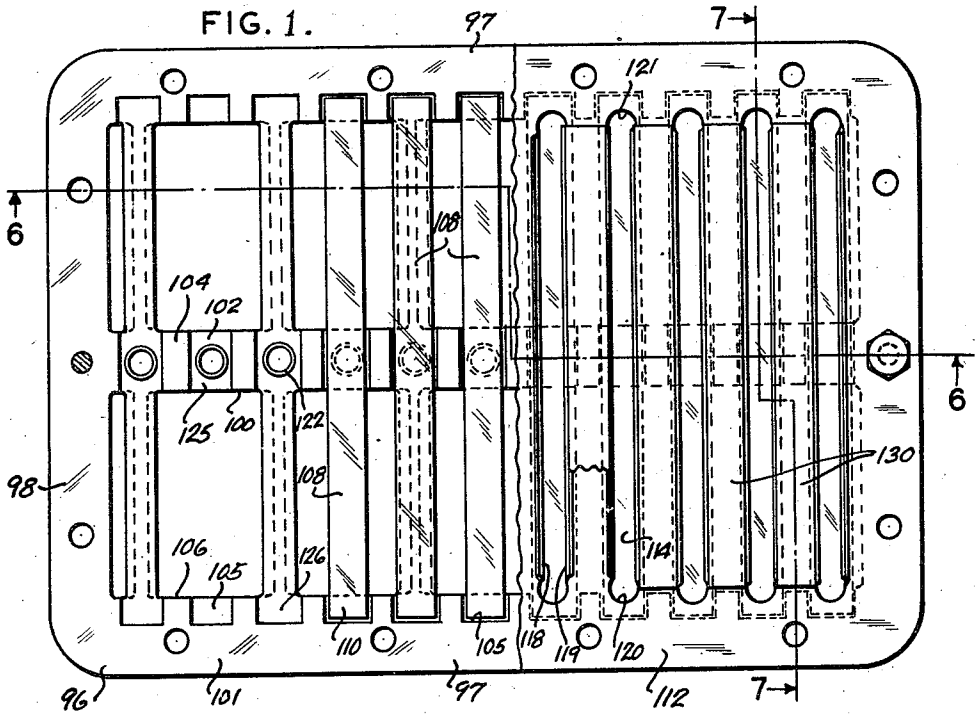
Dec. 22, 1942. J. KUTTNER 2,306,170

PRESSURE RESPONSIVE VALVE

Filed July 29, 1940

FIG. 1.



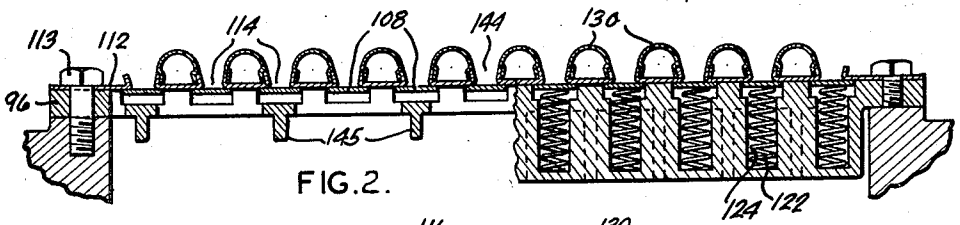


FIG. 2.

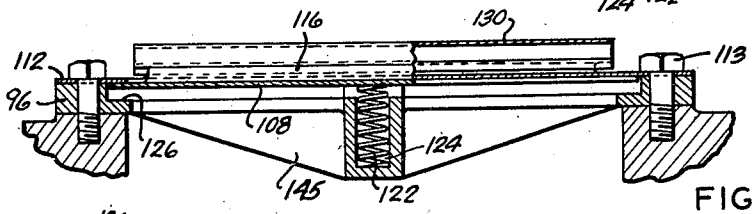


FIG. 3.

