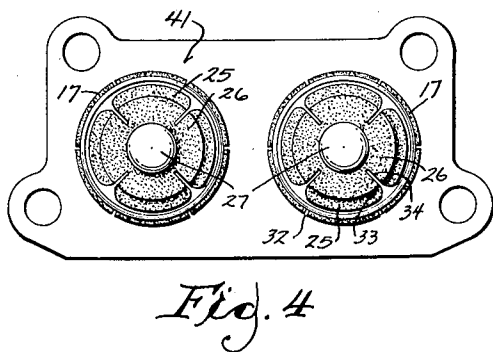
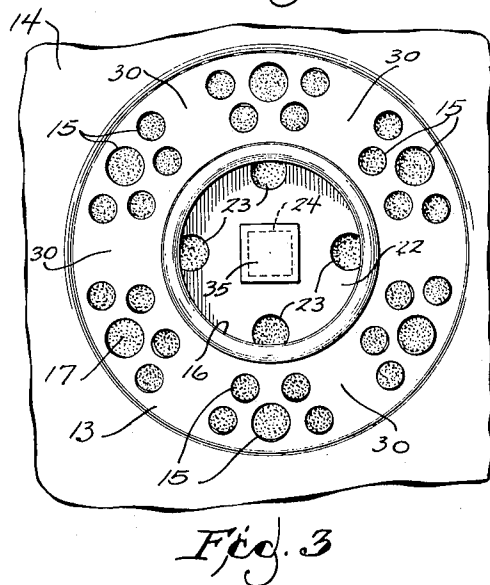
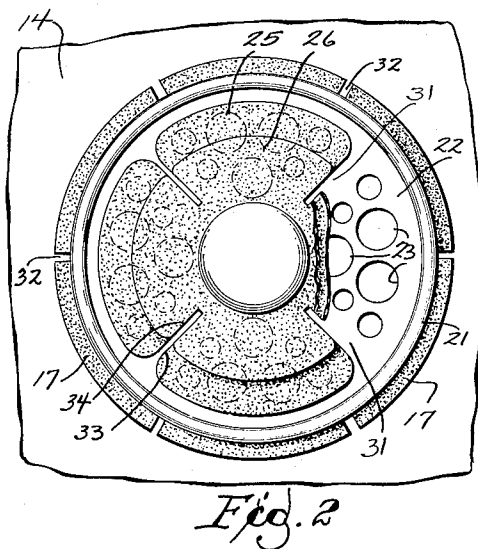
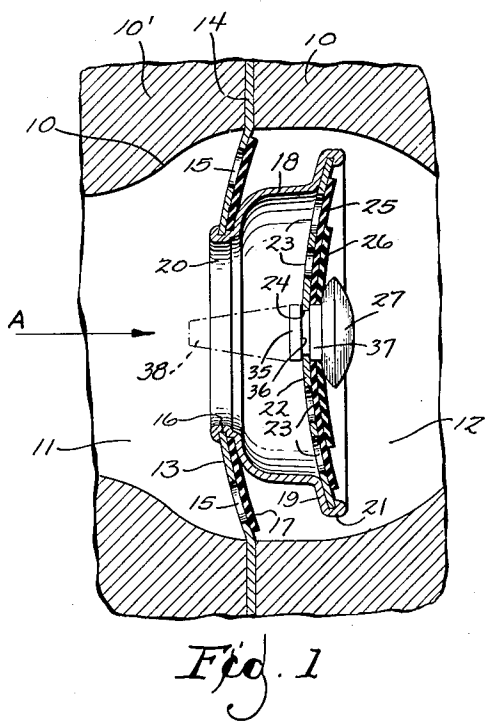


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TANDEM CHECK VALVES
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TANDEM CHECK VALVES

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This invention relates to improvements in check valves disposed between a carburetor and an internal combustion engine, and particularly to a novel arrangement of a plurality of check valves whereby the valves are physically in tandem but act in parallel.

