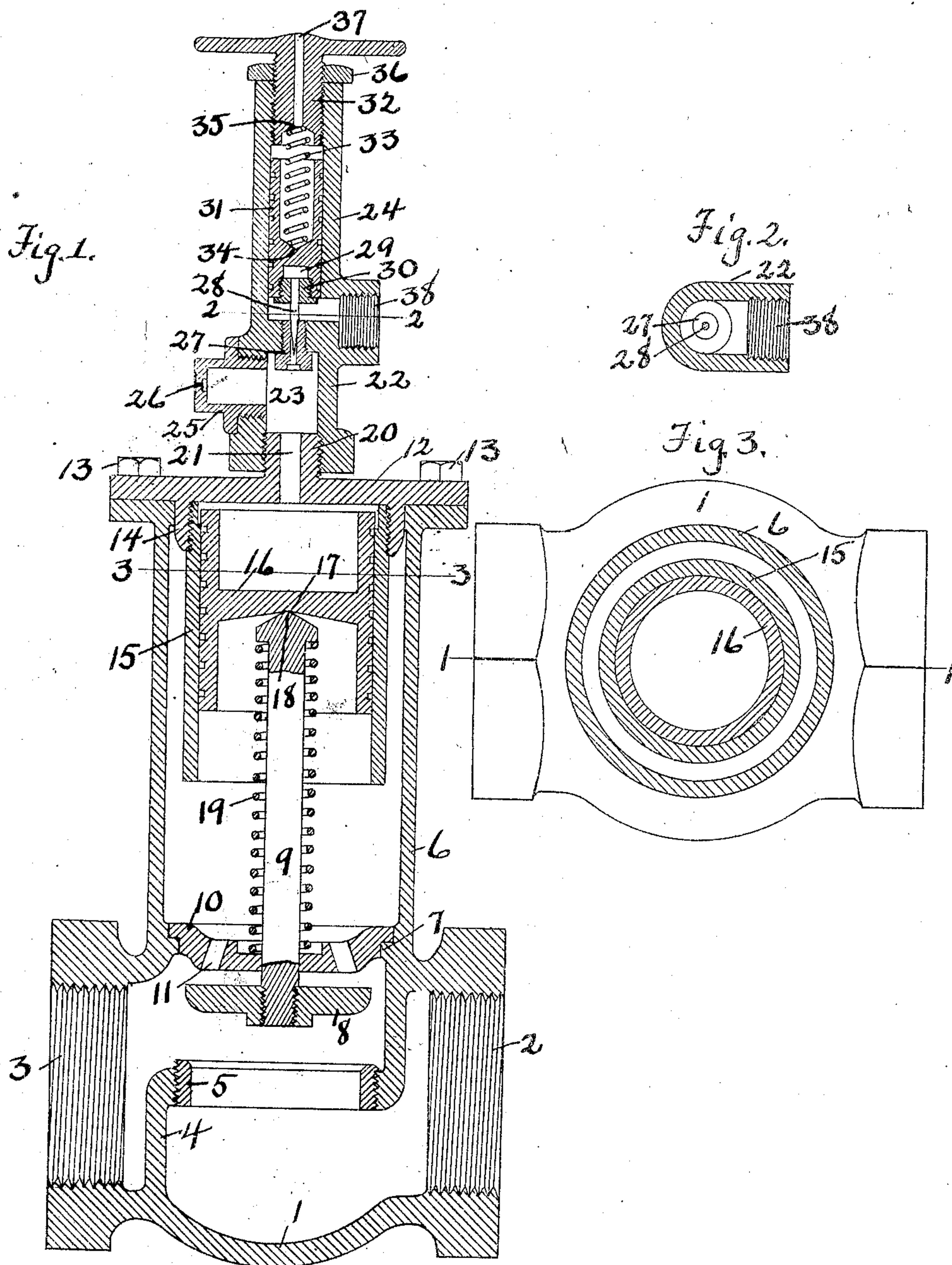


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RELIEF DEVICE.  
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962,551.