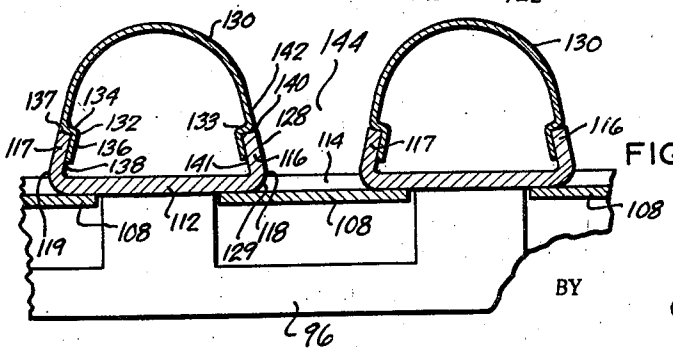


FIG. 4.

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PRESSURE-RESPONSIVE VALVE

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7 Claims. (Cl. 277—60)

This invention relates to improvements in valves for fluid pumps or compressors of a character suitable for use on internal combustion engines to supply the engine cylinders with scavenging and charging air, the invention having particular reference to an improved pressure-responsive valve capable of ready embodiment in a pump of the type indicated.

The principal object of the invention is to provide a pressure-responsive check-valve for fluid pumps and the like, which is greatly improved in form and construction, such that in effectiveness and efficiency, the resulting valve is markedly superior to prevailing or other similar valves provided for a like purpose.

Another object is attained by the provision of an improved, quick-acting pressure-responsive valve of a simple and economical construction, which is adapted for ready incorporation in a fluid pump of the type indicated, and which when so employed, effects a material increase in the fluid pumping efficiency of the pump.

A further object is to provide a compact, quick-acting and highly efficient check valve device which is readily adaptable for embodiment in fluid pumps or similar apparatus, or in fluid handling systems, wherein one or more fluid control valves having the foregoing characteristics, are required.

A further object resides in the provision of an improved check valve of the character indicated, in which the port-forming elements thereof are so formed and arranged as to provide substantially streamlined ports and port-delivery passages, thereby markedly improving the fluid-flow characteristics of the valve, particularly in respect to a substantial minimization or practical elimination of turbulence or eddying in the fluid streams discharged through the valve ports.

Other objects and advantages of the invention will appear readily from the following description of a preferred embodiment thereof, as illustrated by the accompanying drawing, in which:

Fig. 1 is a view in plan, of a pump valve constructed according to the present invention, the valve being shown partly in assembly and partly broken away to illustrate features thereof; Fig. 2 is a longitudinal sectional elevation of the valve, as taken along line 2—2 in Fig. 1; Fig. 3 is a transverse sectional elevation through the valve, as viewed from the line 3—3 in Fig. 1, and Fig. 4 is a greatly enlarged, fragmentary sectional elevation taken longitudinally through the valve structure, illustrating features of the valve port-forming elements.

Referring now to the drawing by suitable characters of reference, the improved valve as illustrated by Fig. 1, includes a rectangular, substantially plate-like valve frame 96 presenting side elements 97, end elements 98 and a central longitudinal rib 100 between the end elements 98. The rib 100 is of thickened section, extending below the upper surface or face 101 of the frame plate, and is provided with a plurality of longitudinally spaced, transversely directed rectangular recesses or notches 102 in the rib face 104. Each of the frame side elements 97 is provided with a plurality of recesses 105 formed in the inner longitudinal face margin 106 of the element, as best appears in Fig. 1. The recesses 105 in each of the side elements 97, correspond in number and longitudinal spacing, to the recesses 102 in the rib 100, so that each recess 105 is in alignment, transversely of the frame plate, with one of the rib recesses 102. A plurality of flat, reed-like valve elements 108 of equal length such as to span the opposite frame sides 97, are arranged so that each has its central portion seating in one of the rib recesses 102, and its ends 110 seating in the frame side recesses 105 which are in transverse alignment with the particular rib recess. The recesses 102 and 105 thus serve to confine the valve elements against displacement longitudinally and transversely of the frame plate, and further serve as guides for the valve elements in their valve-port controlling movement laterally of the frame plate, as will hereinafter appear.

