

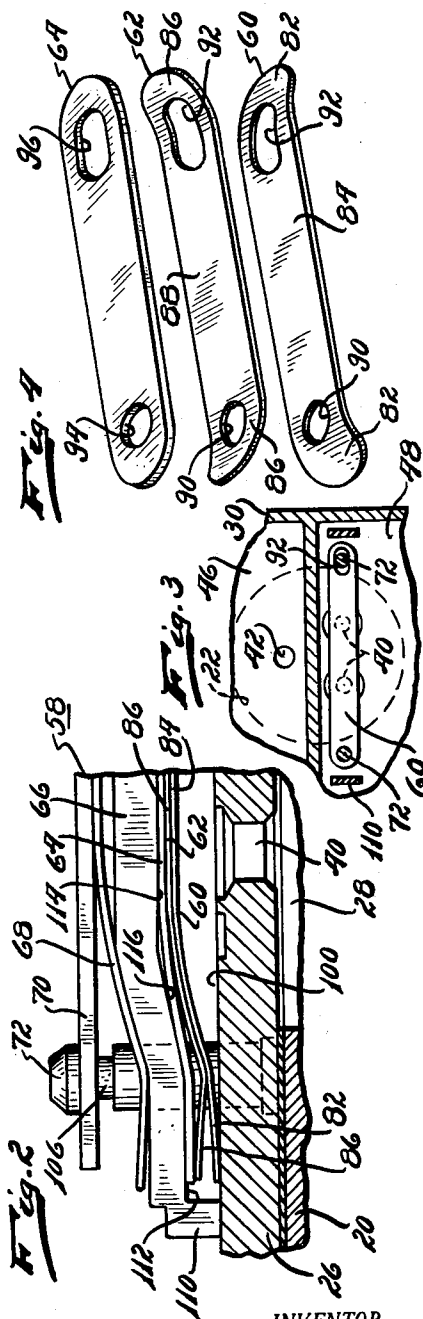
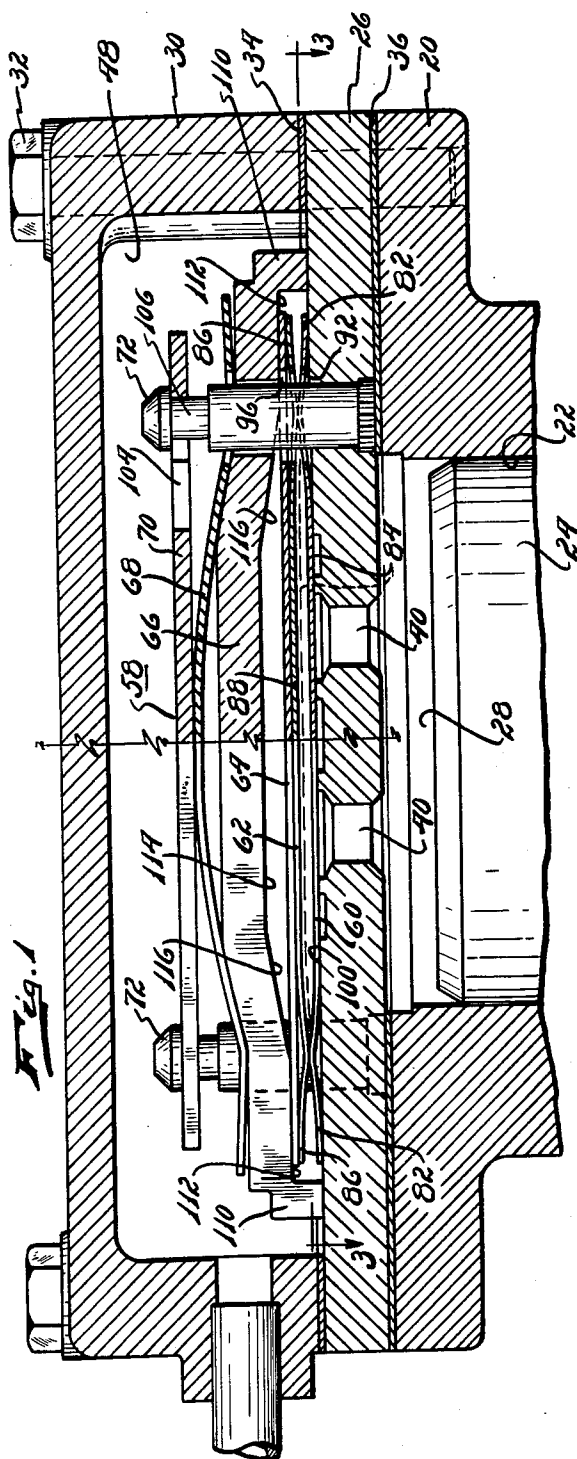
June 19, 1962

