United States Patent

Whitmer

[15] **3,687,157**

[45] **Aug. 29, 1972**

[54] **TRAP FOR DRILL PIPE**

[72] Inventor: **Jeff David Whitmer,** Bloomfield, Mont. 59315

[22] Filed: **April 8, 1971**

[21] Appl. No.: **132,311**

[52] **U.S. Cl.** **137/527,** 166/224, 137/515

[51] **Int. Cl.** **E21b 33/00**

[58] **Field of Search**.....137/515, 515.5, 515.7, 515.3, 137/527, 527.6, 527.2; 166/224; 175/242; 251/280

[56] **References Cited**

UNITED STATES PATENTS

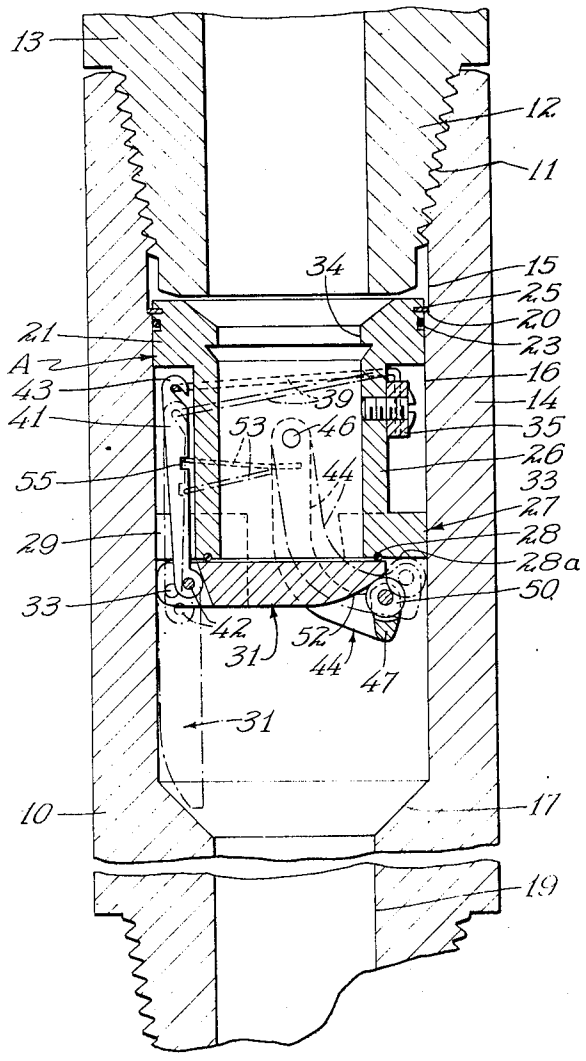
1,871,536	8/1932	Le Bus	137/515
3,016,914	1/1962	Keithahn	137/527 X
3,066,693	12/1962	Taylor	137/515.7 X
3,356,145	12/1967	Fredd	166/224

Primary Examiner—M. Cary Nelson
Assistant Examiner—David J. Zobkiw
Attorney—Robert M. Dunning

[57] **ABSTRACT**

A valve is provided for mounting in the saver sub at the lower end of a Kelly shaft. The valve is capable of remaining closed while subjected to the weight of fluid in the Kelly shaft when the saver sub is disconnected from the top length of a drill pipe to permit another pipe length to be added. The valve will open when fluid under pressure is forced into the top of the Kelly shaft.