Overlying the upper side or face 101 of the frame plate 96, is a valve deck plate 112 which in length and width, is substantially co-extensive with the frame plate. The deck plate is suitably secured in assembly with the frame plate, in a manner permitting a ready disassembly of the plates for the purpose of repair or replacement of the valve elements 108 and other parts of the valve structure, such securement being effected according to the present example, by a plurality of bolts 113 serving to clamp together the peripheral margins of the two plates. The bolts 113 may be employed also for securing the valve assembly to its supporting means in the pump casing, as indicated in Figs. 2 and 3. The deck plate 112 may be formed from suitable sheet metal stock of a predetermined gauge to assure adequate stiffness of the plate, and treated as by appropriate punching and shaping operations, to provide a plurality of valve openings or ports 114 equal in number and spacing, to the valve elements 108, and opposed, upstanding elements or

flanges 116 and 117 along the longitudinal, port-defining, plate margins 118 and 119 respectively, the elements 116 and 117 being provided for a purpose later to appear. The plate marginal portions 120 and 121 defining the ends of each port, are preferably arcuate or curved, as shown, and in the assembly of the deck plate to the frame plate, the port-defining margins 118—121 at each port 114, overlie the edge portions of the associated valve element 108, so that each valve element is thereby effectively retained in assembly, in the guide recesses 102 and 105.

The port-closing position of each valve is that shown by Figs. 2 and 4, wherein the valve 108 abuts the port-defining margins 118—121 of the deck plate 112, thereby closing the port 114. By preference, each of the valves 108 is suitably biased toward port-closing position, as by a compression spring 122 seated in a spring-socket or bore 124 provided in the frame rib 100 at the base or bottom 125 of the rib recess 102, the spring engaging for this purpose, the underside of the valve, as indicated by Fig. 2. The springs serve to effect a quick-closing action of the several valve elements, in the pressure-differential operation thereof to control the ports 114, as this will be readily appreciated. Moreover, in the presently improved valve construction, each of the valve elements is relatively light in weight, so that it may respond quickly to the differential pressures on the opposite surfaces thereof. With respect to the valve-receiving recesses 102 and 105, these are of equal, predetermined depth such that when the valve 108 is in full-open position, i. e., resting upon the bottoms 125 and 126 of the recesses 102 and 105 respectively, the resulting open-area between the valve and the port 114 is substantially equal to or greater than the port area, thereby precluding any restriction in the desired full-volume flow of air or other fluid through the port 114.

While the valve structure as thus far described, may be utilized with improved results, in pumps of the character indicated, the present invention contemplates further and material improvements in the valve structure, to the end of effecting among other objectives, a positive directioning and concentration of the air flow toward each port, and a uniformly smooth air flow through the port throat, as formed in part by the upstanding elements 116 and 117 heretofore noted, and through the port 114. Accordingly, the deck plate margins 118—121 which define each port 114, are rounded substantially to the extent indicated in Fig. 4, while the flanges 116 and 117 which are upstanding from the deck plate margins 118 and 119 and extend over substantially the length thereof (Fig. 1) have their inner surfaces 128 joining smoothly with the rounded surfaces 129 of the port margins 118 and 119. Thus the port-defining elements for each of the ports 114 are devoid of sharp edges or projections which if otherwise present, would tend to create turbulence or eddying in the air stream passing through and beyond the port. The opposed, upstanding elements or flanges 116 and 117 in the zone of each port, are by preference, inclined outwardly from each other, as to the extent indicated in Fig. 4, and as shown by Figs. 2 and 4 in particular, the element 117 of one port and the element 116 of the next adjacent port, cooperate in the support of a substantially semi-cylindrical, air-flow directing and port-throat forming member 130. The length of the member 130 corresponds substantially to the length of the port 114, while the longitudinal ends 132 and 133 are formed such that each provides an inwardly directed shoulder 134 and a downwardly extending flange 136. In assembly to the deck plate elements 117 and 116 of adjacent ports, the shoulder 134 on the end 132 of the member 130, engages and seats upon the upper longitudinal edge 137 of the element 117, with the flange 136 in contact with the rear surface 138 of the element, while in a similar manner, the shoulder 134 of the opposed end 133, seats upon the corresponding upper edge 140 of the next adjacent element 116, with the flange 136 thereof, in contact with the rear surface 141 of the element. The member 130 is formed by preference, from suitable sheet metal characterized by a degree of resiliency sufficient to provide for self-retention of the member in assembly with the elements 116 and 117, as this may be attained by tensioning the member through inward displacement of the ends 132 and 133, to engage and seat the same on the deck plate elements 116 and 117. The member 130 as so mounted, is readily detachable in an obvious manner, as will be now appreciated. Further and as best appears in Fig. 4, the assembly arrangement of each member 130 relative to the supporting elements therefor, is such that the surface section 142 at each longitudinal end of the member, provides a substantially unbroken continuation of the surface 128 of the adjacent one of the elements 116 and 117.