Patented June 28, 1910.



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# UNITED STATES PATENT OFFICE.

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## RELIEF DEVICE.

962,551.

Specification of Letters Patent. Patented June 28, 1910.

Application filed December 26, 1906. Serial No. 349,519.

*To all whom it may concern:*

Be it known that I, RUDOLPH CONRADER, a citizen of the United States, residing at Erie, in the county of Erie and State of Pennsylvania, have invented new and useful Improvements in Relief Devices, of which the following is a specification.

This invention relates to improvements in relief devices and consists in certain improvements in the construction thereof as will be hereinafter fully described and pointed out in the claims.

The invention is peculiarly fitted for use with compressors and in the exemplification shown in the drawings it is arranged with that in view.

Preferably the device is applied to the intake of the compressor and controls the discharge of fluid from the compressor by varying the amount of fluid admitted to the compressor.

There is a difference of opinion among engineers as to the advisability of varying the admission of fluid to the compressor so as to vary the total discharge of the compressor, and to satisfy the objection of engineers holding such opinions it is desirable to arrange the relief device so that there will be a complete operation of the device at a predetermined pressure as an abrupt opening of the device upon a predetermined low pressure, and an abrupt closing of the device upon a predetermined high pressure so that the compressor when the air is cut off will operate substantially in a vacuum and according to some theories advanced, will avoid heating. Other engineers demand a regulating effect with relation to the relief device, that is a closure of proportions varying as the pressure in the receiver varies so that the load on the compressor varies as the requirement varies.

One of the principal objects of this invention is to provide a device which will operate in either of the ways just hereinbefore described, and in the mechanism herein illustrated this is accomplished by simply reversing the relief device. When one end of the same is attached to the compressor it will operate abruptly and when the other end is attached to the compressor it will operate as a regulator and relief device combined.

Other objects of the invention will appear from the specification and claims.

The invention is illustrated in the accompanying drawings as follows:

Figure 1 shows a section on the line 1—1 in Fig. 3. Fig. 2, a section on the line 2—2 in Fig. 1. Fig. 3 a section on the line 3—3 in Fig. 1.

1 marks the valve chamber having the inlet and discharge openings 2 and 3. As before indicated, either of these may be the inlet and either the discharge, according to the manner in which it is desired to have the device operate. The diaphragm 4 is arranged in the chamber and in this is arranged a removable valve seat 5. The device is preferably arranged on the intake of the compressor (not shown), the air passing through the valve chamber and through the seat 5. A cylindrical extension 6 is formed preferably integrally with the chamber 1. It is of sufficient size to permit the introduction of the removable seat 5 and provide the shoulder 7. The valve disk 8 is screwed onto a stem 9. The stem passes through a guide 10 arranged on the shoulder 7. This guide has the perforations 11 so that the fluid pressure in the cylinder 6 is the same as in the valve chamber 1 on the upper side of the diaphragm. A cover 12 is provided for the cylinder 6. It is secured to the cylinder 6 by means of the screws 13. It has the internally screw threaded projecting shoulder 14 onto which a cylinder 15 is screwed. A piston 16 is arranged in this cylinder and forms an actuating mechanism for actuating the valve. It is provided with the conically shaped socket 17 against which the pointed end 18 of the stem 9 operates. A spring 19 is tensioned between the guide 10 and a shoulder on the upper end of the stem 9.