R. W. DOEG

3,039,487

REFRIGERATING APPARATUS

Filed Sept. 26, 1960



INVENTOR.
RALPH W. DOEG
BY
Ralph E. Baker
ATTORNEY

1

3,039,487

REFRIGERATING APPARATUS

Ralph W. Doeg, Highland Park, Mich., assignor to American Motors Corporation, Detroit, Mich., a corporation of Maryland

Filed Sept. 26, 1960, Ser. No. 58,574

6 Claims. (Cl. 137-516.11)

This invention relates to refrigerating apparatus and more particularly to a discharge valve mechanism for use in refrigerant compressors.

It is an object of the present invention to provide a new and improved discharge valve mechanism for use in refrigerant compressors which comprises a plurality of reed members assembled and arranged to open and close a discharge port or ports of the compressor that during normal cycling operation of the compressor, that is when the refrigerant pressure is at normal values, the valve will lift to a height to uncover or open the discharge ports for the flow of the compressed refrigerant therethrough, and under abnormal operating conditions for the compressor, that is the refrigerant pressure is above normal values, the valve will lift to a second or greater height to uncover or open the discharge ports to permit the flow of compressed refrigerant vapors there-through.

Another object of the present invention is to provide a new and improved discharge valve mechanism comprising a plurality of reeds each formed of relatively thin strip material and formed in a manner that upon assembly in a compressor one of the reeds in the assembly will be stressed to seat under a self tension upon a discharge port or ports and this tension will be further increased in the reed as it is unseated to provide therein a force for a rapid accelerated movement in reseating itself upon the discharge port or ports, and the other reeds in the assembly arranged to regulate the height of unseating of the reed dependent upon the pressure of the compressed refrigerant flowing through the discharge port or ports.

Another object of the present invention is to provide a new and improved reed type valve formed of relatively thin strip material that is formed and arranged to provide a fast closing action which will reseal at the moment the piston attains the end of its discharge stroke, is quiet in operation and which will readily and efficiently seat upon the discharge ports to close the ports without leakage.

A further object of the present invention is to provide an improved reed type discharge valve and mechanism for a refrigerant compressor that is compact for assembly in a limited space.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawing, wherein a preferred form of the present invention is clearly shown.

FIG. 1 is an enlarged fragmentary view in cross section of a refrigerant compressor and a discharge valve mechanism embodying features of my invention;

FIG. 2 is a fragmentary view similar to FIG. 1 showing certain parts of the compressor and a discharge mechanism in the position they assume on discharge operation.

FIG. 3 is a fragmentary sectional view taken along line 3-3 of FIG. 1.

FIG. 4 is an exploded perspective view of the discharge reed valve strips embodying features of my invention.

Referring to the drawing, there is shown a refrigerant compressor cylinder block 20 having a bore 22 in which a piston 24 is adapted to reciprocate to compress gase-

2

ous refrigerant. A valve body or plate 26 covers the outer end of the cylinder bore to form therewith a compression chamber 28. Secured upon the valve plate 26 is a cylinder head 30. The valve plate 26 and the cylinder head 30 are assembled and secured to the cylinder block 20 by suitable bolts 32. Suitable gaskets 34 and 36 are interposed between the cylinder block, valve plate and cylinder head to insure fluid tight joints therebetween.