From the foregoing description, it will be observed now that each port 114, with the exception of the end port at each end of the valve assembly, intervenes an adjacent pair of the members 130, while the adjacent members 130 cooperate with the upstanding elements 116 and 117 in the port zone, to form a port throat 144 which converges toward the port. In such association, the members 130 serve to concentrate and direct a stream of air to and into the throat 144, for passage through the port 114 and therebeyond. Moreover, by reason of the rounded plate margins 118—121 which define the port 114, and the surface contour of the cooperating throat-forming elements 116, 117 and 130, both the port and its throat are effectively streamlined, so that any resistance to a smooth flowing air stream therethrough, is minimized to a very great extent.

As shown by Figs. 1, 2 and 3, the valve frame plate 96 and the central longitudinal rib 100 thereof, may be considerably strengthened by a plurality of laterally extending rib elements 145 joining the central rib 100 with the frame side elements 97. In the present example, the strengthening ribs 145 are arranged so that each underlies one of the valve elements 108, whereby to minimize any interference by the ribs, with the free flow of air past the valves and through the open portions of the frame 96.

According to the present invention, the improved valve device is adapted for inclusion in a pump or compressor suitable for providing scavenging air to the cylinders of an internal combustion engine. The valves being of greatly improved construction, and of a character designed to increase the effectiveness and efficiency of valve-operation, serve when utilized in a fluid pump for the purpose indicated, to increase the efficiency and air-delivery pressure of the pump to a marked degree, as this has been demonstrated by exhaustive tests on pumps equipped with the improved valves. Moreover, it is to be noted that the valve assembly as herein shown

and described, presents a sturdy and compact structure having a desirable minimum overall thickness or depth as clearly appears from Figs. 2 and 3.

While the present description and drawing relate to a preferred embodiment of the invention, it is to be understood that the presently improved valve construction may be altered or modified in respect to the parts and assembly arrangement thereof, without departing from the spirit and intended scope of the invention, as defined by the appended claims.

I claim:

1. A fluid-pressure responsive control valve of the character described, comprising a frame, a deck plate on said frame, formed to provide a plurality of substantially rectangular ports and laterally directed flange elements along opposite margins of each port, a resilient semi-cylindrical wall element arranged between each adjacent pair of ports and provided with recessed shoulders along the opposite margins thereof adapted for frictional engagement with the adjacent flange elements of said ports, said shoulders in engagement with the flange elements providing the sole support for said wall element, the flange and wall elements in the zone of each port, cooperating to form a port-throat converging toward and communicating with the port, and fluid-pressure responsive valve means operatively carried by said frame in controlling relation to said ports.

