

G. P. CARROLL.  
ELECTRIC EXPANSION VALVE.  
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925,081.

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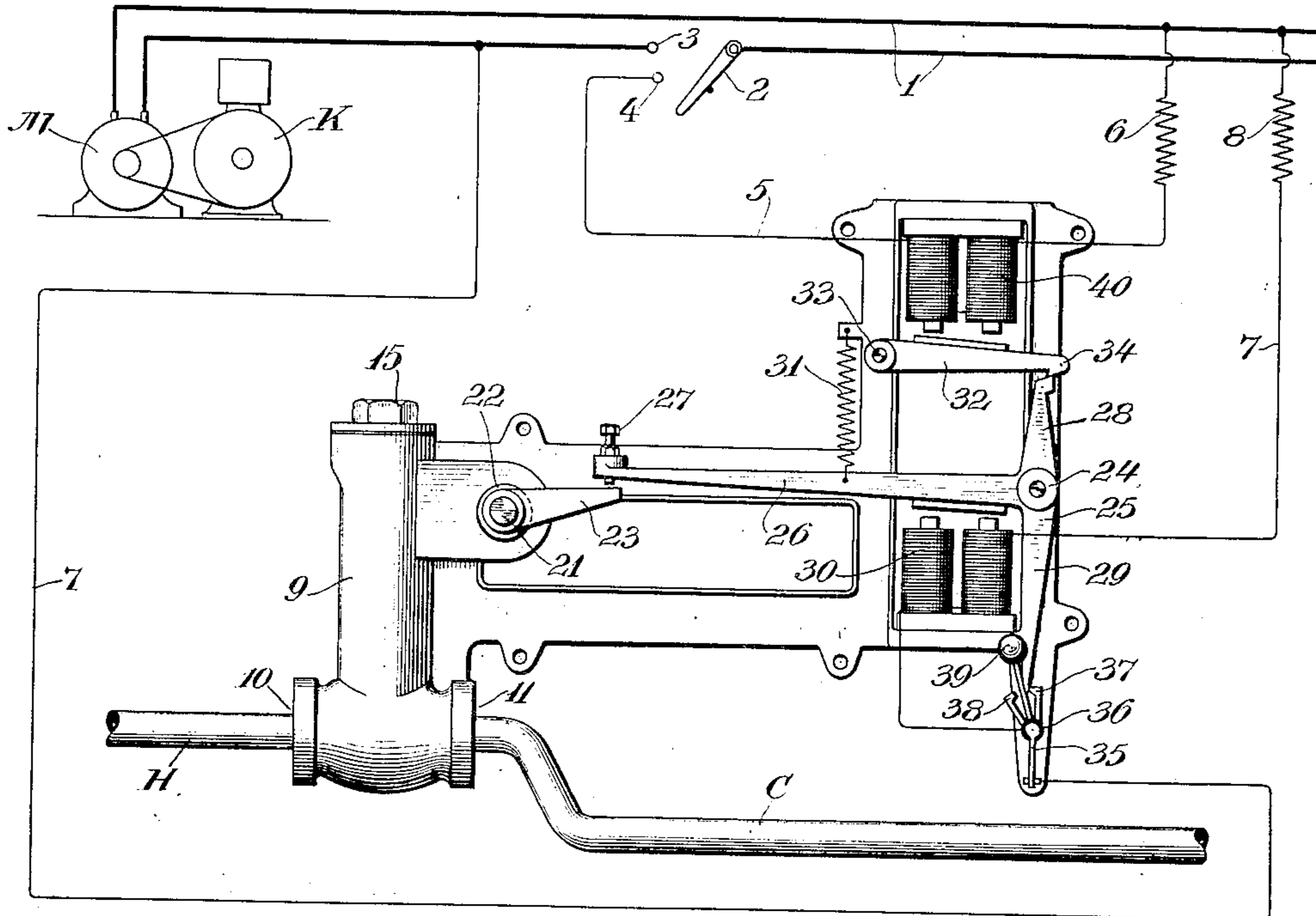


