Feb. 27, 1962 J. T. THORP, JR 3,022,793

EXPLOSIVELY ACTUATED VALVES

Filed Oct. 31, 1958 2 Sheets-Sheet 1

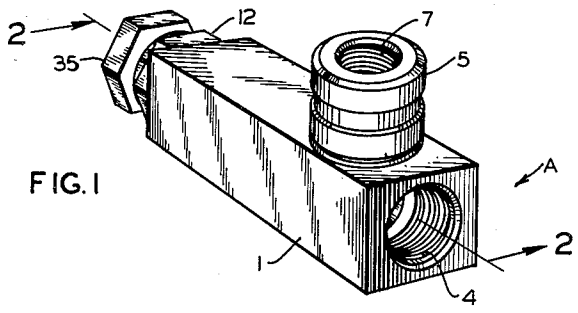


FIG. 1

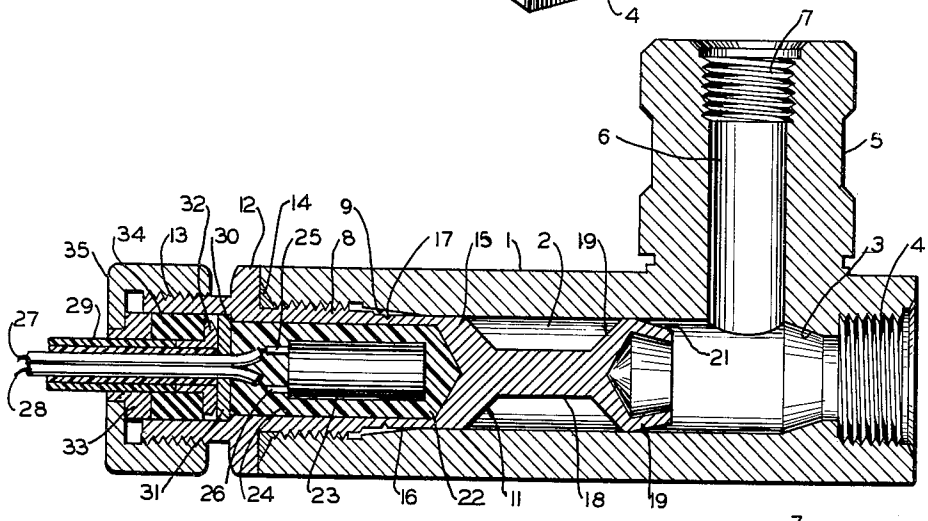


FIG. 2

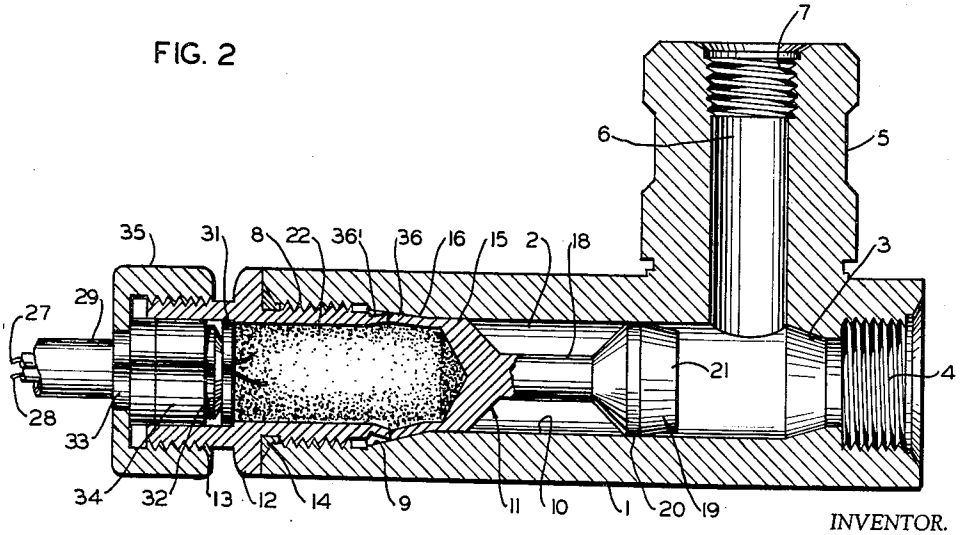


FIG. 3

INVENTOR.
JAMES T. THORP, JR.
BY
ATT'Y.

