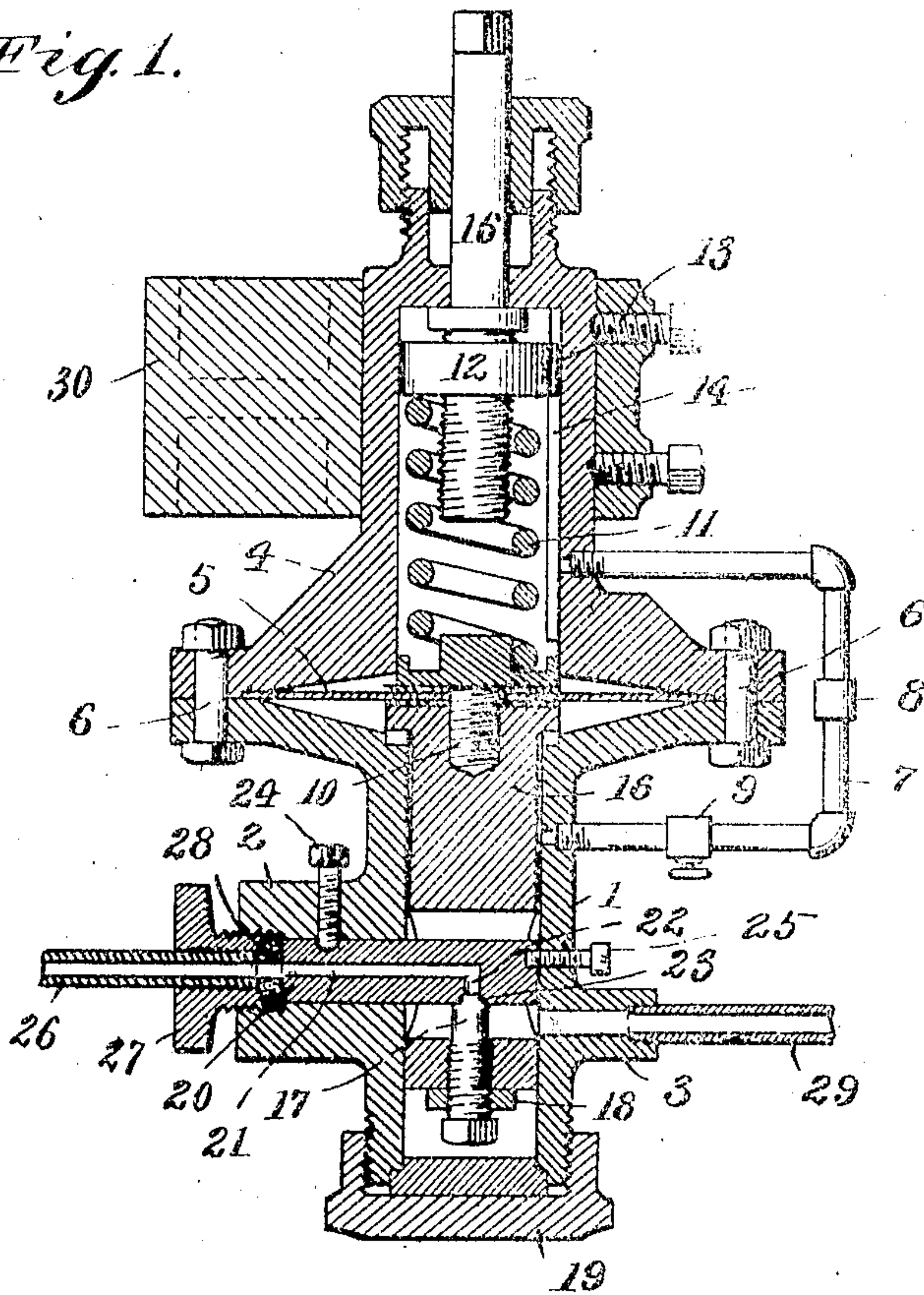


G. P. CARROLL.  
AUTOMATIC EXPANSION VALVE.  
APPLICATION FILED JAN. 7, 1907.

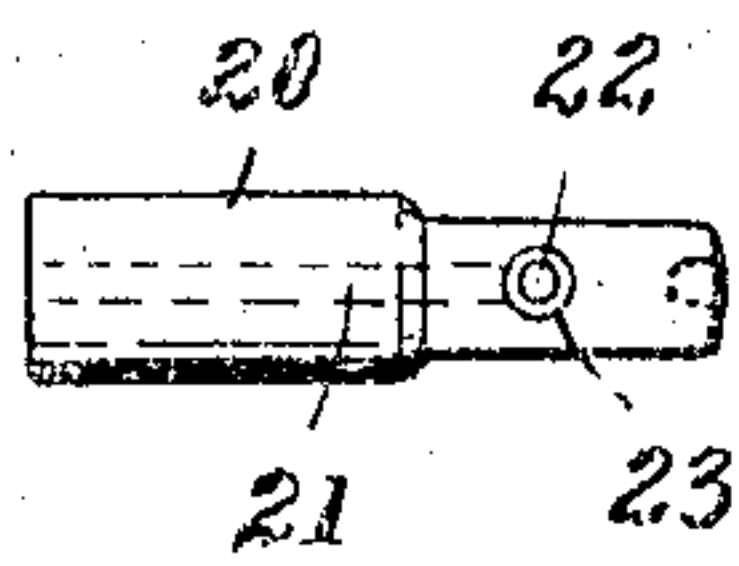
906,508.

Patented Dec. 15, 1908.