10 Claims, 6 Drawing Figures



PATENTED AUG 29 1972

3,687,157

SHEET 1 OF 2

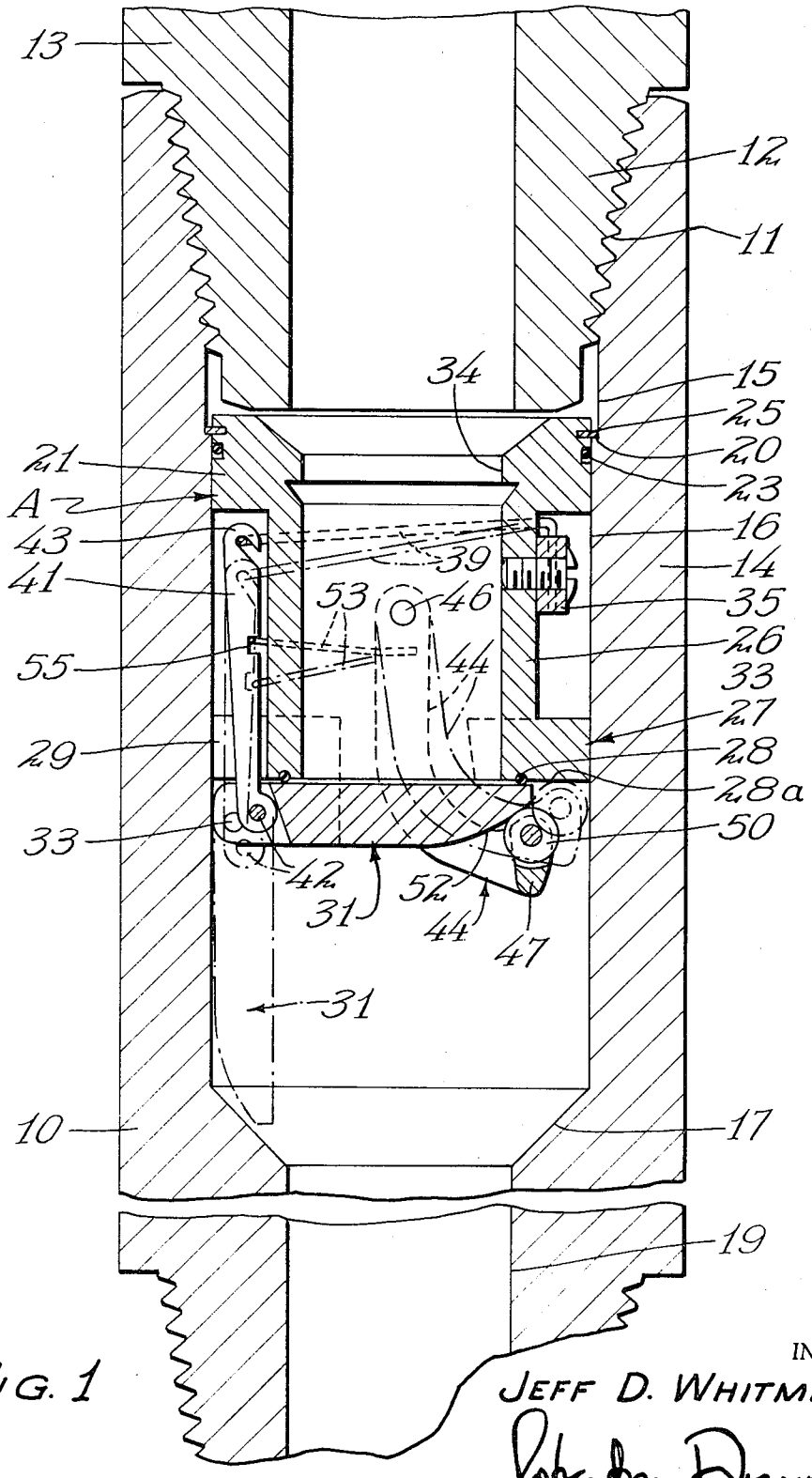


FIG. 1

INVENTOR
JEFF D. WHITMER
BY Robert M. Dunning
ATTORNEY

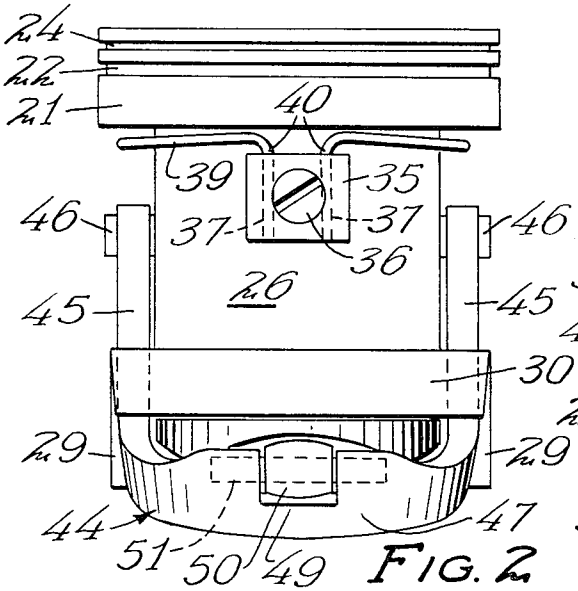


FIG. 2

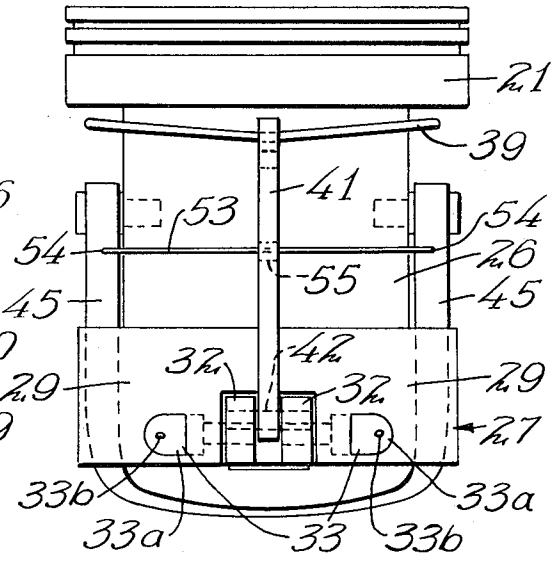


FIG. 3

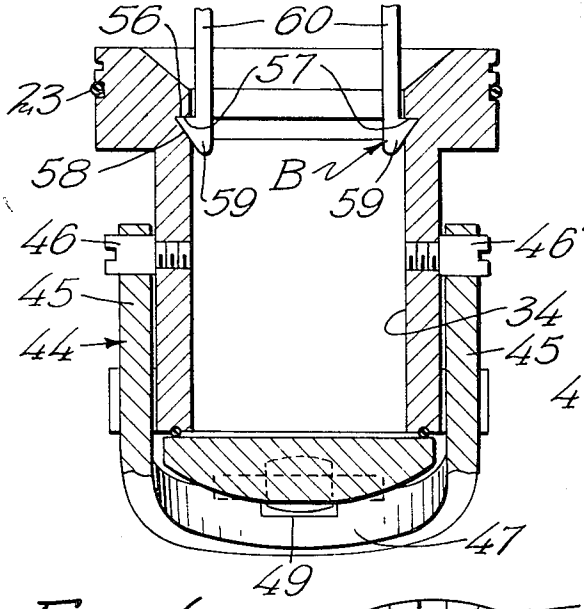


FIG. 4