Feb. 27, 1962 J. T. THORP, JR 3,022,793

EXPLOSIVELY ACTUATED VALVES

Filed Oct. 31, 1958

2 Sheets-Sheet 2

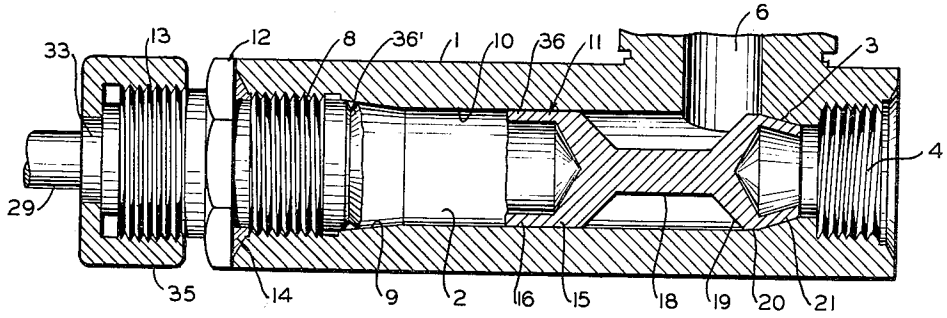


FIG. 4

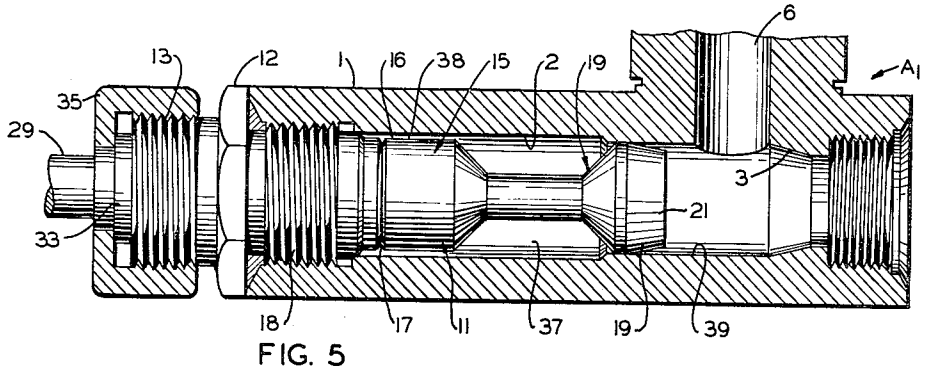


FIG. 5

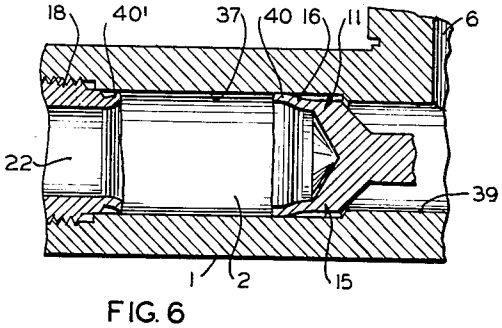


FIG. 6

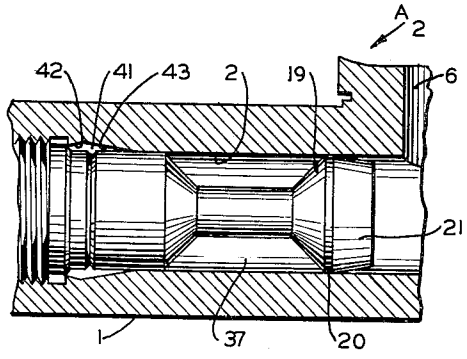


FIG. 7

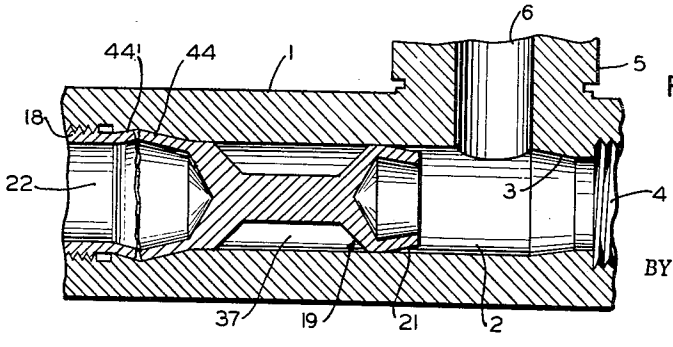


FIG. 8

INVENTOR.
JAMES T. THORP, JR.
BY Alfred W. Petcraft
ATT'Y.

United States Patent Office 3,022,793 Patented Feb. 27, 1962

3,022,793

EXPLOSIVELY ACTUATED VALVES

James T. Thorp, Jr., Webster Groves, Mo., assignor to Universal Match Corporation, St. Louis County, Mo., a corporation of Delaware

Filed Oct. 31, 1958, Ser. No. 770,983
7 Claims. (Cl. 137—68)

This invention relates in general to valves and, more particularly, to valves of the explosively actuated type.

It is, therefore, a primary object of the present invention to provide a one-time operating normally open valve which can be explosively actuated to permit closing thereof.

It is another object of the present invention to provide an explosively actuated valve of the type stated in which the valve is positively locked and retained in the closed position once the valve has been closed.

It is a further object of the present invention to provide an explosively actuated valve of the type stated in which valve leakage is effectively prevented when the valve is closed.

It is another object of the present invention to provide an explosively actuated valve of the type stated which prevents leakage of, or contamination of, the fluid by the gaseous products of combustion resulting from the ignition of the explosive cartridge therein.

It is still another object of the present invention to provide an explosively actuated valve of the type stated having an explosive cartridge which is fully potted within the valve closing member so that there is no volume or head space between the cartridge and closing member, thereby insuring rapid pressure build-up and reliable operation when the cartridge is fired.