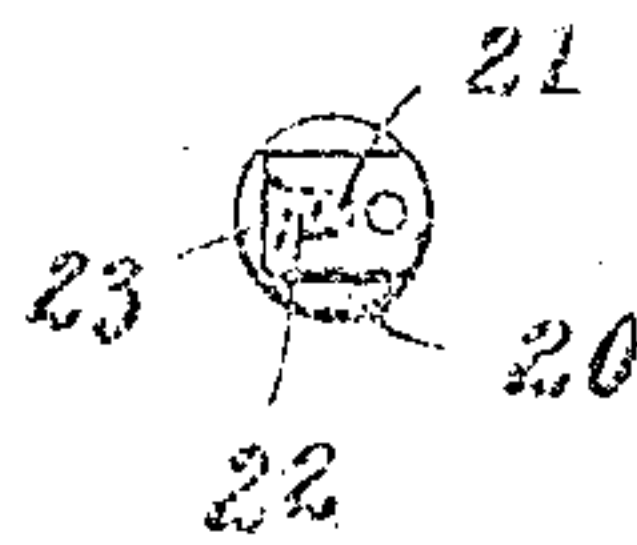
*Fig. 1.*



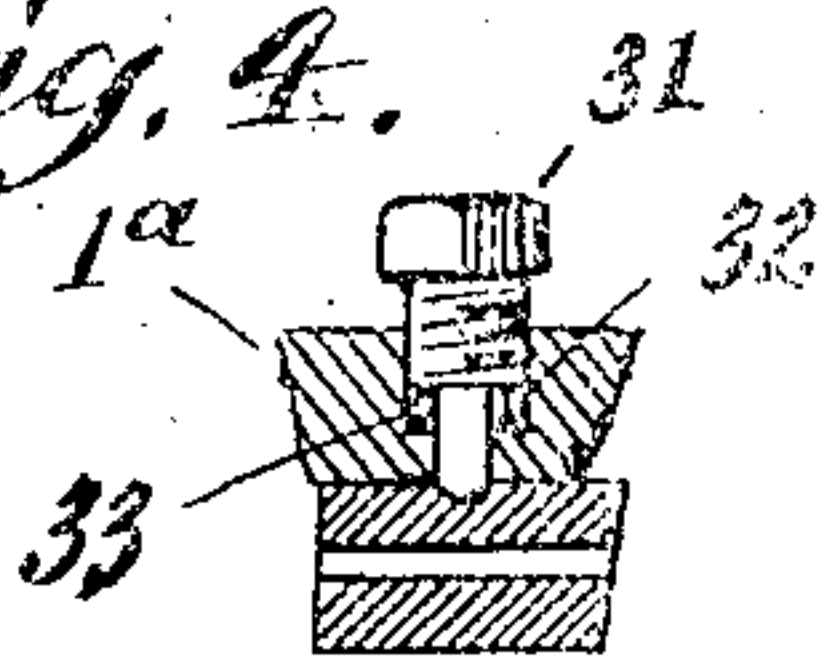
*Fig. 2.*



*Fig. 3.*



*Fig. 4.*



Witnesses

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# UNITED STATES PATENT OFFICE.