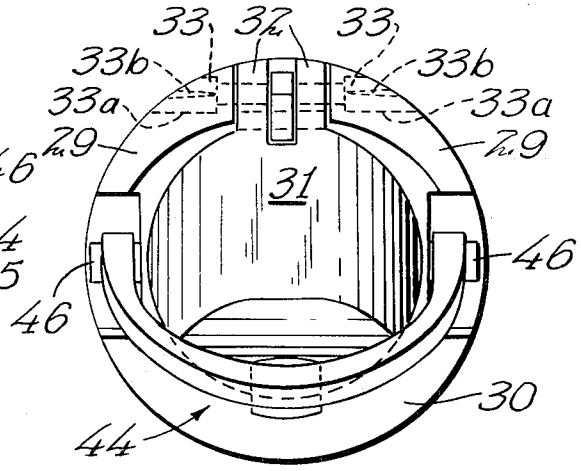


FIG. 5

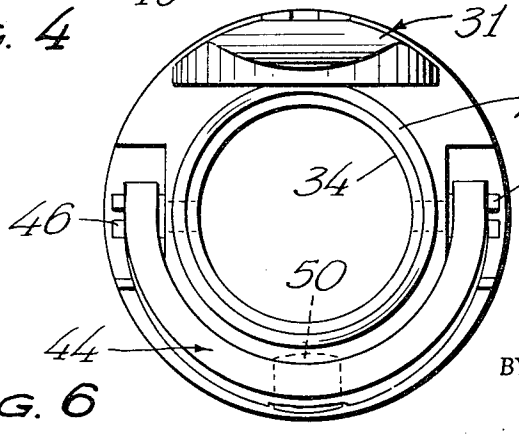


FIG. 6

INVENTOR
JEFF D. WHITMER

BY Robert M. Dunning
ATTORNEY

TRAP FOR DRILL PIPE

This invention relates to an improvement in trap for drill pipe section and deals particularly with a device for retaining fluid in a Kelly Shaft after it has become detached from the pipe string.