It will be readily understood that as pressure is delivered above the piston 16 it forces it downwardly, thus closing the valve 8 against the action of the spring. When the device is operating as a regulator the opening 2 is arranged as the inlet and the opening 3 is arranged next the compressor. The air delivered above the piston 16 varies as the air in the receiver varies so that the valve is forced down a distance varying as the compression in the receiver varies so that the device operates as a regulator. When, however, the opening 3 is arranged as the inlet and the opening 2 arranged next the compressor the initial movement of the



valve 8 incident to increased pressure on the piston 16 moves the valve so that it is influenced by the rush of fluid through the passage in the valve chamber so that the valve instantly closes, in the manner of the check valve, and when closed, the continuous operation of the compressor reduces the pressure in the compressor to approximately a vacuum so that the under side of the valve is practically relieved of all pressure. The upper side of the valve 8 is subjected to atmospheric pressure and the lower side of the piston 16 is also subjected to this pressure. In this respect while the pressures are approximately balanced they do not oppose each other. So long, however, as the pressure in the receiver is above the desired maximum, air is kept in the cylinder 15 on the piston 16 so as to maintain the valve in its closed position. When, however, the air pressure in the receiver falls below a desired predetermined pressure, the pressure is reduced above the piston so that the valve 8 under the influence of the spring 19 is open. It is obvious, therefore, that the spring 19 should be of sufficient strength to open the valve 8 against approximately air pressure based on the area of the valve.

I prefer to arrange a device for so delivering air to the cylinder 15 as to intensify the variation in pressure over the variation in pressure in the receiver. In doing this I utilize in a broad sense a mechanism heretofore patented by me in Patents Nos. 775,392 and 775,393, Nov. 22, 1904.

A projection 20 extends from the cover 12 and is provided with a passage 21. The fitting 22, in which is arranged the intensifier and motor actuated by the fluid pressure in the receiver, is arranged on said projection 20. The intensifier consists of the chamber 23 and cooperating elements. A cap 25 is screwed into one side of this chamber and is provided with an opening 26 forming a continuous leak with the chamber 23. A valve seat 27 is screwed into the upper end of this chamber, preferably in axial alinement with the cylinder 6 and a needle valve 28 operates on this valve seat. The needle valve has the head 29 which is secured to the end of the piston 31 by means of the perforated screw 30. The piston 31 operates in a cylinder 24. An adjusting screw 32 is screwed into the end of the cylinder and operates against a spring 33 which is tensioned against the adjusting nut 32 and the piston 31. The piston has the conically bottomed socket 34 and the screw has the conically bottomed socket 35. The spring has reduced ends by reason of which it readily centers in these conical sockets, preventing the friction on the sides of the piston. The screw 32 is locked in adjustment by the jam nut 36 and is provided with a vent 37 so as to prevent trapping the air back of the piston 31. Air is admitted

from the receiver through the opening 38. This opening may be said for convenience to represent the receiver.

When the receiver pressure exceeds a predetermined maximum it moves the piston 31 against the spring 33 thus opening the needle valve 28, permitting the inflow of air to the chamber 23. If the opening of the needle valve is but slight, the proportion of air admitted to that escaping by means of the leak 26 does not deliver to the cylinder 15 the full receiver pressure. As the receiver pressure increases, however, the wider opening of the needle valve increases the difference in the area of the opening through the seat 27 and the leak 26 so that the pressure rapidly increases. When the needle valve is entirely open the difference in these sizes is so great that approximately receiver pressure is delivered to the cylinder 15. The spring 33 is such that a very slight difference in the receiver pressure will open the valve 28 from a position of minimum opening to full opening with a very slight variation in receiver pressure. It will be observed, therefore, that pressure is varied in the cylinder 15 from approximately air pressure to full receiver pressure so that the variation in pressure in the cylinder 15 is intensified over the variation of pressure in the receiver.

When the device is operating with an abrupt closure of the relief device, any pressure on the cylinder which will effect an initial movement of the piston 15 will move the valve into the area included in a current moving through the chamber 1 which will effect an immediate closure. On the other hand, when operating as a regulator and relief device the air currents are against the valve so that the air currents do not influence the valve in the least to effect a closure and on the other hand are not of sufficient force to neutralize the effect of the air pressure on the piston 16, especially as the pressures on the upper side of the valve and under side of piston are balanced.