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## AUTOMATIC EXPANSION-VALVE.

No. 906,508.

Specification of Letters Patent.

Patented Dec. 15, 1908.

Application filed January 7, 1907. Serial No. 351,063.

*To all whom it may concern:*

Be it known that I, GEORGE P. CARROLL, a citizen of the United States, residing at Bridgeport, in the county of Fairfield and State of Connecticut, have invented a new and useful Automatic Expansion-Valve, of which the following is a specification.

My invention relates in general to improvements in reducing valves such as permit fluid to pass from one chamber to another chamber until the pressure in the second chamber reaches a predetermined limit which is thereafter approximately maintained.

It especially relates to improvements in automatic expansion valves which, in refrigerating systems, are placed between the high pressure side and the low pressure side so as to permit the condensed and liquefied refrigerant to pass freely from its container so as to vaporize into the expansion coils until the pressure in the coils reaches a predetermined limit, which is approximately maintained thereafter so long as the flow continues.

The means employed are detail simplifications and improvements upon the valve construction shown in the United States Patents to Ballentine, No. 549,426, Nov. 5, 1895; and to Marshall, No. 785,265, Mar. 21, 1905, as will hereinafter appear.

As representing the embodiments of my invention, Figure 1 is a central vertical section of the valve with connected parts; Fig. 2 is a view from beneath of an entrance piece; Fig. 3 is an elevation of the inner end of said piece. Fig. 4 is a special form of set screw and adjacent parts.

A lower casing 1 has cast as a part thereof a perforated lateral entrance boss 2 and a perforated lateral outlet 3, the axis of the outlet being preferably slightly below the axis of the entrance boss. The lower casing is flanged at its top and superimposed upon it is an upper casing 4 correspondingly flanged so as to hold a flat disk diaphragm 5 between the flanges clamped together by bolts 6. A by pass 7, having a union 8, in line with the flanges, connects the upper and lower casings and is fitted with a stop valve 9. Extending through the diaphragm is a center screw 10, having at its top an annular pocket for receiving the lower end of the spring 11. This spring is compressed by a

collar 12, which is held from turning by a key 13 fitting into a vertical groove 14. Threaded into the collar 12 is an adjusting screw 15, which extends up through a suitable stuffing box and is provided at its upper end with a wrench section for turning or adjusting the same when it is desired to regulate the action of the diaphragm.

Threaded on to the center screw 10, which extends down through the diaphragm, is a slotted bar 16, cylindrical in form; it is guided by the walls of the lower casing, but fits somewhat loosely therein. By this loose fit a sufficient space is left so that gas can pass up between the bar and the casing and impinge against the under side of the diaphragm 5. Threaded into the slotted bar 16 and extending upwards into its slot is a valve plug 17, preferably conical in form, which is locked in place at its lower end by a lock nut 18. The lower end of the lower casing 1 is closed by a packing collar, which is fastened in place by a bottom cap 19. An entrance piece 20, inserted from without, rests in the perforation of the lateral entrance boss 2 for a part of its length so that its inner end abuts against the inner wall of the lower casing 1, preferably above the outlet 3. So much of the entrance piece as is within the entrance boss fully occupies the same and is thereby steadied. This entrance piece is preferably a solid rod of comparatively large diameter bored out centrally from its outer end up to a place that will be in the axial center of the lower casing 10, making a bore 21. Thence the piece has a downward bore 22 at right angles to the other bore, ending in a conical valve seat 23, on its under side upon which the valve plug 17 can be seated. So much of the entrance piece as projects inside of the lower casing 1 has its sides and bottom surface made plane as seen in Figs. 2 and 3 so as to loosely fit the slot of the slotted bar 16 and so as to afford a better seat for the valve plug 17. A set screw 24 pierces that part of the casing called the lateral entrance boss 2 and fits into the entrance piece 20 without reaching to the bore 21. This set screw of itself will keep the entrance piece from turning or twisting in its place and from moving backward or forward. For greater security, however, another set screw 25 pierces that part of the lower casing 1 against which the entrance piece 20 abuts and fits into it at



some place other than along its axis. This set screw thus has the same effect as the set screw 24. An inlet pipe 26 enters the outer end of the lateral entrance boss 2 so as to lead into the bore 21 and is held in place and so as to prevent leakage by the gland 27 and the packing 28. The lateral outlet 3 is in such position as to receive the current of fluid emerging from the valve seat 28 without deflection and to pass it out through the outlet pipe 29.