Fig. 1

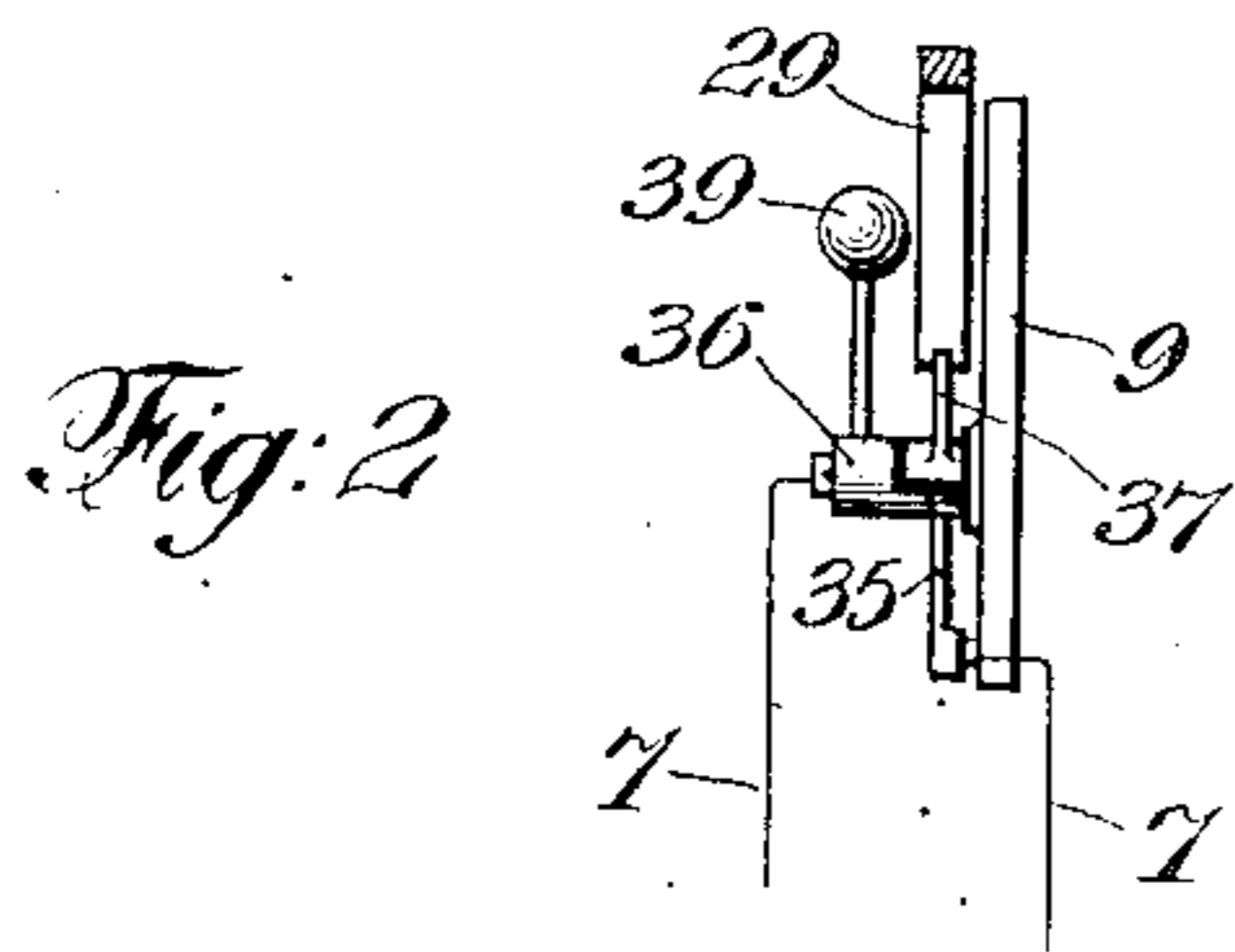


Fig. 2

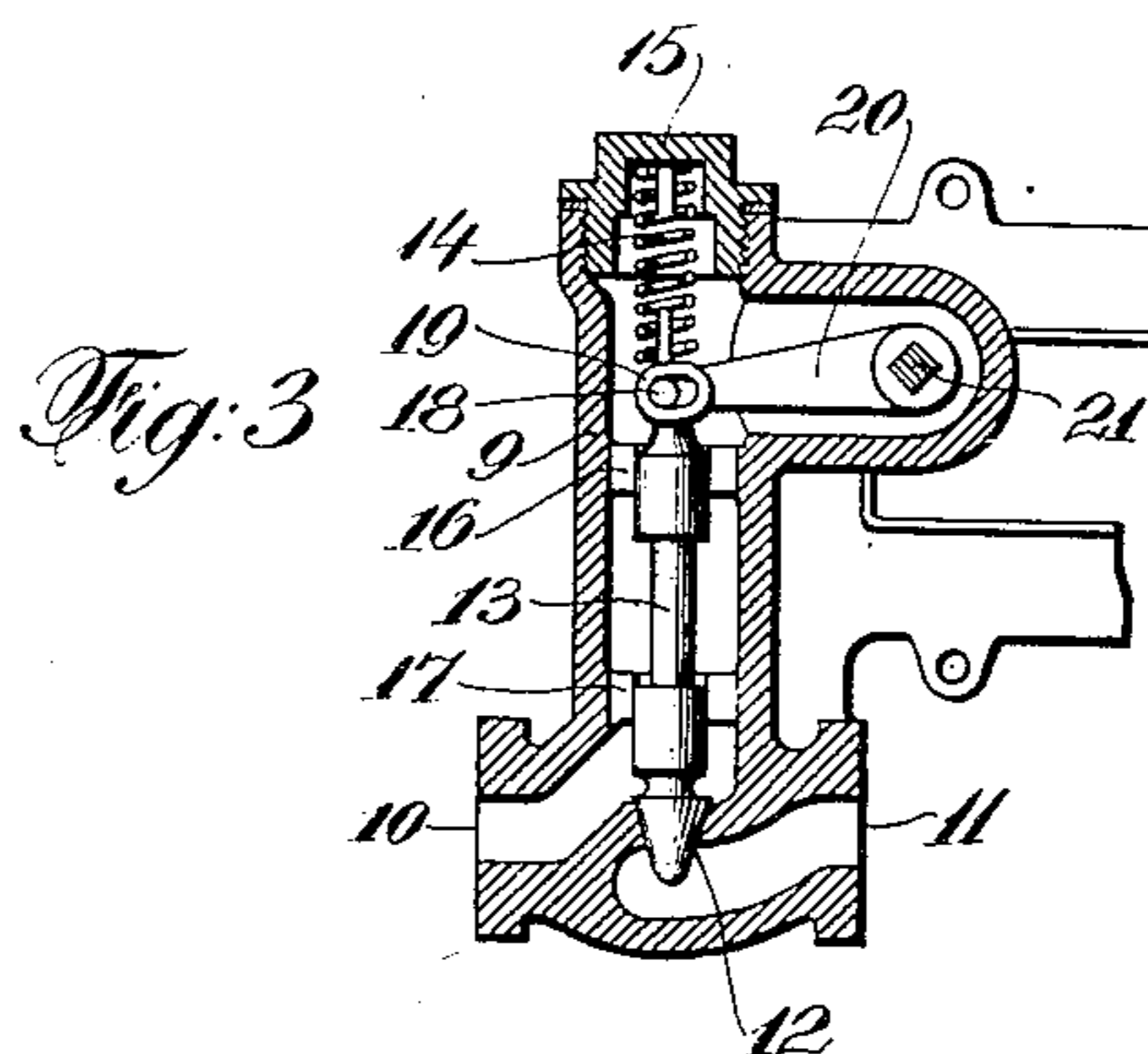


Fig. 3

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# UNITED STATES PATENT OFFICE.