BACKGROUND OF THE INVENTION

In the drilling of oil wells, or in formation testing, it is necessary to withdraw the pipe string from the drilled opening from time to time in order to change drill bits, install formation testing tools and the like. The pipe string is usually filled with liquid such as oil, drill mud and the like. As the well deepens, lengths of drill pipe must be added to the pipe string between the Kelly shaft saver sub and the pipe string. As each subsequent pipe is added, the liquid contained in the Kelly shaft and the saver sub spills out on the derrick floor, tools and crew. This spillage is wasteful and produces extremely dangerous working conditions for the crew.

SUMMARY OF THE INVENTION

The present invention resides in a novel type of valve which is mounted inside the saver sub at the top of a pipe string in such a manner as to not interfere with the flow of fluid through the pipe when the valve is open. The valve is novel in that it is normally closed and is capable of remaining closed when only the weight of the fluid in the Kelly shaft rests upon the valve. However, when fluid is forced into the top of the pipe under pressure, the valve will open to permit unrestricted flow of the fluid.

A feature of the present invention resides in the provision of a valve adapted to fit in a saver sub, the interior of which is reamed out to accommodate the body of the valve. The valve includes a sleeve-like body having a flap valve hinged at the lower end of the body on one side of the fluid passage. Spring means normally urge the flap valve into closed position so that the valve acts as a check valve to prevent the upward flow of fluid in the pipe. The valve is normally held in closed position by means of a yoke pivotally supported to the valve body on an axis parallel to the flap valve axis. This yoke straddles the free end of the flap valve and holds the flap valve from opening. However, when fluid is forced into the pipe under pressures normally employed in drilling, the downward force on the flap valve will cam the yoke from beneath it, and the flap valve will swing open.

A feature of the present invention resides in the formation of the yoke. A roller is provided on the flap valve straddling portion of the yoke or catch designed to engage a rounded under surface of the flap valve. The engagement of the flap valve with the roller is such that the yoke will be pivoted out of engagement with the flap valve by the rounded valve surface when sufficient force is exerted against the upper surface of the flap valve. The force required is considerably greater than that exerted by the weight of fluid in the Kelly shaft. Thus while adding pipe lengths, the liquid content of the Kelly shaft remains in the shaft. The Kelly shaft with its attached swivel and elbow usually contain about fifty gallons of fluid.

A further feature of the present invention resides in the novel means of urging the valve into closed position. A substantially circular spring is anchored to one side of the outer surface of an intermediate reduced diameter portion of the valve body, and extends about the body. A control link is connected to the valve flap on a pivot which is offset from the pivot supporting the valve flap in the direction toward the axis of the valve. This link is connected to the spring in diametrically opposed relation to the point of anchorage. The spring is formed to resist movement of the link in a direction generally parallel to the axis of the valve. As the flap valve opens, the pivots supporting the link swing toward a dead center position relative to the flap valve pivot and point of connection with the valve spring.

An additional feature of my invention lies in the provision of a yoke spring connecting the yoke and the control link. As the flap valve opens, and the control link moves downwardly, the yoke spring acts to exert pressure on the yoke to hold it in its extreme open position.

These and other objects and novel features of the present invention will be more clearly and fully set forth in the following specification and claims.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a vertical sectional view through a pipe connection showing the valve is section.

FIG. 2 is an elevational view of the closed valve.

FIG. 3 is an elevational view of the closed valve, the view showing the side of the valve opposite that illustrated in FIG. 2.

FIG. 4 is a vertical sectional view through the closed valve.

FIG. 5 is a bottom plan view of the valve in closed position.

FIG. 6 is a bottom plan view of the valve in open position.

DESCRIPTION OF THE PREFERRED EMBODIMENT

As indicated in FIG. 1 of the drawings, the valve A is inserted in the box end or female end of a saver sub **10**, the upper end of which is threaded at **11** to accommodate the male or pin end **12** of the Kelly shaft **13**. In order to accommodate the valve A, the box end **14** is drilled out as indicated at **15** for about an inch below the threads **11**, and then drilled as indicated at **16** at a slightly lesser diameter for a length sufficient to accommodate the entire valve A in its open position. The lower end of the bore **16** is tapered as indicated at **17** to the normal pipe bore diameter **19**. This arrangement provides a shoulder **20** between the two different diameter portions **15** and **16** for a purpose which will be set forth.