I prefer to leave some space between the cover 12 and the ends of the piston 16 so that the spring 19 may fully extend. With this arrangement, there is no initial tension on the spring and the counter pressure incident to the spring therefore starts at zero so that there is immediate movement with the initial opening of the needle valve 28. This gives very sensitive and very close regulation.

What I claim as new is:

1. In a relief device the combination of a controlling valve; a reversible valve chamber in which the valve operates; and mechanism actuated by fluid pressure controlled by said valve and acting in connection with said valve and chamber for abruptly operating said valve when the controlled fluid



reaches a predetermined pressure with the fluid passing through the chamber in one direction and for gradually operating the valve as the pressure of the controlled fluid increases with the fluid passing through the chamber in the reverse direction.

2. In a relief device the combination of a controlling valve; a reversible valve chamber in which the valve operates; and mechanism actuated by fluid pressure, acting as the fluid pressure controlled by said valve varies and acting in connection with said valve and chamber for abruptly closing and opening said valve when the controlled fluid reaches a predetermined pressure with the fluid passing through the chamber in one direction and for gradually operating the valve as the pressure of the controlled fluid increases with the fluid passing through the chamber in the reversed direction.

3. In a relief device the combination of a controlling valve a reversible valve chamber in which the valve operates; and mechanism actuated by fluid pressure controlled by said valve and acting in connection with said valve and chamber for abruptly operating said valve and acting in connection with said valve and chamber when the controlled fluid reaches a predetermined pressure with the fluid passing through the chamber in one direction and for gradually operating the valve as the pressure of the controlled fluid increases with the fluid passing through the chamber in the reverse direction.

4. In a relief device the combination of a valve chamber having a fluid passage there-through and a diaphragm with a valve seat thereon; an inlet and discharge opening at opposite sides of the diaphragm; a valve for opening and closing said passage by movement from and toward said seat; and mechanism actuated by fluid controlled by the valve for operating said valve abruptly at a predetermined pressure of the controlled fluid with the inlet and discharge passages of the chamber arranged to make the direction of the movement of the fluid through the passage in the direction of the movement of the valve and for operating said valve gradually as the controlled pressure increases and the inlet and discharge openings are reversed.

5. In a relief device the combination of a valve chamber having a fluid passage there-through and a diaphragm, with a valve seat thereon; an inlet and discharge opening at opposite sides of the diaphragm; a valve for opening and closing said passage by movement from and toward said seat; and mechanism actuated by fluid controlled by the valve for operating said valve abruptly at a predetermined pressure of the controlled fluid with the inlet and discharge passages of the chamber arranged to make the direction of the movement of the fluid through

the passage in the direction of the movement of the valve and for operating said valve gradually as the controlled pressure increases and the inlet and discharge openings are reversed.

6. In a relief device the combination of a controlling valve; and mechanism comprising a motor actuated in one direction by fluid pressure varying with the pressure of the fluid controlled by the valve and in the opposite direction by a counter pressure device for abruptly operating said valve when the controlled fluid reaches a predetermined pressure with the fluid passing through the chamber in one direction and for gradually operating the valve as the pressure of the controlled fluid increases with the fluid passing through the chamber in the reverse direction.

7. In a relief device the combination of a controlling valve; a reversible valve chamber in which the valve operates; and mechanism actuated by fluid pressure, acting as the fluid pressure controlled by said valve varies for abruptly closing and opening said valve when the controlled fluid reaches a predetermined pressure with the fluid passing through the chamber in one direction and for gradually operating the valve as the pressure of the controlled fluid increases with the fluid passing through the chamber in the reverse direction.

8. In a relief device the combination of a controlling valve; a reversible valve chamber in which the valve operates; a mechanism comprising a motor actuated in one direction by the fluid controlled by said valve and in the opposite direction by a counter pressure device for abruptly operating said valve when the controlled fluid reaches a predetermined pressure with the fluid passing through the chamber in one direction and for gradually operating the valve as the pressure of the controlled fluid increases with the fluid passing through the valve in the reverse direction.