The valve body or plate 26 is formed with a pair of outlet or discharge ports 40 and an inlet port 42. The cylinder head 30 is formed with a pair of cavities to form with the valve plate 26 a suction or inlet chamber 46 and a discharge or outlet chamber 48. The suction chamber 46 communicates through the inlet port 42 with the compression chamber 28 for conducting gaseous refrigerant thereto under the control of a thin resilient reed suction valve (not shown). Any suitable type of suction valve may be had for controlling the inlet port, such for example as the valve shown in my Patent #2,372,938, issued April 3, 1945.

Compressed refrigerant vapors pass from the compressor chamber 28 through the ports 40 into the discharge chamber 48 under the control of my new and improved discharge valve mechanism 58. The discharge valve mechanism 58 includes a plurality of resilient reed type members 60, 62, and 64, a member 66 which serves as a pressure plate and as a valve stop, a leaf spring 68, a locking plate 70, and a pair of spaced parallel guide studs or posts 72 upon which the aforementioned valve members are assembled. The guide studs or posts 72 are fixedly secured to the valve plate 26 and are positioned relative to the discharge ports to locate upon the ports the discharge valve mechanism 58 within the discharge chamber 48.

The reed members 60, 62 are each formed from identical material and each formed from a single strip of resilient material, preferably of identical stock thickness, though the reed member 62 may be of a heavier stock thickness. The reed member 64 is formed of a single strip of resilient material which is preferably of heavier stock thickness than used for the reed members 60, 62. Preferably the reed members 60, 62 are formed from stock of .006 inch thick and the reed member 64 is formed from stock of .010 inch thick.

The reed members 60, 62 are each identically preformed. The opposed marginal ends of the strip are bent to extend angularly outwardly in an arc to form legs for the central or intermediate body section therebetween. The reed members 60, 62 are assembled upon the posts 72 with the preformed ends or legs 82 of the reed member 60 extending outwardly and downwardly from the central body section 84, and for the reed member 62 its preformed ends or legs 86 extend outwardly and upwardly from the central body section 88. The legs 82, 86 are shown, see FIG. 4, preferably bent to extend as an arcuate section from the central body section, however, it will be obvious that the legs may be formed as a straight flat section extending angularly from the central body section. The central body sections 84, 88 of each reed is preformed to be substantially flat. A pair of apertures 90, 92 are formed in each of the reed members 60, 62. The apertures 90, 92 are formed in each reed at the junction of the legs with the central body section, and one of the apertures in each reed member, shown as 92, is elongated longitudinally of the respective reed so that when the reed members are mounted upon the posts 72 there is allowed a limited longitudinal sliding and expansion movement for the reed member.

The reed member 64 is formed substantially flat and to the same length as the reed members 60, 62. Apertures 94, 96 are formed in the reed member 64 with the

aperture 96 being formed elongated longitudinally to the strip to allow limited longitudinal sliding or expansion movement for the reed member when mounted upon the posts 72.

In assembling, the reed member 60 is assembled upon the post so that its leg section 82 extends in a downward direction to rest upon a flat planar surface 100 of the valve plate. The reed member 60 is so preformed that when rested by its legs 82 upon the surface 100, before pressure is applied thereupon, the central body section 84 will extend substantially in a spaced parallel relation to the surface 100. The reed 60 becomes the valve or closure strip adapted to close the discharge ports 40. The reed member 62 is assembled upon the posts 72 to rest upon the back of the reed 60. The legs 86 of the reed member 62 extend upwardly and outwardly and the flat reed member 64 is assembled to rest upon the legs 86. Assembled to rest upon the flat reed member 64 is the pressure plate 66 and over and upon the plate 66 is the leaf spring 68 held by the locking plate 70. The pressure plate 66 and the spring 68 are suitably apertured for assembly upon the posts 72. The locking plate 70 is formed with suitable key type slots 104 adapted to receive a respective neck section 106 formed on each post 72, and to lockingly secure the plate 70 fixedly upon the posts 72.