2. A fluid-pressure responsive control valve of the character described, comprising a substantially open rectangular frame having a plurality of recesses in the opposite longitudinal margins thereof, a plurality of fluid-pressure responsive valve elements spanning said longitudinal frame margins and having their ends received in said recesses, a deck plate overlying said frame and valve elements, formed to provide a plurality of substantially rectangular ports arranged such that each thereof is controlled by one of said valve elements, flange elements carried by and directed laterally of the deck plate, along opposite longitudinal margins of each port, and a curved wall element extending longitudinally between each adjacent pair of ports and adapted for sole support by the adjacent flange elements of said ports, said flange and wall elements in the zone of each port, cooperating to form a port-throat converging toward and communicating with the port.

3. A check valve of the character described, comprising a substantially open rectangular frame member, a plate-like member in overlying engagement, with the frame member, said plate-like member being formed to provide a plurality of substantially rectangular ports therein, and upstanding integral flange elements extending along the opposite longitudinal margins of each port, said ports being arranged in parallel adjacence and the marginal edge portions of the member which define each port, being appreciably rounded, a curved wall element arranged between each adjacent pair of ports, and formed to provide recessed shoulders along the longitudinal margins thereof adapted for detachable engagement with the adjacent flange elements of the adjacent pair of ports, said shoulders in engagement with the flange elements providing the sole support for the wall element, said wall and flange elements serving to provide in the zone of each port, a port-throat converging toward and communicating with the associated port, and a plurality of substantially flat, rectangular valve elements, said frame and plate-like members cooperating in the operative support of said valve elements, each in controlling relation to one of said ports.

4. A fluid check valve of the character described, comprising a frame providing parallel side and end elements and a rib element extending parallel to said side elements and between said end elements, said rib and side elements each having a guide recess therein, a substantially flat, reed-like valve element movably seated in said recesses, a deck plate overlying said frame and valve element, formed to provide a substantially rectangular port in register with the valve element for control thereby, flange elements formed integrally with said plate and extending along the opposite longitudinal margins of the port, and curved wall elements each provided with a shouldered seat to receive one of said flange elements, said flange and wall elements cooperating in assembly, to form a port-throat converging toward said port.

5. A check valve of the character described, comprising a substantially open rectangular frame provided with recesses in opposite margins thereof, a flat rectangular valve element having its ends received in said recesses, a plate-like member overlying the frame and valve element, formed to provide a port therethrough in register with the valve element, said plate-like member cooperating with the frame recesses in constraining said valve element to movement toward and away from said port, flange elements integral with said plate member and arranged along opposite margins of said port, said flanges being relatively divergent from the port zone of the plate member, and curved wall elements each provided with mounting means adapted for wall-supporting engagement with one of the flange elements, said wall elements constituting continuations of said flange elements and cooperating therewith in forming a port-throat converging toward said port.

6. A valve of the character described, comprising a substantially open rectangular frame, a sheet metal deck plate on said frame, said deck plate being formed to provide rectangular port-openings therethrough and outstruck relatively divergent flange elements along opposite longitudinal margins of each port, rectangular reed-like valve elements, said frame and deck plate cooperating in the operative support of said valve elements each in controlling relation to one of the port-openings, and substantially semi-cylindrical sheet metal wall elements arranged longitudinally between said port-openings, each of said wall elements being deformed along the opposite margins thereof, to provide mounting elements adapted for frictional wall-supporting engagement with adjacent flange elements of an adjacent pair of said port-openings, said wall elements in assembly constituting continuations of said flange elements and forming therewith port-throats converging toward the port-openings.

7. A valve of the character described, including a frame, a deck plate overlying said frame and formed to provide rectangular ports therein and relatively divergent flange elements along opposite longitudinal margins of each port, rectangular valve elements, said frame and deck plate cooperating in the operative support of said valve elements each in controlling relation to one of said ports, and resilient wall elements

of substantially semi-cylindrical form, arranged longitudinally between said ports, each of said wall elements being deformed along the opposite longitudinal margins thereof to provide mounting elements adapted for frictional wall-supporting engagement with adjacent flange elements of an adjacent pair of ports, said mounting elements in frictional engagement with the port flanges providing the sole support for each of the wall elements, and said wall elements in assembly, constituting continuations of said port flanges and forming therewith, port-throats converging toward the ports.

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