With the above and other objects in view, my invention resides in the novel features of form, construction, arrangement, and combination of parts presently described and pointed out in the claims.

In the accompanying drawings (two sheets)—

FIG. 1 is a perspective view of an explosively actuated valve constructed in accordance with and embodying the present invention;

FIG. 2 is a sectional view taken along line 2—2 of FIG. 1;

FIG. 3 is a sectional view similar to FIG. 2 and showing the valve just after the cartridge has been ignited;

FIG. 4 is a fragmentary sectional view similar to FIGS. 2 and 3 and showing the valve in its closed position;

FIG. 5 is a fragmentary sectional view similar to FIG. 2 and showing a modified form of an explosively actuated valve;

FIG. 6 is a fragmentary sectional view similar to FIG. 5 and showing the valve of FIG. 5 just after the cartridge has been fired;

FIG. 7 is a fragmentary sectional view similar to FIG. 5 and showing another modified form of an explosively actuated valve; and

FIG. 8 is a fragmentary sectional view similar to FIG. 7 and showing the valve of FIG. 7 just after the cartridge has been fired.

Referring now in more detail and by reference characters to the drawings, which illustrate practical embodiments of the present invention, A designates an explosively actuated valve comprising an elongated rectilinear valve body 1 provided with an axially extending bore 2 which terminates at one end in a frusto-conical valve seat 3, and coaxial with the bore 2 is a threaded outlet passageway 4 which opens at one end of the valve body 1. Integrally formed on, and projecting outwardly from, one surface of the valve body 1 is a boss 5 provided with an inlet passageway 6, the upper end of which is provided with threads 7, and the passageway 6 communicates with the bore 2 adjacent the valve seat 3.