The pressure plate 66 extends beyond the terminal ends of the reed members to be formed with a pair of opposed downwardly extending leg sections 110 that are adapted to rest upon the surface 100 of the valve plate and to be held thereagainst by the pressure of the leaf spring 68. Extending inwardly a terminal distance from each leg section 110 the pressure plate is formed with a flat face or shoulder section 112 adapted to engage upon a respective marginal edge portion of the reed member 64. Intermediate the shoulder sections 112 is a rearwardly offset surface or wall section 114 that extends substantially in spaced parallel relation to the surface 100. The opposed ends of the surface 114 connect by opposed downwardly outwardly inclined wall surfaces 116 to a respective shoulder section 112. The shoulder sections 112 are formed to extend in spaced parallel relation to the surface 110 to provide opposed recesses or spaces therebetween to receive the respective end or leg sections of the reed members 60, 62, 64.

The leaf spring 68 that is interposed between the plates 66, 70 applies a pressure force upon the plate 66 to move and hold the plate 66 in contact by its legs 110 against the surface 100 of the valve plate. This pressure force causes the marginal ends of the reeds to be clampingly squeezed between the shoulders 112 and the surface 100. This clamping pressure forces the legs 82, 86 to bend towards a horizontal position, that is, tend to flatten each against its adjacent contacting surface. The legs 82 tending to flatten upon the surface 100, and the legs 86 against the surface of the reed member 64. This flattening or stress action upon the legs will cause stresses and forces to act upon their respective central body section. In the reed member 60 with the legs 82 stressed upwardly the central body section 84 will be caused to bow or arc in a downward direction towards and against the surface 100. As the bowing is limited by the surface 100 the section 84 will flatten out upon the surface 100 for a substantial portion of its longitudinal length to cover and close the discharge or outlet ports 40. The section 84 of the reed is thus seated under pressure upon the discharge ports. The stresses and forces in the reed member 62 will act in a like manner to that described for reed 60 except that as it has been mounted reversely in a back to back relation its central body section will bow or arc upwardly towards and against the reed member 64. The resistance of the reed member 64 is such as to resist the force of the bow-

ing section and cause the section 88 to substantially flatten out against the underside of the reed member 64.

In the designing of smaller and more compact compressors, particularly compressors with low oil capacity, it has been noted that the lower the ratio of oil to the quantity of refrigerant charge in the system to which the compressor has been adapted and particularly when the refrigerant is soluble in the oil, there is no shut down, or off-cycle, a definitely higher equalization pressure in the system than where the ratio of oil to refrigerant charge is greater. This increase in pressure causes a corresponding increase in the density of the refrigerant vapors which density and pressure can further increase when the system is further subjected to a high or above normal ambient temperature. As the density increases it correspondingly increases the initial pull down load of the compressor and consequently where a conventional discharge valve is used a greater pull out torque for the drive motor is required to drive the compressor and requiring an increase in wattage consumption for the drive motor. The present valve arrangement 58 tends to keep this initial pull down load to a minimum and with a minimum of increase in wattage consumption to provide for an economically operated compressor.

During the initial pull down period the pressure of the compressed refrigerant will be greater than the combined resistance offered by the reeds 60, 62, 64. The pressure will force the reed 60 to unseat and lift it together with the reeds 62, 64 upwardly against the stop surface 114 of the plate 66 to allow the compressed refrigerant vapors to flow through the ports 40 (see FIG. 3) into the discharge chamber during each compression stroke of the piston until the discharge pressure has dropped below the resistance value of the reeds 62, 64. Upon the pressure returning to a normal value the continuing operation of the piston will compress the refrigerant to a pressure value that will only overcome the resistance offered by the reed or closure strip 60 to force the unseating and lifting of the section 84 upwardly off the discharge ports towards and against the reed stop 62.