GEORGE P. CARROLL, OF BRIDGEPORT, CONNECTICUT.

## ELECTRIC EXPANSION-VALVE.

No. 925,081.

Specification of Letters Patent.

Patented June 15, 1909.

Application filed March 1, 1907. Serial No. 360,055.

*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 Electric Expansion-Valve, of which the following is a specification.

My invention relates to valves which are automatically opened when power is applied to operate some other mechanism and are automatically closed when such power is turned off from said other mechanism; and it especially relates to expansion valves in compression refrigerating systems which are made to open and close simultaneously with the starting and stopping of the compressor.

The means employed are automatic means whereby, at the time the compressor or other mechanism is started and stopped, the valve, by the application of electric power, is opened and closed; and also automatic means whereby, while the compressor or other mechanism is in operation, the valve is locked in an open position so that it will remain open without the further employment of power until the compressor or other mechanism is to be stopped.

In the drawings Figure 1 is a front elevation of the valve and connections, the latter being diagrammatic in part. Fig. 2 is a side elevation of a switch and connections. Fig. 3 is a vertical section of the valve.

Electric mains 1 lead to and return from a motor M operatively connected with a compressor K of a refrigerating system. A switch 2 is used to turn on the current to the motor by making contact at 3; and, as a part of the movement of closing or breaking the current to the motor, intermediately to make contact at 4 so as to send a current through a branch line 5 provided with a resistance 6. Another branch line 7 is provided with a resistance 8.

A valve casing 9 has an inlet port 10 adapted for connection with a high pressure pipe H and an outlet port 11 adapted for connection with an expansion coil C. Intermediate between the inlet and outlet is a horizontal conical valve seat 12. A needle valve 13 is adapted to occupy and close the valve seat from above and when not otherwise raised is pressed down upon its seat by a coiled spring 14, abutting at one end against the inside of the top cap 15 of the casing and at its other end against the top of the needle valve. The needle valve is

guided along its length by the guides 16 and 17, cast as parts of the casing, so that the valve readily finds its seat. The upper part of the valve is provided with a projecting pin 18, adapted for engagement with the slotted end 19 of the inner lever 20, extending in a horizontal direction. The other end of this lever is secured to or made of one piece with a lever shaft 21, journaled at one end in the back wall of the casing and passing out through the front of the casing where it is provided with a suitable stuffing box 22. Instead of the pin 18 the top of the valve might be provided with a stationary collar and instead of the slot 19 the inner lever might be provided with a fork to engage the collar on its under side. An outer lever 23 is secured to the outer end of the lever shaft 21 and extends in a horizontal direction opposite to that of the inner lever.

Pivoted at 24 on the extended outside part of the casing 9 is a three-part lever 25 having its main arm 26 extending horizontally toward and terminating in a position just above the outer end of the outer lever 23. The extreme end of the main arm 26 is provided with an adjusting screw 27 so that the contact of the main arm 26 and the outer end of the outer lever 23 may be suitably regulated. The length with which the screw projects below the main arm determines the depression of the outer lever 23 and the consequent elevation of the inner lever 20, the pin 18, and the needle valve 13 from off its seat. Substantially at right angles to the main arm an upper arm 28 extends upward and a lower arm 29 extends downward from the pivot 24.

Intermediately placed in the branch line 7 is an electro-magnet 30. This magnet is placed immediately under the main arm 26, which is there provided with an armature on its under side, and when energized by the passage of a current depresses the main arm downward so as to be in contact through the adjusting screw 27 with the outer end of the outer lever 23. The depression of the main arm 26 overcomes a spring 31 which keeps the main arm elevated when the magnet is not energized or when the main arm is not locked in a depressed position. The depression of the main arm 26 throws the upper arm 28 to the left and the lower arm 29 to the right.

