in successive well defined steps.

45. In a fluid compressor, the combination with single acting pumping mechanism, of means for loading or unloading it in successive well defined steps.

46. In a fluid compressor, the combination with single acting pumping mechanism, of fluid pressure controlled means for loading or unloading it in successive well defined steps.

In testimony, that I claim the foregoing as my invention, I have signed my name in presence of two witnesses, this 25th day of May, 1907.

WILLIAM PRELLWITZ.

Witnesses:
F. GEORGE BARRY,
HENRY THIEME.