By the present valve arrangement when the compressor operates under normal refrigerant pressure values the reed member 60, to uncover the ports, is flexed towards and against the reed 62 as shown by dotted lines in FIG. 1. The reed 62 in cooperation with the resistance of the reed member 64 limits for normal operation the lift height of the reed member 60. This lift height is sufficient normally for an efficient operation of the pump and provides a fast and efficient closing of the port. The reed 60, when seated upon the ports 40, exerts an initial force against the seat and this force is further increased in the reed as the body section 84 is unseated during the compression stroke so that the moment the piston completes its stroke the body section 84 will rapidly reseat itself moving in a rapidly accelerated manner. The same rapid closing action of the ports is had when the compressor operates under refrigerant pressures above normal value. Here, the resistance to the flow of compressed refrigerant about the outlet of the port is further reduced to permit a more unrestricted flow by increasing the valve lift. The increased refrigerant pressure forces the reed 64 to flex upwardly against the stop 114 with the reeds 60 and 62 following. This additional lift for the reed 62 further increases its own force to cause it to rapidly reseat itself to close the port at the moment the piston completes its compression stroke. By forming the reed or closure strip 60 of relatively thin stock slapping is reduced to a minimum and resulting in a quieter valve operation.

By forming the reed member 62 identical to the reed 60 and interposing it between the reeds 60 and 64 there is had a more efficient and compact valve arrangement. The pressure applied upon the reed 60 is at the junction of the legs with the central body section which is in contact with a respective junction line formed in the

5

reed 62. This arrangement permits the junction line, that is, the pressure points of the reeds, to move relatively close to the surface 100 to effect an effective flattening of the greater portion of the section 84 upon the surface area of the valve plate to provide an efficient covering and closing of the ports. With the reed 62 taking an arcuate outward curvature over the section 84 there is provided an effective clearance and lift control for the section 84 as it unseats from the ports. The reed 62 maintains the same effective pressure force upon the reed 60 when the reed 60 unseats from the ports as when seated.

Although only a preferred form of the invention has been illustrated, and that form described in detail, it will be apparent to those skilled in the art that various modifications may be made therein without departing from the spirit of the invention or from the scope of the appended claims.

I claim:

1. A discharge valve for refrigerant compressors comprising a valve plate having a substantially flat planar surface and a pair of discharge ports extending therethrough, a pair of reed members having a portion intermediate their ends in longitudinal alignment and in contact with each other, said reeds each having their opposed marginal ends preformed to extend in an angular outward direction to the intermediate portions of said reeds and in outward diverging relationship to the adjacent preformed end of the other reed, guide means carried by said valve plate, said reeds movably held by said guide means whereby one of said reeds overlies and controls said ports, pressure means upon said marginal ends applied upon one of said reeds in a manner to cause said ends to move from their preformed positions to stressed positions and moving upon said adjacent reed overlying said ports to stress the preformed ends thereof against said surface of said valve plate, the stressed ends of said reeds imposing a force upon the intermediate portions of said reeds in a manner to cause one of the intermediate portions to assume a substantially flattened position upon said surface of said valve plate to close said ports and the other to assume a position a spatial distance from said surface to be a stop for the intermediate portion seated on said ports, said seated portion caused to flex away against said stop to open said ports by pressure of fluid discharging therefrom, and means to regulate the position of said stop in response to the pressure of the fluid discharging from said ports.

