

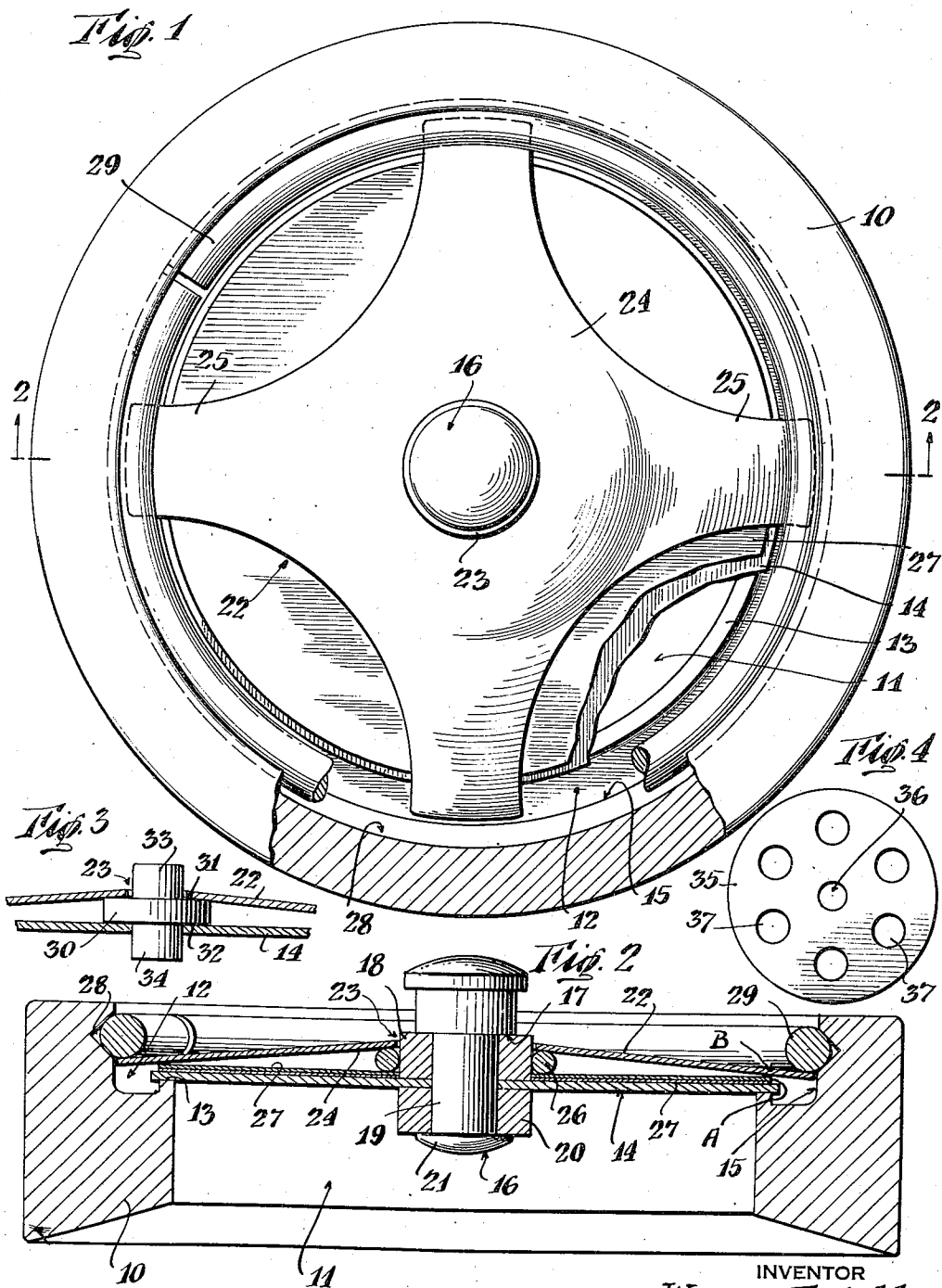
June 30, 1942.

W. T. TABB

2,287,842

VALVE

Filed Oct. 22, 1940



INVENTOR

Warner T. Tabb

BY

Watson, Bristol, Johnson & Leavenworth
ATTORNEYS

UNITED STATES PATENT OFFICE

2,287,842

VALVE

Warner T. Tabb, Brooklyn, N. Y., assignor, by
mesne assignments, to Reconstruction Finance
Corporation, New York, N. Y., a corporation of
the United States

Application October 22, 1940, Serial No. 362,180

5 Claims. (Cl. 251-144)

The present invention relates to valves and, more particularly to that type of valve adapted for opening under pressure to permit one-way passage therethrough of fluid, either liquid or gaseous, and commonly termed a "check valve."