As indicated in FIG. 2 through 6 of the drawings, as well as FIG. 1, the valve A includes at its upper end a cylindrical flange portion **21** which is externally grooved as indicated at **22** to accommodate a sealing ring **23**, and as indicated at **24** to accommodate a snap ring **25**.

The valve A includes an intermediate elongated tubular body **26**, which is of somewhat smaller outside diameter than the cylindrical portion **21** at the top of the valve body. An enlarged diameter portion **27** having its outer surface on a cylindrical plane is also provided at the lower end of the valve body. The lower cylindrical portion **27** is partially cut away in order to

accommodate the working part of the valve. However, the lower cylindrical surface includes a pair of arcuate sections 29 on one side of the valve body which extend a total angular distance of somewhat less than one half the circumference of the valve, and an arcuate section 30 on the opposite side which also extends somewhat less than one half the circumference of the valve body. The upper enlarged diameter flange portion 21, the lower diameter portion 27, and the intermediate valve body 26 are all concentric, and the enlarged diameter portions fit snugly within the bored portion 61 of the box end 14. The snap ring 25 rests upon the shoulder 20 to support the valve body from downward movement. The valve body is held from upward movement by the pin end 12 of the pipe 13 should upward fluid pressure be experienced.

A flap valve 31 is designed to seal against a sealing ring 28 recessed into the flat lower valve surface 28*a* forming the lower end of the valve body at the lower end of the concentric fluid passage 34. As is perhaps best indicated in FIG. 5 of the drawings, the flap valve 31 is provided with a pair of spaced parallel pivot ears 32 projecting from the flap valve in a generally radial direction. A pair of aligned pivot pins 33 having enlarged diameter ends 33*a* supported in the arcuate portions 29 of the enlarged flanged structure at the lower end of the valve body, and extend into the ears 32 to pivotally support the flap valve 31. The pivot pins 33 may be held from outward movement by expansion pins 33b. As will be noted from FIGS. 1 and 6 of the drawings, when the flap valve 31 is in its open position, the valve is completely outwardly of the direct flow of fluid through the valve passage 34. When in closed position, the upper surface of the flap valve is sealed against the sealing ring 28.

A valve spring anchor block 35 (see FIG. 2) is anchored to the outer surface of the intermediate portion 26 of the valve A. The anchor block 35 is secured to the valve wall by a bolt 36 threaded into the wall and extending through the anchor block. The anchor block 35 is provided with two vertical spaced holes 37 on opposite sides of the bolt 36. A generally circular valve spring 39 is provided with down turned parallel ends 40 which are engaged in the holes 37. The spring ring 39 is of somewhat greater diameter than the outer surface of the intermediate portion 26 of the valve and resists downward flexing. With reference to FIG. 1 of the drawings, in the closed position of the flap valve 31, the spring is in the position indicated in dotted outline in FIG. 1. When the valve is open, the spring is flexed into the lower position indicated by the broken line.

A valve control link 41 connects the valve 31 with the spring 39 and has a lower end which is pivotally connected between the ears 32 of the flap valve by means of a pivot pin 42. When the valve is closed, the pivot pin 42 is offset inwardly and slightly upwardly from the pivots 33 connecting the flap valve 31 to the flange portion 29 of the valve body. When the flap valve 31 is in the closed position indicated in FIG. 1, the link 41 may exert a maximum pull upon the flap valve 31 due to the fact that the pivot 42 is offset inwardly from the pivots 33. The link 41 is provided with a hook shaped upper end 43 which hooks over the portion of the spring 39 which is diametrically opposite the anchored ends of the spring ring. As the flap valve 31 swings into open position, the axis of the pivot 42 swings about the axis of the flap valve pivots 33 so as to move more nearly toward a position in which the axis of the pivot 33 and 42 are more nearly aligned with the link 41. As a result, the force tending to close the valve decreases as the flap valve approached fully open position.

A yoke 44 forms a catch for assisting in holding the flap valve 31 in its closed position. The yoke 44 includes generally parallel sides 45 which are pivotally connected to diametrically opposite sides of the valve body by aligned pivots 46. The cross member 47 of the yoke 44 is notched as indicated at 49 to accommodate a slightly barrel-shaped roller 50 rotatably supported upon a pivot 51 which is parallel to the axes of the aligned pivots 46. As indicated in FIG. 1, the roller 50 engages the curved surface 52 on the side of the flap valve 31 most remote from the supporting ears 32. The center of curvature of the surface 52 is laterally offset to the left from the pivot 46 (as viewed in FIG. 1 of the drawings) so that the surface 52 may act as a cam to pivot the yoke 44 from the position shown in full lines in FIG. 1 toward the position shown in dotted lines therein. As a result, the pressure against the flap valve 31 may pivot the yoke 44 into the dotted line position when this pressure reaches a predetermined amount.