2. A discharge valve for refrigerant compressors comprising a valve plate having a substantially planar surface and a pair of discharge ports extending therethrough, a reed member overlying and controlling said discharge ports, said reed member formed of relatively thin resilient material, a second reed member formed of resilient material, said first and second members each having a similar body section and a pair of opposed leg sections formed integrally therewith, said leg sections extending oppositely from opposed ends of said body section in an angular outward direction therefrom, guide means carried by said valve plate, said first member being movably mounted upon said guide means with said leg sections extending outwardly downwardly towards and in engagement with said planar surface to resist the movement of said body sections thereupon, said second member movably mounted upon said guide means to rest upon said first member in back to back relation with the leg sections thereof extending upwardly outwardly, said first and second members arranged on said guide means so that when pressure is applied upon said members the physical contact therebetween is solely at the junction lines of leg section to body section, a third resilient member being planar and movably mounted upon said guide means to rest upon said leg sections of said second member, pressure means upon opposed marginal edge portions of said third member in a direction to urge said third member to force the respective legs of said first

6

and second members to be flexed to impose a force upon each respective body section to assume for said first member a flattened position upon said planar surface to close said ports and to assume for said second member an abutting relation against said third member, said body section of said first member being flexible away from said ports, towards and against said second member by pressure of fluid discharging therethrough and when the pressure of the fluid discharging from said ports exceeds a predetermined value said body section of said first member abutting to force therewith an upward arcing movement of said second and third members from said ports to permit a higher unseating of said body section from said ports.

3. A discharge valve for refrigerant compressors comprising a valve plate having a substantially planar surface and a pair of discharge ports extending therethrough, a reed member overlying and controlling said discharge ports, said reed member formed of relatively thin resilient material, a second reed member formed of resilient material, said first and second members each having a similar body section and a pair of opposed leg sections formed integrally therewith, said leg sections extending oppositely from opposed ends of said body section in an angular outward direction therefrom, guide means carried by said valve plate, said first member being movably mounted upon said guide means with said leg sections extending outwardly downwardly towards and in engagement with said planar surface to resist the movement of said body sections thereupon, said second member movably mounted upon said guide means to rest upon said first member in back to back relation with the leg sections thereof extending upwardly outwardly, said first and second members arranged on said guide means so that when pressure is applied upon said members the physical contact therebetween is solely at the junction lines of leg section to body section, a third resilient member being planar and movably mounted upon said guide means to rest upon said leg sections of said second member, pressure means upon opposed marginal edge portions of said third member in a direction to urge said third member to force the respective legs of said first and second members to be flexed to impose a force upon each respective body section to assume for said first member a flattened position upon said planar surface to close said ports and to assume for said second member an abutting relation against said third member, said body section of said first member being flexible away from said ports, towards and against said second member by pressure of fluid discharging therethrough and when the pressure of the fluid discharging from said ports exceeds a predetermined value said body section of said first member abutting to force therewith an upward arcing movement of said second and third members from said ports to permit a higher unseating of said body section from said ports, and means carried by said guide means to limit the upward arcing movement of said third member.

4. A discharge valve for refrigerant compressors comprising a valve plate having a substantially planar surface and a pair of discharge ports extending therethrough, a reed member overlying and controlling said discharge ports, said reed member formed of relatively thin resilient material, a second reed member formed of resilient material, said first and second members each having a similar body section and a pair of opposed leg sections formed integrally therewith, said leg sections extending oppositely from opposed ends of said body section in an angular outward direction therefrom, guide means carried by said valve plate, said first member being movably mounted upon said guide means with said leg sections extending outwardly downwardly towards and in engagement with said planar surface to resist the movement of said body sections thereupon, said second member movably mounted upon said guide means to rest upon said first member in back to back relation with the leg sections thereof extending upwardly outwardly, said first

and second members arranged on said guide means so that when pressure is applied upon said members the physical contact therebetween is solely at the junction lines of leg section to body section, a third resilient member being planar and movably mounted upon said guide means to rest upon said leg sections of said second member, pressure means upon opposed marginal edge portions of said third member in a direction to urge said third member to force the respective legs of said first and second members to be flexed to impose a force upon each respective body section to assume for said first member a flattened position upon said planar surface to close said ports and to assume for said second member an abutting relation against said third member, said body section of said first member being flexible away from said ports, towards and against said second member by pressure of fluid discharging therethrough and when the pressure of the fluid discharging from said ports exceeds a predetermined value said body section of said first member abutting to force therewith an upward arcing movement of said second and third members from said ports to permit a higher unseating of said body section from said ports, means carried by said guide means to limit the upward arcing movement of said third member, and means to limit the movement of said third member by said pressure means upon said first and second members.