A dog 32, provided with an armature on its upper side, pivoted at 33 on the extended outside part of the casing 9, has a tooth 34,

which rests upon the inclined outside of the extreme top of the upper arm 28 while the main arm 26 is elevated. But with the depression of the main arm by the energizing of the electro-magnet 30, the upper arm 28 slips inside of the tooth 34 and there continues in a locked position after the electro-magnet 30 is no longer energized. If necessary a light spring may be provided to press the dog 32 downward so as to be constantly ready to permit of the upper arm being engaged; or, as shown, the force of gravity may be sufficient to depress the dog.

A switch 35 is pivoted at 36 on the extended outside part of the casing 9 and connects the electro-magnet 30 back to the mains 1. This switch has two limit arms 37 and 38 and also a weight arm intermediate between them and ending in a small globular weight 39. Both these limit arms are adapted in turn to be engaged by the lower end of the lower arm 29 as it is moved to the right by the depression of the main arm 26 and back again by its elevation. When the electro-magnet 30 is energized, the first effect of depressing the main arm 26 is to lock the upper arm 28 into engagement with the tooth 34. Simultaneously the lower arm 29 is thrown against the limit arm 37 so as to thrust it to the right and to throw the center of gravity of the weight 39 to the right of the center of the pivot 36. This shifting of the weight 39 then opens the switch and breaks the flow of current through the branch line 7. The time required for this last action is sufficient to permit the upper arm 28 to become engaged with the tooth 34 before the current is broken. A second electro-magnet 40 is secured to the upper part of the extended outside part of the casing 9 immediately above the dog 32 and intermediate in the branch line 5. When the electro-magnet 40 is thus energized it lifts the dog 32 and thereby releases the upper arm 28. This action permits the spring 31 to raise the main arm 26, the electro-magnet 30 being, as just seen, in a condition of non-energization. The lifting of the main arm 26 throws the lower arm 29 against the limit arm 38 so as to thrust it to the left and to throw the center of gravity of the weight 39 to the left of the center of the pivot 36. This shifting of the weight then closes the switch 35 and makes possible a flow of current to again energize the electro-magnet 30.

The method of operation is as follows: When the valve is used, as especially intended, as the expansion valve in a refrigerating system, the turning on of the electric current to the motor M, by the switch 2 making contact at 3, also supplies a current to the branch line 7. The electro-magnet 30 is thereby energized since the switch 35 has been closed by the prior shifting of the weight 39 to the left. The energizing of the

electro-magnet 30 depresses the main arm 26 and the outer lever 23. This action raises the inner lever 20 and the pin 18 so as to lift the needle valve 13 from off its seat 12. Simultaneously with the depression of the main arm 26 the upper arm 28 is locked in engagement with the tooth 34 and the shifting of the weight 39 to the right next opens the switch 35 and breaks the flow of current through the branch line 7. When subsequently the current is turned off from the motor so as to shut down the compressor by the switch 2 making an intermediate contact at 4 on its way to the position shown in Fig. 1, a current is sent over the branch line 5 to the electro-magnet 40. The energization of this electro-magnet lifts the dog 32, disengages the upper arm 28, permits the main arm 26 to rise and again closes the switch 35. As the main arm 26 rises, the spring 14 depresses the valve 13 into its seat and forces down the inner lever 20 so as to elevate the outer lever 23 into its original position. It is to be observed that while the turning on of the current also energizes the electro-magnet 40, this has no effect other than to raise the dog 32 for an instant at a time when it is not in engagement. The flow of fluid through the expansion valve is thus made automatically to begin with the starting of the compressor and to end with its shutting down. The electric current opens the valve and is then shut off, with the locking of the valve in an open position, not to be turned on again until the valve is to be closed. By thus locking the valve no current is wasted in maintaining the valve in an open position. Owing to greatness of the pressure on the high side of the usual ammonia system, being oftentimes normally 180 lbs., a needle valve such as 13 must be employed as the expansion valve, rather than some form of gate valve or rotary valve exposing greater surface to the high pressure. And owing to the extreme tenuity of ammonia gas, the part of the mechanism, like the shaft 21 connecting the valve with moving parts outside of the casing, must have a rotary rather than a reciprocating motion.