A general object is to provide such a valve which is of simple and economical construction having a minimum number of parts assembled in an easy manner without necessitating use of many securing means and which is capable of positive operation with a variety of types of fluids at extremely high frequency in an efficient manner.

Another object of the invention is the provision of such valve structure characterized by few parts which are of light weight and a high sensitivity whereby ports of large area in passages carrying fluids at pressures within a wide range are effectively controlled with precision and rapidity.

A more specific object of the invention is the provision of such valve structure characterized by a valve plate structure and a leaf-like spring structure having lateral rigidity which are spaced apart by suitable abutment means and in assembled position are held against lateral relative movement with the plate guided to and centered on its seat without having contact with any other structure, anchorage of peripheral portions of the spring structure to frame structure serving as the means for holding the parts in assembled positions, the spring structure being of such configuration and dimension as to provide for free passage of fluid through the valve when the plate is unseated and to serve as a stop for limiting travel of the plate.

A further object of the invention is the provision in such apparatus of combined means for spacing and tying together valve plate structure and biasing spring structure which is stressed only in compression thereby making possible the use thereof of relatively easily shaped material having low tensile strength and since tension in such means is avoided effective elimination of likelihood of straining with possible attendant deformation and breakage of parts is attained.

Other objects of the invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises the features of construction, combination of elements and arrangement of parts, which will be exemplified in the construction hereinafter set forth and the scope of the invention will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention, reference should be had to the following detailed description taken in connection with the accompanying drawing, in which:

Fig. 1 is a top plan view with parts broken

away of one embodiment of the device of the present invention;

Fig. 2 is a sectional view taken on line 2-2 of Fig. 1;

Fig. 3 is a sectional elevational view with parts broken away of the valve plate structure and biasing spring structure of the invention showing a modified form of plate and spring spacing means; and

Fig. 4 is a plan view of a modified plate centering and biasing spring structure suitable for use in the device of the present invention.

Referring to the drawing like numerals refer to like parts throughout. A frame or valve cage 10, preferably sleeve-like in shape, adapted readily to be secured in a fluid passage in a desired manner, such as by press fitting, may be provided but it is to be understood that such frame structure may constitute a portion of the wall of a fluid passage. The frame or cage 10 having a valve port 11 therethrough is shaped or machined to provide a recess 12 therein and an annular seat 13 adjacent the port 11. The valve seat 13 as shown is substantially flat but it is to be understood that it may be tapered or otherwise shaped as desired. A substantially flat valve plate structure 14 preferably comprising a disc which may be formed of one or more laminae is seated upon the annular seat 13 and is of such dimension as to be spaced laterally from the outer side wall 15 of the recess 12. Should a tapered seat or other form of seat be used in lieu of the flat valve seat 13 of course the valve plate structure will be of such shape as to cooperate therewith.

The valve plate 14 is centrally apertured and carries a stud 16, preferably of a metallic material having relatively low tensile strength such as "duralumin," provided with a shoulder 17 against which seats a ring or collar 18 preferably of steel slipped over the shank portion 19 of the stud. The collar or ring 18 rests upon the upper face of the valve plate 14 with the shank 19 snugly received in the central aperture of the valve plate and projecting therebelow to receive a second ring or collar 20 also preferably of "duralumin" or the like. The stud 16, collars 18 and 20 and the valve plate structure 14 are assembled to form a unitary structure with the stud shank 19 anchored in the valve plate structure in a substantially fluid-tight manner, such as by peening or spinning over the end of the stud as shown at 21.

A valve plate biasing and centering spring structure 22 may comprise one or more laminae of spring steel or the like to form a leaf-like spring structure having lateral rigidity, and preferably has a central aperture 23 adapted to receive the collar 18 and/or the head of the stud 16. This leaf-like spring structure 22 may be in

the form of a disc with suitable provision for passage of fluid therepast but preferably comprises a central portion 24 having two or more, preferably four, radiating arms 25—25, as shown.

In the preferred structure a split ring 26 5 snugly engages around the circumference of the collar 18 with, if desired, one or more spacing discs 27—27 located between the upper face of the valve plate 14 and the ring 26. When the central aperture 23 in the spring structure 22 is large enough to receive the collar 18 therein the upper side of the split ring 26 forms an abutment for the central portion of the spring structure 22 with the lower portion of the split ring 26 10 serving as an abutment for the valve plate structure. It is obvious, however, that similar spacing means may be provided by the ring or collar 18 when the central aperture 23 in the spring structure 22 is of such dimension as to be received over the head of the stud 16 with the central portion of the spring structure engaging the outer face of the collar 18 as an abutment.