The object of the invention is to provide a valve structure with high volumetric capacity, but of compact physical structure whereby space and weight limits can be reduced while at the same time the capacity of the valve may be increased.

In the embodiment shown a main valve is provided with an annular port area providing one flow path for the fuel mixture, and with a central opening to which there is coupled a tandem valve comprising a cup-shaped holder flaring from the inlet to a port area which provides an additional flow path for the fuel mixture. In this manner the volumetric capacity of the valve may be increased without necessitating increase in the lateral dimensions of the valve structure. It is broadly immaterial how many tandem valves are mounted one upon the other, this being a matter dictated by the fuel requirements of the engine.

In this connection, a novel arrangement of valve diaphragm, port pattern, and a diaphragm damper or backing member has been provided whereby to improve the operation of the valve over valves heretofore known.

In the drawings:

Fig. 1 is a view in axial cross section through a passage leading from a carburetor to an internal combustion engine, a tandem check valve embodying the invention being disposed in said passage.

Fig. 2 is an elevation view of the outlet side of the valve shown in Fig. 1, portions being broken away.

Fig. 3 is a view of the valve shown in Fig. 1 looking in the direction of the arrow A in Fig. 1.

Fig. 4 is a plan view of two of the valves embodying the invention mounted on a single plate.

A tandem check valve structure embodying my invention is herein disclosed in a typical environment such as its application to a two cycle internal combustion engine of the type used in outboard motors where the fuel mixture from the carburetor is admitted to the crank case portion of the engine. These valves commonly comprise check valves which admit fuel mixture on the intake stroke of the piston but which close to prevent escape of the mix on the power stroke of the piston. However, the valve is adapted for other uses wherever a check valve having high volumetric capacity is needed.

As best shown in Fig. 1 the wall 10 defines a passage affording communication between a carburetor chamber 11 and an engine chamber 12. Spanning the passage 10 so as to control fluid flow from chamber 11 to chamber 12 is a check valve structure comprising an apertured mounting plate and partition 14 having a concave valve seat portion 13. The plate 14 has its margins clamped between wall elements 10 and 10' whereby to support the concave seat 13 and the tandem valve to be hereinafter described.

The dished or concave seat 13 is provided with an an-

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nular series of grouped ports 15, surrounding a central aperture which has a margin 16. The ports 15 of the concave valve seat 13 are normally covered on the outlet, or engine chamber, side of the valve seat by a flat valve, here comprising a flexible annular diaphragm 17, to be hereinafter described in more detail.

To the aperture margin 16 is clinched the annular flange 20 of a cup-shaped member or housing 18 which flares from its inlet 20 to an integral shoulder at 19 which is of greater area extent than inlet 20 and is bounded by a rim 21.

The shoulder 19 of cup 18 embraces a concave partition disk 22 which is provided with an annular series of ports 23 surrounding a central aperture 24. The ports 23 are normally covered on the outlet, or engine chamber, side of disk 22 with a flexible annular diaphragm valve 25, normally self biased to seat against the disk and anchored by the mounting button 27.

The main diaphragm valve 17 has its inner margin 21 securely held to the main valve seat 13 by pressure of the base of the cup 18 against the margin 16 of the seat. The outer periphery of the diaphragm is free to lift under fluid pressure to mould the diaphragm about the cup, the shape of which is such that very little movement is permitted the diaphragm near its fixed central portions and progressively greater movement is permitted toward the perimeter.

Similarly, the button 27 has a flaring form to limit the movement of valve 25 in a manner tending to preclude crystallization of the valve. Button 27 desirably comprises rubber or resilient plastic. The tandem valve is, however, desirably provided with an additional backing member or damper 26 which is also annular, but of less radial extent than diaphragm 25, and mounted at its inner margin between the button 27 and the seat 22.

While the disposition of the ports of both valves is generally annular, it is preferred that the ports be arranged in groups which are angularly spaced in patterns as best shown in Fig. 2 and Fig. 3. The unported radial zones between groups of ports provide support for the respective hub portions of the main valve seat and tandem valve seat to which the diaphragms aforesaid are mounted.