The central bore 2 is also provided with a threaded end 8 which terminates at its inner end in a conically tapered clearance portion 9, the latter, in turn, merging with a cylindrical walled section 10. Mounted in the threaded end 8 is a valve closer or ram 11 integrally including a nut 12 and a threaded extension 13 projecting axially therefrom. Adjacent the nut 12, the valve body 1 is chamfered for receiving a lead sealing ring 14 which forms a fluid-tight seal between the ram 11 and the valve body 1. The ram 11 also integrally includes a piston member 15 which is disposed within the cylindrical walled portion 10, and a thin walled zone of weakness 16 formed with a peripheral groove 17, the latter lying within the tapered clearance portion 9. At its forward end, the ram 11 is provided with a diametrally reduced forwardly extending rod 18 which terminates in an integrally formed closure head 19 provided with a cylindrical surface 20 which fits snugly, but slidably, against the cylindrical walled section 10. The head 19 is, furthermore, formed with a frusto-conical surface 21 which is sized for fluid-tight metal-to-metal contact with the valve seat 3 when the head 19 is driven to the closed position, as will be presently more fully described.

Internally thereof, the ram 11 is provided with a cartridge chamber 22 for receiving an explosive cartridge 23 which is potted in place by a suitable sealing compound 24. Soldered to the terminals 25, 26, of the cartridge 23 are lead wires 27, 28, which are fully insulated and encased in a plastic cover 29. Encircling the wires 27, 28, and disposed against a shoulder 30 within the cartridge chamber 22 is a washer 31 which also covers the potting compound 24. Similarly disposed over the wires 27, 28, adjacent the washer 31 is a clamping sleeve 32 and disposed around the plastic cover 29 in spaced relation to the sleeve 32 is a second clamping sleeve 33. Also positioned over the plastic cover 29 between the sleeves 31, 33, is a rubber bushing 34, and threaded onto the extension 13 is a cable clamp 35. The potting compound 24 completely surrounds the cartridge 23 and also fills up the cartridge chamber 22, thereby eliminating any free volume or head space between the cartridge 24 and valve closer 11. Moreover, the potting compound 24 protects the soldered connections between the terminals 25, 26, and wires 27, 28, against deterioration due to moisture or other corrosive elements.

In use, suitable inlet and outlet conduits (not shown) may be threaded into the passageways 6, 4, respectively, so that fluid from any suitable source of supply may flow into the passageway 6 and outwardly through the passageway 4. When it is desired to close the valve A, current is supplied to the cartridge 23 through the wires 27, 28, and, upon explosion of the cartridge 23, the zone of weakness 16 will rupture at the groove 17 and form flared skirts 36, 36', which will expand in contact with the walls of the tapered portion 9. The resulting pressure created by explosion of the cartridge 23 will then drive the piston member 15 and its associated head 19 across the passageway 6 and to the position shown in FIG. 4, causing the conical surface 21 to strike against the valve seat 3 and form a fluid-tight metal-to-metal seal therewith. Furthermore, the skirts 36, 36', engage the walls of the bore 2 and form fluid-tight metal-to-metal seals against leakage of incoming fluid across the piston member 15, and also prevents gaseous products of combustion from the cartridge 23 from contaminating the fluid. Fluid pressure exerted on the head 19 will serve to urge the head 19 more tightly against the valve seat 3 and thus prevent displacement thereof.

It is also possible to provide a modified form of an explosively actuated valve A_1, as shown in FIGS. 5 and 6, which is similar to the valve A previously described, except that the tapered clearance portion 9 is omitted and the central bore 2 is formed with a cylindrical walled

section 37 which is of somewhat greater diameter than the piston 15, so as to form a cylindrical clearance space 38 which completely surrounds the zone of weakness 16 and groove 17. The section 37 terminates at its forward end in a diametrally reduced portion 39 which snugly, but slidably, receives the head 19. Consequently, when the cartridge 24 is fired in the manner previously described, the ram 11 will rupture at the groove 17 and form flared piston skirts 40, 40', which form fluid-tight metal-to-metal seals against the section 37, as shown in FIG. 6.