9. In a relief device the combination of a controlling valve; a reversible valve chamber in which the valve operates; and mechanism actuated by fluid pressure and comprising an intensifier for increasing the fluid pressure acting on the mechanism over a change of pressure in the fluid controlled by the valve for abruptly operating said valve when the controlled fluid reaches a predetermined pressure with the fluid passing through the chamber in one direction and for gradually operating the valve as the pressure of the controlled fluid increases with the fluid passing through the chamber in the reverse direction.

10. In a relief device the combination of a controlling valve; a reversible valve chamber in which the valve operates; and mechanism actuated by fluid pressure and comprising an intensifier for increasing the fluid



pressure acting on the mechanism over a change of pressure in the fluid controlled by the valve for abruptly closing and opening said valve when the controlled fluid reaches a predetermined pressure with the fluid passing through the chamber in one direction and for gradually operating the valve as the pressure of the controlled fluid increases with the fluid passing through the chamber in the reverse direction.

11. In a relief device for compressors the combination of a valve controlling the intake, said valve closing and opening by a movement toward and from its seat, the closing movement being in the direction of the fluid passing the valve with one direction of movement of fluid through the device; and mechanism actuated at a predetermined pressure of the fluid controlled by said valve for closing and opening said valve, the maintenance of the closure being assisted by the absence of pressure at the compressor side of the device.

12. In a relief device for compressors the combination of an unbalanced valve controlling the intake, said valve closing and opening by a movement toward and from its seat, the closing movement being in the direction of movement of the fluid passing the valve with one direction of movement of fluid through the device; and means for operating said valve at a predetermined pressure of the fluid controlled by the valve.

13. In a relief device for compressors the combination of an unbalanced valve controlling the intake, said valve closing and opening by a movement toward and from its seat, the closing movement being with one direction of movement of fluid through the device in the direction of movement of the fluid passing the valve; mechanism for operating said valve at a predetermined pressure of the fluid controlled by the valve, said mechanism operating said valve abruptly.

14. In a relief device for compressors the combination of an unbalanced valve controlling the intake, said valve closing and opening by a movement toward and from its seat, the closing movement being in the direction of movement of the fluid passing the valve; means for operating said valve at a predetermined pressure of the fluid controlled by the valve; said means operating said valve abruptly, and being adapted to operate the valve gradually as the controlled pressure varies when the inlet to the device is reversed.

15. In a relief device for compressors the combination of a valve controlling the intake, said valve closing and opening by a movement toward and from its seat, the closing movement being in the direction of the fluid passing the valve; means for operating said valve abruptly at a predeter-

mined pressure of the fluid controlled by the device, said means being adapted to operate the valve gradually as the controlled pressure varies when the inlet to the device is reversed.

16. In a relief device for compressors the combination of a valve controlling the intake, said valve closing and opening by a movement toward and from its seat, the closing movement being in the direction of the fluid passing the valve with the fluid passing through the device in one direction and opposed to the movement of fluid through the device with fluid passing through the device in the reverse direction; and means for opening and closing said valve abruptly at a predetermined pressure of the fluid controlled by the device with the closing movement in the direction of the flow of fluid, said means being adapted to operate the valve gradually as the controlled pressure varies when the fluid passing through the device is reversed.

17. In a relief device for compressors the combination of an unbalanced valve controlling the intake, said valve closing and opening by a movement toward and from its seat, said valve being closed in the direction of the movement of the fluid through it; a spring tending to hold the valve open; a pressure device acting against the spring for closing the valve; and means for subjecting the pressure device to pressure changed by a variation of pressure of the controlled fluid.

18. In a relief device for compressors the combination of an unbalanced valve controlling the intake said valve closing in the direction of the flow of fluid; a spring tending to hold the valve open; a pressure device acting against the spring for closing the valve; means for subjecting the pressure device to pressure changed by a variation of pressure of the controlled fluid; and an intensifying device for intensifying the variation of the pressure of the pressure device over that in the fluid controlled by the device.