While broadly immaterial, it has been found that a more satisfactory valve action is obtained by providing the respective valve diaphragms 17 and 25, as well as the backing member 26 for valve 25, with radial slots which respectively give the valves and backing member a clover-leaf form. For this purpose the main diaphragm 17 is provided with radial slots 32, the tandem valve diaphragm 25 is provided with radial slots 33 and the backing member 26 is provided with radial slots 34. In the embodiment illustrated the main valve seat 13 has six groups of ports 15, and hence has six imperforate zones 30 spaced at 60° intervals, the diaphragm 17 having six slots 32 complementarily spaced. The tandem valve seat, being of less radial extent than the main valve seat, need only have four groups of ports 23 with four intervening spokes 31 angularly spaced by 90°. The valve diaphragm 25 and backing member 26 have four complementarily spaced slots 33 and 34. The respective slots 32, 33 and 34 are aligned to overlie imperforate radial zones 30 and 31 of the respective valve seats so as not to interfere with the checking function of the valve diaphragms in closing the ports. Stated generally the function of the radial slots is to render the flexible diaphragms more flexible and yieldable and to be more responsive to pressure differential at the inlet and outlet sides of the ports.

For the purpose of insuring registry of the radial slots 33 and 34 with the spokes 31 of the tandem valve seat 22, the diaphragm 25 and backing member 26 are keyed to the valve seat 22 in such a way that when the button 27 is engaged with the central aperture 24 in the valve seat 22

the respective radial slots will automatically align with the spokes 31 of the valve seat. While the keying arrangement is broadly immaterial it has been found that a square aperture 24 in the valve seat in conjunction with a square shank 35 on the button 27 is more effective to properly key the respective diaphragms to the valve seat. Accordingly, it is assured that each leaf of the cloverleaf pattern of diaphragm and backing member will cover one group of ports.

As best shown in Fig. 1 the square shank 35 of button 27 has a peripheral groove 36 which is in normal engagement with the margins of the aperture 24 in the valve seat 22. The shaft portion 37 between the groove 36 and the undersurface or shoulder of the button 27 is substantially equal in dimension to the combined thickness of the diaphragm 25 and the backing member 26 so that these elements will be snugly mounted between the button and the valve seat when the groove 36 is engaged with the margins 24 of the valve aperture. To provide for ease of assembly the button shank 35 is provided with an extension 38 shown in dotted lines in Fig. 1 which is normally cut off after the button has been wedged into position.

The arrangement shown in Fig. 4 illustrates the mounting of two of the tandem check valves upon a single plate 41. This common mount adapts the valve assembly for use with multi-cylinder engines in which different cylinders have different fuel cycles.

From the foregoing it will be evident that on the intake stroke of the engine piston both valve diaphragms 17 and 25 will open to admit fuel mixture to the engine in response to the higher pressure on the intake or carburetor side of the respective ports. Upon the power stroke of the piston, and a higher pressure on the outlet or engine side of the ports, the respective valve diaphragms 17 and 25 will close against the ported plates to prevent escape of the fuel mixture from the engine. Accordingly, the valves act in parallel. As volumetric capacity of engines is increased and the size and weight of engine parts are decreased it has been found that a single valve will frequently not permit sufficient fuel mixture to enter the engine on the intake stroke to permit the full power of the engine to be developed upon the power stroke of the piston. The present tandem valve structure provides for ample influx of fuel mixture to the engine without requiring enlargement of the passage between the engine and carburetor. This improved result is attained without departing from the preferred use of the diaphragm check valves illustrated. The tandem arrangement disclosed is highly flexible as one or more tandem valves may be used as desired without requiring enlargement of passageway 10.