It is also possible to provide a further modified form of explosively actuated valve A_2, as shown in FIGS. 7 and 8, which is similar to the valve A previously described, except that the clearance space 41 is formed by adjacent diverging and converging tapered portions 42, 43, in the bore 2. Preferably, the groove 17 is located in approximate longitudinal alignment with the intersection of the tapered portions 42, 43, and, therefore, a slightly greater clearance space for expansion of the piston skirts 44, 44' (FIG. 8), is formed than is formed in the valves A, A_1, previously described.

It should be understood that changes and modifications in the form, construction, arrangement, and combination of the several parts of the explosively actuated valve may be made and substituted for those herein shown and described without departing from the nature and principle of my invention.

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

1. A normally open valve comprising a body having a rearward portion and a forward portion and which is provided with a bore having a cylindrical wall which merges with a conically tapered clearance portion, said bore being provided with inlet and outlet passageways, a valve seat formed in said bore intermediate the passageways, a valve closer formed of malleable metal which includes a piston member disposed within the bore, said piston member being provided with a rearwardly extending skirt portion having an annular cylindrical wall and being rigidly secured at its rearward end to the rearward end of the bore, said skirt portion also being provided with an internal chamber, the annular cylindrical wall of said skirt portion being sized for slidable but snug-fitting engagement with the cylindrical wall of said bore, said skirt portion having a peripheral groove defining a thin-walled zone of weakness lying within the tapered clearance portion, said zone of weakness disposed forwardly in the bore with respect to the secured end of the skirt portion, said valve closer integrally including a forward portion projecting axially from the piston member and having a head normally spaced from said valve seat and being of such shape as to fit tightly within said valve seat, and pyrotechnical means adapted upon detonation for rupturing said valve closer at said zone of weakness and thereby form a severed portion which includes the piston member and that part of the skirt portion which is located forwardly of said zone of weakness, said pyrotechnical means being adapted to expand said skirt portion into gas-tight wiping engagement with the cylindrical wall of said bore and for driving the severed portion of the valve closer along said bore to force said head into fluid-tight closurewise contact with the valve seat.

2. A normally open valve comprising a body having a rearward portion and a forward portion and which is provided with a bore having a cylindrical wall which merges with a conically tapered clearance portion, said bore being provided with inlet and outlet passageways, a valve seat formed in said bore intermediate the passageways, a valve closer formed of malleable metal which includes a piston member disposed within the bore, said piston member being provided with a rearwardly extending skirt portion having an annular cylindrical wall and being rigidly secured at its rearward end to the rearward end of the bore, said skirt portion also being provided with an internal chamber, the annular cylindrical wall of said skirt portion being sized for slidable but snug-fitting engagement with the cylindrical wall of said bore, said skirt portion having a peripheral groove defining a thin-walled zone of weakness lying within the tapered clearance portion, said zone of weakness disposed forwardly within the bore with respect to the secured end of the skirt portion, said valve closer integrally including a forward portion projecting axially from the piston member and having a head normally spaced from said valve seat and being of such shape as to fit tightly within said valve seat, said skirt portion being internally provided with an explodable charge lying in the region of said zone of weakness, said explodable charge upon detonation being operable to rupture said valve closer at the zone of weakness, and thereby form a severed portion which includes the piston member and that part of the skirt portion which is located forwardly of said zone of weakness, said explodable charge being adapted to expand said skirt portion into gas-tight wiping engagement with the cylindrical wall of said bore and to drive the severed portion of the valve closer along said bore to force said head into fluid-tight closurewise contact with said valve seat.