19. In a relief device for compressors the combination of an unbalanced valve controlling the intake; a reversible valve chamber in which said valve operates; a spring tending to hold the valve open; a pressure device acting against the spring for operating the valve, said valve operating abruptly with the inlet at one side of the chamber and operating gradually as the pressure of the controlled fluid varies when the inlet is reversed.

20. In a relief device for compressors the combination of an unbalanced valve controlling the intake said valve closing and opening by a movement toward and from its seat; a spring tending to open said valve in the direction opposed to the movement



of the fluid passing the valve; a pressure device opposing said spring having the side of its moving part next the valve subjected to atmospheric pressure and the opposing side to pressure changing as the controlled pressure varies.

21. In a relief device for compressors the combination of an unbalanced valve controlling the intake; a spring tending to open said valve; a pressure device opposing said spring having the side of its moving part next to the valve and the face of the valve next the pressure device subjected to the same pressure in all positions with the inlet arranged to pass the fluid in a direction opposing the closing of the valve.

22. In a relief device for compressors the combination of an unbalanced valve controlling the intake; a spring tending to open said valve; a pressure device opposing said spring having the side of its moving part next to the valve and the face of the valve next the pressure device subjected to the same pressure in all positions with the inlet arranged to pass the fluid in a direction opposing the closing of the valve, and also with the inlet arranged to have the fluid pass in the direction of the closing the valve.

23. In a relief device for compressors the combination of a valve chamber having the diaphragm 4 in which is arranged a valve seat; the valve 8 arranged to move to and from the valve seat in closing and opening the valve; the pressure device comprising the cylinder 15 and piston 16; the stem 9 extending from the valve 8 to the piston; the removable guide plate 10 through which the stem 9 passes; and the spring 19 tensioned against said guide plate and said stem opposing the pressure device and tending to open the valve.

24. In a relief device the combination of the valve chamber having a diaphragm and valve seat therein, the valve chamber being adapted to be connected for the flow of fluid in either direction; the valve arranged to move to and from the seat to close and open the valve; a pressure device arranged opposite the valve; the valve stem extending from the valve to the pressure device; a spring opposing the pressure device; and an inclosing chamber inclosing the spring, stem and pressure device.

25. In a relief device the combination of a valve chamber; the valve arranged to operate therein; a stem extending from said valve; an inclosing chamber 6 extending from the valve chamber; the cover 12 arranged on the inclosing chamber; the cylinder 15 secured to the cover; the piston 16 operating in said cylinder against the stem extending from the valve; and the spring opposing the action of the piston.

26. In a relief device the combination with

a valve chamber having a diaphragm and removable seat 5 therein; the valve 8 arranged to operate on said seat; an inclosing chamber 6 provided with the shoulder 7; the chamber and shoulder being of sufficient size to permit the passage of the seat 5 to the opening within the shoulder 7; a removable guide 10 arranged on the shoulder 7; a pressure device arranged within the inclosing chamber; a stem extending from the valve to the pressure device; and a spring acting on the stem.

27. In a relief device the combination with a valve chamber having a diaphragm and removable seat 5 therein; the valve 8 arranged to operate on said seat; an inclosing chamber 6 provided with the shoulder 7; the chamber and shoulder being of sufficient size to permit the passage of the seat 5 through the opening within the shoulder 7; a removable guide 10 arranged on the shoulder 7; a pressure device arranged within the inclosing chamber; a stem extending from the valve to the pressure device; a spring acting on the stem; and a removable cover in the inclosing chamber to which the pressure device is attached whereby the pressure device may be removed with the cover.