The valve plate structure 14, the stud assembly 16 and biasing spring structure 22 are assembled in the frame or valve cage 10 by a single operation. A circumferential groove 28 in the side wall 15 of the recess 12 is adapted to receive a split ring 29. The valve plate structure 14 is seated on the seat 13, the spring structure fitted over the stud assembly 16, the split ring 29 30 positioned to engage peripheral portions of the spring structure 22, and the split ring 29 then forced downwardly to snap into the circumferential groove 28 flexing the spring structure 22 transversely to bias the valve plate structure 14 to and center it on the valve seat 13. It will be understood that suitable means other than the split ring 29 may be used to hold peripheral portions of the spring structure 22 in or on the frame or valve cage 10 in the desired position.

Obviously spacing means other than the stud assembly structure described above may be used in accordance with the present invention. Such a modified spacing means is shown in Fig. 3 which may comprise a spacing block 30 such as a disc having opposed faces 31 and 32 to form abutments for the central portion of the spring structure 22 and valve plate structure 14. Stud members 33 and 34 project from the abutment faces 31 and 32 respectively with the projecting member 33 received in the central aperture 23 of the spring structure 22 and the projecting member 34 received in the central aperture of the valve plate structure 14. Preferably the projecting member 34 is snugly fitted into the central aperture of the valve plate structure 14 and the engagement between faces of the spacing member 30 and the valve plate structure 14 is such as to assure a substantially fluid-tight connection therebetween.

Although a spring structure having a central portion with a plurality of arms radiating therefrom is preferred, disc-like spring members may be used such as that shown in Fig. 4. Such a spring structure may comprise one or more discs 35 of steel or the like, preferably flat and provided with a central aperture 36 (corresponding to the central aperture 23 of the structure shown in Figs. 1, 2 and 3) and a plurality of holes 37—37 to provide fluid passages therethrough.

In operation, with the check valve unit of the present invention acting as a valve in a fluid passage, with a differential in pressure on opposite sides of the valve and with the higher pressure acting against the valve plate structure 75

opposed by the biasing action of the spring structure the valve will suddenly open when such differential in pressure is great enough to overcome the biasing action of the spring structure, permitting fluid to flow past the valve until such time as the differential in pressure becomes less than the biasing action of the spring structure, at which time the valve will close preventing back-flow of fluid. The travel of the valve plate structure during such operation is predetermined by the space between the spring structure and the valve plate structure at the points of nearest approach. In the structure depicted by way of example in the drawing this is the distance between the point "A" on the periphery of the outermost spacing washer 27 and an opposed point "B" on the inner surface of the spring structure 22. In this manner the spring structure serves as a stop for limiting travel of the valve plate structure.

Although in the preferred embodiment of the invention the overall lateral dimension of the spring structure is greater than the diameter of the valve plate structure so that the spring structure overhangs the valve plate structure to provide this stop feature, it is to be understood that similar results may be obtained when the overall lateral dimension of the spring structure is less than the diameter of the valve plate structure. In the latter case suitable spring anchorage means overhanging from the frame can be used without interfering with the valve plate structure and in such case stops will be provided by peripheral portions of the spring structure which are adapted to engage at opposed points on the valve plate structure whereby similar predetermined travel of the valve plate structure is attained. Further it is understood that when desired one or more of the washers 27 may be omitted to obtain a different valve plate travel. In case all of the spacing washers 27 are omitted peripheral portions of the valve plate engage the spring structure at opposed points to limit travel.

Obviously it is not essential to the invention that the valve seat and the valve plate structure be circular. The desired ends may be attained where they are of other configuration such as oval, rectangular, etc.

By virtue of the simplicity of the construction and the possibility of forming the parts from light weight material, the device can be made highly sensitive for rapid operation with precision in controlling relatively large dimension fluid passages carrying either liquid or gaseous medium, such as in pneumatic apparatus, fuel supplies for internal combustion engines and the like. By way of example the use of such a valve structure is exemplified in the transfer pump disclosed in my copending application Serial No. 362,179, filed October 22, 1940. As therein disclosed such transfer pump may be utilized for transferring fuel at low pressure for Diesel engine purposes, wherein it may be desired to have the transfer pump operate through one complete cycle for every cycle of operation of each cylinder of the engine. It has been found in such a system that check valves of the present invention in which the biasing force of the spring structure of the valve varies from about six ounces to two pounds, will operate with precision without any appreciable variation in efficiency at the extremely high frequency of operation there demanded.