I claim:

1. In combination a chamber having a port, a valve positionable either into a position where said port is open or into a position where said port is closed, a magnetizable device movable through a segment of a circle only and operative when magnetized to position said valve into one of said positions, a magnet operative upon the passage of an electric current through it to so magnetize and to so move said device, and means controlled by electric power for automatically shutting off such current.

2. In combination a chamber having a port, a valve positionable either into a position where said port is open or into a position

where said port is closed, a magnetizable device movable through a segment of a circle only and operative when magnetized to position said valve into one of said positions, a magnet operative upon the passage of an electric current through it to so magnetize and to so move said device, means controlled by electric power for automatically shutting off such current, and means for subsequently applying power to position said valve into its other position.

3. In combination a valve, a magnetizable device movable through a segment of a circle only and operative when magnetized to open said valve, a magnet operative upon the passage of an electric current through it to so magnetize and to so move said device, and means controlled by electric power for automatically shutting off such current.

4. In combination a valve, a magnetizable device movable through a segment of a circle only and operative when magnetized to open said valve, a magnet operative upon the passage of an electric current through it to so magnetize and to so move said device, means controlled by electric power for automatically shutting off such current, and means for subsequently applying power to close said valve.

5. In combination a chamber having a port, a valve positionable either into a position where said port is open or into a position where said port is closed, a first device adapted to position said valve into one of said positions, a second device adapted to position said valve into the other of said positions, means for applying power so that said second device positions said valve into said other of said positions, means controlled by the power applied with such positioning effect for automatically shutting off the power so applied, and means for subsequently applying power so that said first device positions said valve into said one of said positions.

6. In combination a chamber having a port, a valve positionable either into a position where said port is open or into a position where said port is closed, a first device adapted to position said valve into one of said positions, a second device adapted to position said valve into the other of said positions, means for applying electric power so that said second device positions said valve into said other of said positions, means controlled by electric power for automatically shutting off the power so applied, and means for subsequently applying power so that said first device positions said valve into said one of said positions.

7. In combination a chamber having a port, a valve positionable either into a position where said port is open or into a position where said port is closed, a first device adapted to position said valve into one of

said positions, a second device adapted to position said valve into the other of said positions, means for applying power so that second device positions said valve into said other of said positions, means actuated by the power applied with such positioning effect for automatically shutting off the power so applied, and means for subsequently applying power so that said first device positions said valve into said one of said positions.

8. In combination a chamber having a port, a valve positionable either into a position where said port is open or into a position where said port is closed, a first device adapted to position said valve into one of said positions, a second device adapted to position said valve into the other of said positions, means for applying electric power so that said second device positions said valve into said other of said positions, means actuated by electric power for automatically shutting off the power so applied, and means for subsequently applying power so that said first device positions said valve into said one of said positions.

9. In combination a valve, a first device adapted to close said valve, a second device adapted to open said valve, means for applying power so that said second device opens said valve, means controlled by the power applied with such opening effect for automatically shutting off the power so applied, and means for subsequently applying power so that said first device closes said valve.

10. In combination a valve, a first device adapted to close said valve, a second device adapted to open said valve, means for applying electric power so that said second device opens said valve, means controlled by electric power for automatically shutting off the power so applied, and means for subsequently applying power so that said first device closes said valve.

11. In combination a valve, a first device adapted to close said valve, a second device adapted to open said valve, means for applying power so that second device opens said valve, means actuated by the power applied with such opening effect for automatically shutting off the power so applied, and means for subsequently applying power so that said first device closes said valve.

12. In combination a valve, a first device adapted to close said valve, a second device adapted to open said valve, means for applying electric power so that said second device opens said valve, means actuated by electric power for automatically shutting off the power so applied, and means for subsequently applying power so that said first device closes said valve.