3. A normally open valve comprising a body having a rearward portion and a forward portion and which is provided with a bore having a cylindrical wall which merges with a conically tapered clearance portion, said bore being provided with inlet and outlet passageways, a valve seat formed in said bore intermediate the passageways, a valve closer formed of malleable metal which includes a piston member disposed within the bore, said piston member being provided with a rearwardly extending skirt portion having an annular cylindrical wall and being rigidly secured at its rearward end to the rearward end of the bore, said skirt portion also being provided with an internal chamber, the annular cylindrical wall of said skirt portion being sized for slidable but snug-fitting engagement with the cylindrical wall of said bore, said skirt portion having a peripheral groove defining a thin-walled zone of weakness lying within the tapered clearance portion, said zone of weakness disposed forwardly within the bore with respect to the secured end of the skirt portion, said valve closer integrally including a forward portion projecting axially from the piston member and having a head normally spaced from said valve seat and being of such shape as to fit tightly within said valve seat, an explodable charge positioned in said chamber, and potting composition completely surrounding said charge and filling said chamber, said explodable charge being operable upon detonation to rupture said valve closer at the zone of weakness and thereby form a severed portion which includes the piston member and that part of the skirt portion which is located forwardly of said zone of weakness, said explodable charge being adapted to expand said skirt portion into gas-tight wiping engagement with the cylindrical wall of said bore and to drive the severed portion of the valve closer along said bore to force said head into fluid-tight closurewise contact with said valve seat.

4. In a fluid flow controlling valve having a central bore forming a normal fluid flow path, said central bore having a rearward and a forward portion, inlet and outlet passageways communicating with said bore, a valve seat formed in said bore between said passageways, said bore having a cylindrical wall, said bore being provided with an enlarged tapered clearance portion that merges with said cylindrical wall and being remote from said valve seat, a valve closer formed of malleable metal which includes a piston member disposed within the bore, said piston member being provided with a rearwardly extending skirt portion having an annular cylindrical wall and being rigidly secured at its rearward end to the rearward end of the bore, said skirt portion also being provided with an internal chamber, the annular cylindrical wall of said skirt portion being sized for slidable but snug-fitting

engagement within the cylindrical wall of said bore, said skirt portion having a peripheral groove defining a thin-walled zone of weakness lying within the tapered clearance portion, said zone of weakness disposed forwardly within the bore with respect to the secured end of the skirt portion, said valve closer integrally including a forward head-like portion projecting axially from an integral rod-like shaft and having a head normally spaced from said valve seat and being of such shape as to fit tightly within said valve seat, and means for rupturing said valve closer at said zone of weakness and thereby form a severed portion which includes the piston member and that part of the skirt portion which is located forwardly of said zone of weakness, said last-named means being adapted to flare said skirt portion outwardly to expand and form gas-tight wiping engagement with the cylindrical wall of said bore, said means also being operable to drive said severed portion along the bore toward said valve seat to force the head into fluid-tight contact with the valve seat.

5. In a fluid flow controlling valve having a central bore forming a normal fluid flow path, said central bore having a rearward and a forward portion, inlet and outlet passageways communicating with said bore, a valve seat formed in said bore between said passageways, said bore having a cylindrical wall, said bore being provided with an enlarged tapered clearance portion that merges with said cylindrical wall and being remote from said valve seat, a valve closer formed of malleable metal which includes a piston member disposed within the bore, said piston member being provided with a rearwardly extending skirt portion having an annular cylindrical wall and being rigidly secured at its rearward end to the rearward end of the bore, said skirt portion also being provided with an internal chamber, the annular cylindrical wall of said skirt portion being sized for slidable but snug-fitting engagement with the cylindrical wall of said bore, said skirt portion having a peripheral groove defining a thin-walled zone of weakness lying within the tapered clearance portion, said zone of weakness disposed forwardly within the bore with respect to the secured end of the skirt portion, said valve closer integrally including a forward head-like portion projecting axially from an integral rod-like shaft and having a head normally spaced from said valve seat and being of such shape as to fit tightly within said valve seat, and an explodable charge positioned within said chamber in the region of the zone of weakness for rupturing said valve closer at said zone of weakness and thereby form a severed portion which includes the piston member and that part of the skirt portion which is located forwardly of said zone of weakness, said explodable charge being adapted to flare said skirt portion outwardly to expand and form gas-tight wiping engagement with the cylindrical wall of said bore, said explodable charge also being operable to drive said severed portion along the bore toward said valve seat to force the head into fluid-tight contact with the valve seat.