5. A discharge valve for refrigerant compressors comprising a valve plate having a substantially planar surface and a pair of discharge ports extending therethrough, a reed member overlying and controlling said discharge ports, a second and third reed member, said first and second reed members formed of relatively thin resilient material and each similarly formed having a body section and a pair of opposed leg sections formed integrally therewith, said leg sections extending oppositely from opposed ends of said body section in an angular outward direction therefrom, said third reed member formed planar, guide means carried by said valve plate, said first member being movably mounted upon said guide means with said leg sections extending outwardly downwardly towards and in engagement with said planar surface to resist the movement of said body section thereupon, said second member being movably mounted upon said guide means to rest upon said first member in back to back relation with the leg sections thereof extending upwardly outwardly, said first and second members arranged on said guide means so that when pressure is applied upon said members the physical contact therebetween is solely at the junction lines of leg section to body section, said third member being movably mounted upon said guide means to rest upon said leg sections of said second member, pressure means upon opposed marginal edge portions of said third member in a direction to urge said third member to force the respective legs of said first and second members to be flexed to impose a force upon each respective body section to assume for said first member a flattened position upon said planar surface to close said ports and to assume for said second member an abutting relation against said third member, said body section of said first member being flexible away from said ports, towards and against said second member by pressure of fluid discharging therethrough and when the pressure of the fluid discharging from said ports exceeds a predetermined value said body section of said first member abut-

ting to force therewith an upward arcing movement of said second and third members to permit a higher unseating of said body section from said ports.

6. A discharge valve for a refrigerant compressor comprising a valve plate having a substantially flat surface and a pair of laterally positioned ports extending therethrough, a relatively thin closure strip overlying and controlling said ports, said closure strip having an intermediate section and opposed marginal end sections being preformed to said intermediate section to extend arcuately in a downward outward direction therefrom in engagement with said flat surface of said valve plate, a member formed of relatively thin resilient material having an intermediate section and opposed marginal end sections being preformed to said intermediate section to extend arcuately in an upward outward direction therefrom, said member assembled upon said closure strip with their intermediate sections in back to back relation and the junction lines formed by leg section to intermediate section in cooperative alignment for physical engagement therebetween, a second member being formed normally planar and of resilient material, said second member assembled upon to engage the upwardly extending marginal ends of said member, a plate member having shoulder sections adapted to engage upon opposed end sections of said second member, pressure means upon said plate member to urge and hold said plate member in a pressure relation upon said second member and to effect a pressure force upon said member and closure strip in a manner to cause said arcuate marginal ends of said member to flex to a substantially flattened position against an adjacent surface of said second member and said member through contact upon the junction lines of said closure strip effecting a pressure force to substantially flatten the marginal ends of said closure strip upon said planar surface, each of the flattened ends imposing a force upon the intermediate section to effect a bowing action thereupon in a direction where said intermediate section of said member abuts said second member and said intermediate section of said closure strip substantially flattens upon said surface of said valve plate to close said ports, said intermediate section of said closure strip flexible away from said ports by pressure of fluid discharging therefrom and flexible towards and against said member, said second member flexible in a direction to permit said intermediate sections of closure strip and member to flexibly travel a greater distance away from said ports when the pressure flow is above a predetermined value and to travel a lesser distance from said ports when the pressure flow is below a predetermined value, stop means on said plate member to limit the flexible movement of said second member, and means on said plate adapted to abut against said surface of said valve plate to limit the movement of said plate member by said pressure means.

References Cited in the file of this patent

UNITED STATES PATENTS

2,353,751	Osgood	July 18, 1944
2,372,938	Doeg	Apr. 3, 1945
2,752,943	Doeg	July 3, 1956
2,970,608	Doeg	Feb. 7, 1961