The valve may be supported in a bracket 30, in which the upper casing 4 is fastened by small clamping bolts.

In Fig. 4 is shown a preferred form of set screw 31 to be used in place of those shown in the other figures. As shown the casing 1<sup>a</sup> is recessed at 32 as a stuffing box and the set screw has an enlargement at its upper end so that it can hold in place the packing 33.

The method of operation is as follows: When a vacuum is being pumped in a refrigerating system preliminary to charging it with anhydrous ammonia, the stop valve 9 is left open so that the air above the diaphragm 5 is pumped out. The ammonia is gradually introduced into the system and is allowed to reach a pressure in the expansion coils somewhat below the minimum pressure that will be subsequently maintained. The stop valve 9 is then closed. When the system is in operation, liquid ammonia enters the inlet pipe 26 and the entrance piece 20, and emerges as vapor from the valve seat 23, the valve plug 17 being normally depressed from off its seat by force of gravity and by the spring 11 if necessary. Thence the expanded fluid passes out through the outlet 3 and the outlet pipe 29. A part of the expanded fluid, however, passes up between the inner walls of the lower casing 1 and the slotted bar 16 so as to impinge against the diaphragm 5. When such pressure reaches a predetermined limit as determined by adjusting the spring 11, the diaphragm tends to lift the slotted bar 16 and to seat the valve plug 17, so that the pressure of the gas in the expansion coils is kept practically constant.

When used as an automatic expansion valve in a refrigerating system, the location of the valve in the gas circuit is as is shown in the above patents. The valve may also be located in an expansion coil just beyond an expansion valve operated by hand or so operated as to remain open during such time as the compressor is running. It is then adjusted so as to permit of the maximum density and tension of gas, in all of the expansion coil beyond itself, that can be maintained in correspondence with the temperature to be maintained in that part of the expansion coil—as determined in practice by reference to the “ammonia tables.”

This valve is an improvement on the valves shown in the above patents in that: The en-

trance piece cannot be turned or twisted around in the parts which surround it so as to dislocate the valve seat nor can it be moved backward towards the stuffing box gland so as to cause a like dislocation if the packing is insufficient to hold it in its forward position. There is no chance of leakage through a broken diaphragm from the gas circuit into the atmosphere nor of leakage of air from above the diaphragm into the gas circuit. The gas outlet is at the nearest point to the place of emergence from the valve seat and the course of the gas circuit is not interrupted. The closeness of contact of the entrance piece with its environment for its entire length within the entrance boss holds the entrance piece steady and prevents its being rocked by the impact of valve plug on its seat.

I claim:

1. In combination a chamber having a perforated entrance boss and an outlet, a diaphragm above said boss and outlet and closing the top of said chamber, a reciprocating slotted bar fitting loosely in said chamber and depending from said diaphragm, a valve supported by said bar and extending upward into its slot, a rod inserted through said boss and having a single channel which channel proceeds from its outer end and emerges on its under side within said chamber as a seat for said valve, a set screw piercing said boss and fitting into said rod, and means forcing said diaphragm downward except when opposed by greater fluid pressure on its under side so as to seat said valve.

2. In combination a chamber having a perforated entrance boss and an outlet, a diaphragm above said boss and outlet and closing the top of said chamber, a reciprocating slotted bar depending from said diaphragm, a valve supported by said bar and extending upward into its slot, a rod inserted through said boss, abutting at its inner end against the opposite wall of said chamber and having a single channel which channel proceeds from its outer end and emerges on its under side within said chamber as a seat for said valve, a set screw piercing said boss and fitting into said rod, and means forcing said diaphragm downward except when opposed by greater fluid pressure on its under side so as to seat said valve.