6. In a fluid flow controlling valve having a central bore forming a central fluid flow path, said central bore having a rearward and a forward portion, inlet and outlet passageways communicating with said bore, a valve seat formed in said bore between said passageways, said bore having a cylindrical wall, said bore being provided with an enlarged tapered clearance portion that merges with said cylindrical wall and being remote from said valve seat and converging toward said valve seat, a valve closer formed of malleable metal which includes a piston member disposed within the bore, said piston member being provided with a rearwardly extending skirt portion having an annular cylindrical wall and being rigidly secured at its rearward end to the rearward end of the bore, said skirt portion also being provided with an internal chamber, the annular cylindrical wall of said skirt portion being sized for slidable but snug-fitting engagement with the cylindrical wall of said bore, said skirt portion having a peripheral groove defining a thin-walled zone of weakness lying within the tapered clearance portion, said zone of weakness disposed forwardly within the bore with respect to the secured end of the skirt portion, said valve closer integrally including a forward portion projecting axially from the piston member and having a head normally spaced from said valve seat, said head being integrally connected to said valve closer by a small rod-like member and being of such shape as to fit tightly within said valve seat, and pyrotechnical means adapted upon detonation for rupturing said valve closer at said zone of weakness and thereby form a severed portion which includes the piston member and that part of the skirt portion which is located forwardly of said zone of weakness, said pyrotechnical means being adapted to flare said skirt portion on the severed portion of the valve closer outwardly to form gas-tight wiping engagement with the cylindrical wall of said bore, said pyrotechnical means also being operable to drive said severed portion along the bore toward said valve seat to force the head into fluid-tight contact with the valve seat.

7. In a fluid flow controlling valve having a central bore forming a central fluid flow path, said central bore having a rearward and a forward portion, inlet and outlet passageways communicating with said bore, a valve seat formed in said bore between said passageways, said bore having a cylindrical wall, said bore being provided with an enlarged clearance portion formed by adjacent oppositely tapered sections which are remote from said valve seat, said clearance portion merging with the cylindrical wall of said bore, a valve closer formed of malleable metal which includes a piston member disposed within the cylindrical wall, said piston member being provided with a rearwardly extending skirt portion having an annular cylindrical wall and being rigidly secured at its rearward end to the rearward end of the bore, said skirt portion also being provided with an internal chamber, the annular cylindrical wall of said skirt portion being sized for slidable but snug-fitting engagement with the cylindrical wall of said bore, said skirt portion having a peripheral groove defining a thin-walled zone of weakness lying within the tapered clearance portion, said zone of weakness disposed forwardly within the bore with respect to the secured end of the skirt portion, said valve closer integrally including a forward portion projecting axially from the piston member and having a head normally spaced from said valve seat, said head being integrally connected to said valve closer by a small rod-like member and being of such shape as to fit tightly within said valve seat, and pyrotechnical means adapted upon detonation for rupturing said valve closer at said zone of weakness and thereby form a severed portion which includes the piston member and that part of the skirt portion which is located forwardly of said zone of weakness, said pyrotechnical means being adapted to flare said skirt portion on the severed portion of the valve closer outwardly to form gas-tight wiping engagement with the cylindrical wall of said bore, said pyrotechnical means also being operable to drive said severed portion along the bore toward said valve seat to force the head into fluid-tight contact with the valve seat.

References Cited in the file of this patent

UNITED STATES PATENTS

2,515,068	Young	July 11, 1950
2,557,448	Mathisen	June 19, 1951
2,777,455	Daudelin	Jan. 15, 1957
2,796,074	Daudelin	June 18, 1957
2,808,847	Segal	Oct. 8, 1957
2,815,698	Burrows	Dec. 10, 1957
2,815,882	Connell	Dec. 10, 1957

OTHER REFERENCES

Explosive Actuated Valves, by Maurice M. Connell, published Sept. 24, 1956, catalog 5501–KV.