28. In a relief device the combination of the valve chamber 1 having the diaphragm 4 and removable valve seat 5 therein; the valve 8 arranged to operate on said seat; the inclosing chamber 6 extending from the valve chamber and having the shoulder 7; the opening through the shoulder being of sufficient size to permit the introduction of the seat 5; the movable guide 10 resting on said shoulder; the stem 9 extending from the valve through the guide 10; the spring 19 operating upon said stem; a cover 12 in said inclosing chamber 6 having a screw threaded projection 14 thereon; the cylinder 15 screwed into said projection; the piston 16 operating against the stem 9; and means for supplying fluid to the cylinder.

29. In a relief device the combination of a valve chamber adapted to be connected for the passage of fluid in either direction through it; a valve operating therein, and opening and closing by a movement from and toward its seat; a pressure device arranged to operate on said valve; a spring opposed to the pressure device and means controlled by the pressure of the fluid controlled by the valve for acting on the pressure device to close the valve, said pressure device having movement relatively to said spring to permit the spring to completely extend whereby the spring is free from initial tension and movement begins with a minimum pressure on the pressure device.

30. In a relief device the combination of a valve chamber adapted to be connected for the passage of fluid in either direction through it; a valve operating therein and



opening and closing by a movement from  
and toward its seat; a pressure device ar-  
ranged to operate on said valve; a spring  
opposed to the pressure device; and means  
5 controlled by the pressure of the fluid con-  
trolled by the valve for acting on the pres-  
sure device to close the valve, said pressure  
device having movement relatively to said  
spring to permit the spring to completely  
10 extend whereby the spring is free from  
initial tension and movement begins with a  
minimum pressure on the pressure device;  
and an intensifier connected with the pres-  
sure device for intensifying a change of  
15 pressure in the pressure device over a change  
of pressure in the fluid controlled by the  
valve.

31. In a relief device the combination of  
a controlling valve; a main pressure device  
20 for closing said valve; a spring tending to  
open said valve, an auxiliary valve control-  
ling the admission of fluid to the pressure  
device; and an auxiliary device actuating  
the auxiliary valve, said valves and pressure  
25 devices being in axial alinement.

32. In a relief device the combination of  
a controlling valve; a main pressure device  
actuating said valve; an auxiliary valve con-  
trolling the admission of fluid to the pres-  
30 sure device; an auxiliary device actuating  
the auxiliary valve, said valves and pressure  
devices being in axial alinement; and a mi-  
nute leak being provided between the auxil-  
iary valve and the main pressure device.

33. In a relief device the combination of  
the controlling valve; a main pressure de-  
vice actuating said valve to operate the con-  
trolling valve abruptly with the fluid mov-  
ing in one direction through the valve and

gradually with the fluid moving in the op- 40  
posite direction; an auxiliary valve control-  
ling the admission of fluid to the pressure  
device; and an auxiliary pressure device ac-  
tuating the auxiliary valve, said valves and  
pressure devices being in axial alinement. 45

34. In a relief device the combination of  
the valve chamber; a valve operating in said  
chamber and closing and opening by a move-  
ment to and from its seat; a pressure device  
comprising a cylinder and piston for clos- 50  
ing said valve and in axial alinement with  
the axis of said valve; a spring tending to  
open said valve; an auxiliary valve control-  
ling the admission of the fluid to the cylin-  
der 15; there being provided a leak opening 55  
between said valve and the pressure device,  
the auxiliary pressure device comprising a  
piston 31 and cylinder 24 controlling the  
auxiliary valve, said valves and pressure de-  
vices all being in axial alinement. 60

35. In a relief device the combination of  
a controlling valve; a main pressure device  
actuating said valve; an auxiliary valve con-  
trolling the admission of fluid to the pres-  
sure device; and an auxiliary pressure de- 65  
vice comprising a cylinder 24, piston 31 with  
the conically bottomed socket 34; the ad-  
justing nut 32 with the conically bottomed  
socket 35 and spring 33 with the reduced  
ends tensioned against said conically bot- 70  
tomed sockets.

In testimony whereof I have hereunto set  
my hand in the presence of two subscribing  
witnesses.

RUDOLPH CONRADER.

Witnesses:

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