3. In combination a chamber having a perforated entrance boss and an outlet, a diaphragm above said boss and outlet and closing the top of said chamber, a reciprocating slotted bar fitting loosely in said chamber and depending from said diaphragm, a valve supported by said bar and extending upward into its slot, a rod inserted through said boss and having a channel from its outer end emerging on its under side within said chamber as a seat for said valve, a set screw



5 piercing the wall of said chamber and fitting into the inner end of said rod, and means forcing said diaphragm downward except when opposed by greater fluid pressure on its under side so as to seat said valve.

10 4. In combination a chamber having a perforated entrance boss and an outlet, a diaphragm above said boss and outlet and closing the top of said chamber, a reciprocating slotted bar fitting loosely in said chamber and depending from said diaphragm, a valve supported by said bar and extending upward into its slot, a rod inserted through said boss and having a channel from its outer end  
15 emerging on its under side within said chamber as a seat for said valve, a set screw piercing the wall of said chamber and fitting into the inner end of said rod between its axis and circumference, and means forcing said diaphragm downward except when opposed by  
20 greater fluid pressure on its under side so as to seat said valve.

25 5. In combination a chamber having a perforated entrance boss and an outlet, a diaphragm above said boss and outlet and closing the top of said chamber, a reciprocating slotted bar depending from said diaphragm, a valve supported by said bar and extending upward into its slot, a rod inserted  
30 through said boss and having a channel from its outer end emerging on its under side within said chamber as a seat for said valve, a set screw piercing said boss and fitting into said rod, a second set screw piercing the wall  
35 of said chamber and fitting into the inner end of said rod, and means forcing said diaphragm downward except when opposed by greater fluid pressure on its under side so as to seat said valve.

40 6. In combination a chamber having a perforated entrance boss and an outlet, a diaphragm above said boss and outlet and closing the top of said chamber, a reciprocating slotted bar fitting loosely in said chamber  
45 and depending from said diaphragm, a valve supported by said bar and extending upward into its slot, a rod inserted through said boss, making a close contact with the inner surface of said boss for substantially its entire length  
50 therein and having a single channel which channel proceeds from its outer end and emerges on its under side within said chamber as a seat for said valve, means for preventing said rod from turning in said boss, and means forcing said diaphragm downward except when opposed by greater fluid pressure on its under side so as to seat said valve.

60 7. In combination a chamber having a perforated entrance boss and an outlet, a diaphragm above said boss and outlet and closing the top of said chamber, a reciprocating slotted bar fitting loosely in said chamber and depending from said diaphragm, a valve  
65 supported by said bar and extending upward

into its slot, a rod inserted through said boss, making a close contact with the inner surface of said boss for substantially its entire length therein and having a single channel which channel proceeds from its outer end and  
70 emerges on its under side within said chamber as a seat for said valve, means in contact with said rod and said boss for preventing said rod from turning in said boss, and means forcing said diaphragm downward except  
75 when opposed by greater fluid pressure on its under side so as to seat said valve.

8. In combination a chamber having a perforated entrance boss and an outlet, a diaphragm above said boss and outlet and closing the top of said chamber, a reciprocating  
80 slotted bar fitting loosely in said chamber and depending from said diaphragm, a valve supported by said bar and extending upward into its slot, a rod inserted through said boss, making a close contact with the inner surface of said boss for substantially its entire length therein and having a single channel which  
85 channel proceeds from its outer end and emerges on its under side within said chamber as a seat for said valve, a set screw piercing said boss and fitting into said rod, and means forcing said diaphragm downward except when opposed by greater fluid pressure on its under side so as to seat said valve.

9. In combination a chamber having a perforated entrance boss and an outlet, a diaphragm above said boss and outlet and closing the top of said chamber, a reciprocating  
95 slotted bar depending from said diaphragm, a valve supported by said bar and extending upward into its slot, a rod inserted through said boss, making a close contact with the inner surface of said boss for substantially its entire length therein, abutting at its inner  
100 end against the opposite wall of said chamber and having a single channel which channel proceeds from its outer end and emerges on its under side within said chamber as a seat for said valve, means for preventing said rod  
105 from turning in said boss, and means forcing said diaphragm downward except when opposed by greater fluid pressure on its under side so as to seat said valve.