Since the spring structure and valve plate structure of the present invention are tied to-

gether and spaced apart by means under compression rather than in tension, not only can the valve plate structure be correctly seated on its seat and guided in operation without necessitating frictional engagement between plate structure and fixed structure but in addition tension on the centering and spacing means is effectively eliminated making possible the use thereof of easily shaped or machined material while avoiding tendency to strain or break the guiding and spacing means during high speed operation.

It will thus be seen that the objects set forth above are efficiently attained and since certain changes may be made in the above construction and different embodiments of the invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

Having described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. A check valve comprising, in combination, a frame, a valve seat on said frame, a valve plate structure seated on said seat free from contact with said frame elsewhere and having a centering aperture, a leaf-like spring structure having lateral rigidity and a guiding aperture, spacing means comprising opposed projecting members one of which is received in the valve plate centering aperture and another of which is received in the spring guiding aperture and opposed abutments spacing said valve plate structure and said spring structure from each other, and means on said frame holding peripheral portions of said spring structure in a fixed manner whereby it is stressed to bias and center said valve plate structure to said seat, said spring structure being of such configuration and dimension as to provide for free passage of fluid through the valve when said valve plate structure is unseated and to serve as a stop for limiting travel of said valve plate structure.

2. A check valve comprising, in combination, a substantially circular frame, a valve seat interiorly of said frame, a substantially circular valve plate structure seated on said seat free from contact with said frame elsewhere and having a central aperture, a leaf-like spring structure having a guiding aperture, spacing means comprising a member having a pair of opposed abutments and studs projecting beyond said abutments with one stud received in the valve plate central aperture and another stud received in the spring guiding aperture and the opposed abutments spacing said valve plate structure and said spring structure from each other, and means holding peripheral portions of said spring structure in a fixed manner on said frame whereby said spring structure is stressed to bias said valve plate structure to said seat, such spring structure being of greater overall dimension than said valve plate structure to provide a stop for limiting travel of said plate and of such configuration as to provide for free passage of fluid through the valve when said valve plate structure is unseated.

3. A check valve comprising, in combination, a frame having a substantially circular valve seat therein, a relatively flat valve plate structure

seated on said seat free from contact with said frame elsewhere and having a central aperture, a relatively flat valve plate biasing and centering leaf-like spring structure of greater overall dimension than said plate structure having a substantially centrally located aperture, spacing means comprising a member having a pair of opposed abutments and studs projecting beyond said abutments with one stud received in the valve plate central aperture in a substantially fluid-tight manner and another stud received in the spring guiding aperture and the opposed abutments spacing said valve plate structure and said spring structure from each other, and means holding peripheral portions of said spring structure in a fixed manner on said frame radially beyond the periphery of said plate structure with said plate structure spaced from said spring structure at points of nearest approach a distance equal to predetermined travel of said plate structure, said spring structure being of such configuration as to provide for free passage of fluid through the valve when said plate structure is unseated.

4. A check valve comprising in combination, a frame having a substantially circular valve seat therein, a relatively flat valve plate structure seated on said seat free from contact with said frame elsewhere and having a central aperture, a relatively flat valve plate biasing and centering leaf-like spring structure having a central aperture and a plurality of radiating arms the ends of which lie substantially on the circumference of a circle described about the central aperture with a diameter greater than that of said plate structure, spacing means comprising a member having a pair of opposed abutments and a pair of studs each projecting beyond one of said abutments with one stud received in the valve plate central aperture in a substantially fluid-tight manner and the other stud received in the spring guiding aperture and the opposed abutments spacing said valve plate structure and said spring structure from each other, and means holding the ends of the spring arms in a fixed manner on said frame with said valve plate structure spaced from the spring arms at the points of nearest approach a distance equal to predetermined travel of said plate structure.

5. A check valve comprising, in combination, a sleeve-like valve cage adapted to be mounted in a fluid passage, a valve seat formed on said cage adjacent a port therethrough, a relatively flat valve plate structure seated on said seat free from contact with said cage elsewhere and having a central aperture, a spacing member having a pair of opposed abutments and a pair of studs each projecting beyond one of said abutments with one of said studs anchored in the valve plate central aperture in a substantially fluid-tight manner, a relatively flat valve plate biasing and centering leaf-like spring structure of greater overall dimension than said valve plate structure having a substantially centrally located aperture receiving the second of said studs, and means holding peripheral portions of said spring in a fixed manner on said cage radially beyond the periphery of said valve plate structure with provision of fluid passages past said spring structure and with said valve plate structure spaced from said spring structure at points of nearest approach a distance equal to predetermined travel of said plate structure.

WARNER T. TABB.