13. In combination a chamber having a port, a valve positionable either into a posi-

tion where said port is open or into a position where said port is closed, a first device adapted to position said valve into one of said positions, a second device adapted to position said valve into the other of said positions, a switch  
5 connected with a source of electric power for turning on such power so that second device so positions said valve, means for automatically shutting off such power between said  
10 switch and the source of electric power, and means to which power is subsequently applied so that said first device positions said valve into said one of said positions.

14. In combination a chamber having a  
15 port, a valve positionable either into a position where said port is open or into a position where said port is closed, a first device adapted to position said valve into one of  
20 said positions, a second device adapted to position said valve into the other of said positions, a switch connected with a source of electric power for turning on such power so  
25 such power between said switch and the source of electric power, and means to which electric power is subsequently applied so that said first device positions said valve into said one of said positions.

30 15. In combination a chamber having a port, a valve positionable either into a position where said port is open or into a position where said port is closed, a first device adapted  
35 to position said valve into one of said positions, a second device adapted to position said valve into the other of said positions, a switch connected with a source of electric power for turning on such power so that said  
40 second device so positions said valve, means for automatically shutting off such power in the connections between said switch and the source of electric power, and means to which power is subsequently applied so that said  
45 first device positions said valve into said one of said positions.

16. In combination a chamber having a  
50 port, a valve positionable either into a position where said port is open or into a position where said port is closed, a first device adapted to position said valve into one of said positions, a second device adapted to position  
55 said valve into the other of said positions, a switch connected with a source of electric power for turning on such power so that said second device so positions said valve, means for automatically shutting off such power in  
60 the connections between said switch and the source of electric power, and means to which electric power is subsequently applied so that said first device positions said valve into one of said positions.

17. In combination a valve, a first device adapted to close said valve, a second device adapted to open said valve, a switch con-

nected with a source of electric power for 65 turning on such power so that second device so opens said valve, means for automatically shutting off such power between said switch and the source of electric power, and means  
70 to which power is subsequently applied so that said first device closes said valve.

18. In combination a valve, a first device adapted to close said valve, a second device adapted to open said valve, a switch connected with a source of electric power for  
75 turning on such power so that said second device so opens said valve, means for automatically shutting off such power between said switch and the source of electric power, and means to which electric power is subse-  
80 quently applied so that said first device closes said valve.

19. In combination a valve, a first device adapted to close said valve, a second device adapted to open said valve, a switch con-  
85 nected with a source of electric power for turning on such power so that said second device so opens said valve, means for automatically shutting off such power in the connections between said switch and the source  
90 of electric power, and means to which power is subsequently applied so that said first device closes said valve.

20. In combination a valve, a first device adapted to close said valve, a second device  
95 adapted to open said valve, a switch connected with a source of electric power for turning on such power so that said second device so opens said valve, means for automatically shutting off such power in the con-  
100 nections between said switch and the source of electric power, and means to which electric power is subsequently applied so that said first device closes said valve.

21. In combination a valve, a spring nor-  
105 mally tending to close said valve, means adapted to open said valve by mechanical action and to store up energy in said spring, a device for mechanically acting upon said  
110 means to so open said valve and to store up energy, means for applying power to said device with such effect, and means for auto-  
115 matically shutting off the power so applied.

22. In combination a valve, a spring nor-  
115 mally tending to close said valve, means adapted to open said valve by mechanical action and to store up energy in said spring, a device for mechanically acting upon said  
120 means to so open said valve and to so store up energy, means for applying electric power to said device with such effect, and means for automatically shutting off the power so applied.

23. In combination a valve, a spring nor-  
125 mally tending to close said valve, means adapted to open said valve by mechanical action and to store up energy in said spring, a device for mechanically acting upon said

tioning said valve in one position, auxiliary means operative to close said port when said valve is not so positioned by said intermediate means, a three-part lever having a main arm, an upper arm and a lower arm and adapted through its main arm to act on said intermediate means so as to open said port, a dog operative to lock said upper arm so as to hold said main arm in position after having so acted on said intermediate means, electric means operative to so actuate said three-part lever, automatic means operative through said lower arm to shut off the current from said electric means after said dog locks said upper arm, electric means subsequently operative to release said upper arm, and means for restoring said three-part lever to its original position.