10. In combination a chamber having a  
115 perforated entrance boss and an outlet, a diaphragm above said boss and outlet and closing the top of said chamber, a reciprocating slotted bar depending from said diaphragm, a valve supported by said bar and extending  
120 upward into its slot, a rod inserted through said boss, making a close contact with the inner surface of said boss for substantially its entire length therein, abutting at its inner end against the opposite wall of said chamber and having a single channel which channel proceeds from its outer end and emerges on its under side within said chamber as a seat for said valve, a set screw piercing said boss and fitting into said rod, and means  
125 130



forcing said diaphragm downward except when opposed by greater fluid pressure on its under side so as to seat said valve.

11. In combination a chamber having a  
5 perforated entrance boss and an outlet, a  
diaphragm above said boss and outlet and  
closing the top of said chamber, a reciprocating  
slotted bar fitting loosely in said chamber  
and depending from said diaphragm, a  
10 valve supported by said bar and extending  
upward into its slot, a rod inserted through  
said boss, making a close contact with the inner  
surface of said boss for substantially its  
entire length therein and having a single  
15 channel which channel proceeds from its  
outer end and emerges on its under side  
within said chamber as a seat for said valve,  
a set screw piercing said boss and fitting into  
said rod, a second chamber above said dia-  
20 phragm, and a spring operative so that said  
spring and fluid pressure in said second  
chamber will force said diaphragm downward  
except when opposed by greater fluid pressure  
on its under side so as to seat said valve.
12. In combination a chamber having a  
25 perforated entrance boss and an outlet, a  
diaphragm above said boss and outlet and  
closing the top of said chamber, a reciprocating  
slotted bar depending from said diaphragm,  
30 a valve supported by said bar and extending  
upward into its slot, a rod inserted through  
said boss, making a close contact with the inner  
surface of said boss for substantially its entire  
length therein and having  
35 a single channel which channel proceeds from  
its outer end and emerges on its under side  
within said chamber as a seat for said valve,  
means for preventing said rod from turning in  
said boss, a second chamber above said  
40 diaphragm, and a spring operative so that  
said spring and fluid pressure in said second  
chamber will force said diaphragm downward  
except when opposed by greater fluid pressure  
on its under side so as to seat said valve.
13. In combination a chamber having a  
45 perforated entrance boss and an outlet, a  
diaphragm above said boss and outlet and  
closing the top of said chamber, a reciprocating  
slotted bar depending from said dia-

phragm, a valve supported by said bar and 50  
extending upward into its slot, a rod inserted  
through said boss, making a close contact  
with the inner surface of said boss for substantially  
its entire length therein, abutting at its inner  
end against the opposite wall of 55  
said chamber and having a single channel  
which channel proceeds from its outer end  
and emerges on its under side within said  
chamber as a seat for said valve, means in  
contact with said rod and said boss for preventing  
said rod from turning in said boss, a 60  
second chamber above said diaphragm, and a  
spring operative so that said spring and fluid  
pressure in said second chamber will force  
said diaphragm downward except when opposed  
65 by greater fluid pressure on its under  
side so as to seat said valve.

14. In combination a chamber having an  
entrance aperture and an outlet, a diaphragm  
above said aperture and outlet and 70  
closing the top of said chamber, a reciprocating  
slotted bar depending from said diaphragm,  
a valve supported by said bar and extending  
into its slot, a rod inserted through said  
aperture so as to project into 75  
said chamber and to abut against its opposite  
wall and having a passage from its outer  
end emerging on its under side within said  
chamber as a seat for said valve, means to  
80 hold said rod steady, and means forcing said  
diaphragm downward except when opposed  
by greater fluid pressure on its under side  
so as to seat said valve.

15. In combination a chamber having an  
inlet port, a diaphragm above said port and 85  
closing the top of said chamber, a reciprocating  
slotted bar depending from said diaphragm,  
a valve supported by said bar, extending  
into its slot and adapted for seating on  
said port, an outlet below said port, and 90  
means forcing said diaphragm downward  
except when opposed by greater fluid pressure  
on its under side so as to seat said valve.

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Witnesses:

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