The novel relation between the valve diaphragm 25 and backing member 26 provides a stiffener for the diaphragm 25 to insure its quick return to port closing position during the power stroke of the engine. This is particularly important after the diaphragm 25 has been in use over a period of time. The main valve diaphragm 17 is backed by the under surface of the cup 18 which performs a similar backing function. While the composition of the diaphragm and backing member is broadly immaterial for the purpose of the present invention, they should be flexible and resilient.

The respective valve diaphragms may be of thin resilient or non-resilient metal, or of plastic or rubber, or of coated fabric. Natural and synthetic rubber compositions have been used with satisfactory results.

I claim:

1. A valve comprising a partition element having ports arranged in an annular pattern, an annular flexible diaphragm peripherally comprising a flap valve covering said ports at one side of the element and mounted to said element centrally of the port pattern, and an annular backing member of less radial extent than the diaphragm and secured to said element in clamping engagement with

the diaphragm at its inner annular margin and progressively divergent outwardly from said element whereby to control diaphragm port uncovering movement, said ports being arranged in groups angularly spaced in said annular pattern, said element having intervening unported portions of said element, said diaphragm being radially slotted in registry with said unported portions, said backing member comprising a cup shaped member having a central opening and marginally connected about said opening with said partition element and flaring outwardly from such connection over said element and diaphragm in clamping engagement with the diaphragm near said opening and progressively diverging from said element, in further combination with a second partition mounted on said flaring cup shaped member in a position axially offset from said opening and having materially greater diameter than said opening, said second partition having a central opening and having ports between said opening and its periphery, a second flap valve diaphragm mounted on the second partition and covering the valve ports therein, and mounting means fixed in the central opening of the second partition and clampingly holding said second flap valve diaphragm to the second partition, the opening in the second partition being non-circular and the last named means having a complementary form whereby to be keyed non-rotatively to the second partition, the second diaphragm valve means having a corresponding central opening whereby it likewise is keyed against rotation respecting the second partition, said second partition having its ports arranged in groups angularly spaced from each other and the second diaphragm valve means having generally radial slots positioned to lie between the groups of ports.

2. A tandem valve organization comprising a mounting plate having a dished portion and provided near the center of said portion with an opening and further having valve ports arranged in annular series around said opening, a generally annular flap valve having outer peripheral portions covering said ports and an inner peripheral portion proximate to said opening, a cup shaped housing having at its bottom an annular flange extending through the annular valve means and the opening of said plate and thence radially in clamping relation to said plate, said housing having outwardly flaring side wall portions in clamping relation with the inner periphery of said annular valve means and progressively divergent from said valve means and plate, an integral shoulder on said housing axially remote from said plate and overhanging the valve ports of said plate, a disc mounted on said shoulder and provided with a second set of valve ports in annular series, a second generally annular flap valve means mounted on the disc and having outer peripheral portions covering said ports, and means connected with the disc and extending through the second flap valve means and overlying inner peripheral portions of said second flap valve means in clamping relation thereto for mounting said second flap valve means on said disc.

3. A tandem check valve to control fluid flow, said valve comprising a plate having an annular series of valve ports and an opening within said annular series, a cup-shaped housing mounted to said plate about said opening and having a bottom opening aligned with the opening in the plate, said housing comprising a wall flaring radially outwardly from said opening and convexly away from said plate to constitute a progressively engageable diaphragm backing, a first annular diaphragm over said ports, said diaphragm having an inner periphery clamped between said wall and plate, said diaphragm having an outer periphery disposed radially beyond said valve ports and free for movement respecting said plate, said first diaphragm being yieldable away from said plate under

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fluid pressure through said ports toward contact with said convexly flaring wall, said housing having a top of greater area than its open bottom, a plate across said top provided with an annular series of valve ports, a second annular diaphragm over said ports, and a button 5 clamping the center of said second diaphragm to said plate, said button comprising a head constituting a backing for said second diaphragm.

4. The device of claim 3 in which said annular series of valve ports in said plates are arranged in angularly 10 spaced groups of apertures, said plates comprising radial spokes between said groups, said diaphragms being provided with radial outwardly opening slits aligned with said spokes.

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