41. In combination a chamber having a port, a valve positionable either so as to open said port or to close the same, a stem attached to said valve, intermediate means adapted to move said stem so as to open said port by positioning said valve in one position, auxiliary means operative to close said port when said stem is not so positioned by said intermediate means, a three-part lever having a main arm, an upper arm and a lower arm and adapted through its main arm to act on said intermediate means so as to so move said stem, a dog operative to lock said upper arm so as to hold said main arm in position after having so acted on said intermediate means, electric means operative to so actuate said three-part lever, automatic means operative through said lower arm to shut off the current from said electric means after said dog locks said upper arm, electric means subsequently operative to release said upper arm, and means for restoring said three-part lever to its original position.

42. In combination a chamber having a port, a valve adapted to open said port when lifted and to close the same when dropped, a stem attached to said valve, intermediate means adapted to lift said stem and thus open said valve, auxiliary means operative to drop said valve when said stem is not so lifted, a three-part lever having a main arm, an upper arm and a lower arm and adapted through its main arm to act on said intermediate means so as to lift said stem, a dog operative to lock said upper arm so as to hold said main arm in position after having so acted on said intermediate means, electric means operative to so actuate said three-part lever, automatic means operative through said lower arm to shut off the current from said electric means after said dog locks said upper arm, electric means subsequently operative to release said upper arm, and means for restoring said three-part lever to its original position.

43. In combination a chamber having a

port, a valve positionable either so as to open said port or to close the same, a connected two-arm lever intermediately pivoted, having an inner arm within said chamber adapted to open said port by positioning said valve in one position, and an outer arm outside of said chamber, means operative on said valve to close said port when said valve is not so positioned by said inner arm, a three-part lever having a main arm, an upper arm and a lower arm and adapted through its main arm to move said two-arm lever through its outer arm so as to open said port, a dog operative to lock said upper arm so as to hold said main arm in position after having so moved said two-arm lever, electric means operative to so move said three-part lever, automatic means operative through said lower arm to shut off the current from said electric means after said dog locks said upper arm, electric means subsequently operative to release said upper arm, and means for restoring said three-part lever to its original position.

44. In combination a chamber having a port, a valve positionable either so as to open said port or to close the same, a stem attached to said valve, a two-arm lever intermediately pivoted, having an inner arm within said chamber adapted to move said stem so as to open said port by positioning said valve in one position, and an outer arm outside of said chamber, means operative on said stem to close said port when said stem is not so positioned by said inner arm, a three-part lever having a main arm, an upper arm and a lower arm and adapted through its main arm to move said two-arm lever through its outer arm so as to so move said stem, a dog operative to lock said upper arm so as to hold said main arm in position after having so moved said two-arm lever, electric means operative to so move said three-part lever, automatic means operative through said lower arm to shut off the current from said electric means after said dog locks said upper arm, electric means subsequently operative to release said upper arm, and means for restoring said three-part lever to its original position.

45. In combination a chamber having a port, a valve adapted to open said port when lifted and to close the same when dropped, a stem attached to said valve, a two-arm lever intermediately pivoted, having an inner arm within said chamber adapted to lift said stem and thus open said valve, and an opposite outer arm outside of said chamber, means operative on said stem to drop said valve when said stem is not so lifted, a three-part lever having a main arm, an upper arm and a lower arm and adapted through its main arm to depress said outer arm, a dog operative to lock said upper arm so as to

hold said main arm in its depressed position  
after having so depressed said two-arm le-  
ver, electric means operative to so depress  
said main arm, automatic means operative  
5 through said lower arm to shut off the cur-  
rent from said electric means after said dog  
locks said upper arm, electric means subse-

quently operative to release said upper arm,  
and means for restoring said three-part lever  
to its original position.

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