The catch or yoke 44 is normally held engaged with the flap valve 31 by means of a spring 53 which is generally semi-circular in shape with the ends of the spring engaging in substantially parallel openings 54 in the sides 45 of the yoke 44. The center portion of the spring 53 is engaged in a notch 55 in the control link 41. When the flap valve 31 is in closed position, the spring 53 will be positioned in the upper dotted line position shown in FIG. 1. When the flap valve is open, the spring 53 will be positioned in the broken line lower position shown in this figure.

When the flap valve is closed, it is urged into the closed position by the upward pull of the valve spring 39 which acts through the control link 41 to exert an upward pull on the eccentrically located link pivot pin 42. However, the roller 50 on the yoke 44 engages the flap valve to hold the flap valve closed sufficiently to support fluid in the Kelley joint 13 above the valve. However, when fluid is forced downwardly through the pipe and exceeds a predetermined pressure, fluid swings the flap valve 31 downwardly about its pivots 33, this action swinging the yoke 44 about its aligned axes 46 until it clears the end of the flap valve. As the flap valve opens, the control link pivot 42 swings about the axis of the valve pivots 33, swinging the pivots 42 and 33, and a portion of the spring 39 engaged in the hook end 43 of the control link toward alignment, reducing the effective upward pull exerted by the valve spring 39.

As the control link 41 moves downwardly, the notch 55 also moves downwardly, and in completely open position of the valve 31, the spring 53 holds the central portion of the yoke 44 out of alignment with the passage through the valve and holding the yoke out of the direct flow of fluid passing through the valve.

When the pressure forcing fluid through the pipe is reduced and becomes static, the spring 39 swings the flap valve 31 toward closed position, the pull upon the control link 41 increasing as the flap valve closes. The

end of the flap valve passes the roller 50 due to the fact that the spring 39 is much stronger than the spring 53 and the roller 50 then rolls over the curved end 52 of the flap valve returning to its starting position.

As diagrammatically illustrated in FIG. 4 of the drawings, a groove 58 is provided in the inner surface of the valve body having an upper surface 56 which is normal to the axis of the valve. This groove is designed for engagement with the outwardly projecting shoulders 57 of the wedge-shaped ends 59 of a valve removing tool B. This tool, not shown in its entirety, is usually an inverted U-shaped member of spring steel with generally parallel arms 60 which support the end members 59. The tool B is used in removing the valve when desired.

It will be seen that the flap valve 31 will serve as a check valve in the event of a reverse flow of fluid upwardly in the pipe. The valve will remain closed unless fluid is being pumped downwardly through the pipe in which it will open completely to provide an unrestricted flow through the valve.

In accordance with the Patent Office Statutes, I have described the principles of construction and operation of my trap for drill pipes, and while I have endeavored to set forth the best embodiment thereof, I desire to have it understood that changes may be made within the scope of the following claims without departing from the spirit of my invention.

I claim:

1. A valve adapted for use in a saver sub at the lower end of a Kelly shaft and adapted to retain fluid in the Kelly shaft when the saver sub is disconnected from a drilling pipe string, the valve including:

a valve body having flanged ends adapted to fit a cylindrical bore, and an intermediate smaller diameter portion,

an axial valve passage through said valve body,

a flap valve member hingedly connected to said valve body at the outlet end of said passage and pivotal from a position closing said valve passage to a position out of alignment with said axial valve passage,

a link pivotally connected to said flap valve member on an axis parallel to, but spaced from, the hinge axis of said flap valve member,

a substantially circular spring anchored to said valve body on the side thereof opposite to said link encircling the intermediate portion of said valve body,

said link engaging said spring, and said spring resisting axial movement of said link and the opening of said flap valve member.

2. The structure of claim 1 and in which said pivotal connection between said flap valve member and link is toward the valve axis from the hinge axis.

3. The structure of claim 1 and in which the pivotal connection between said link and said flap valve member swings about the hinge axis as said flap valve member opens.

4. The structure of claim 3 and in which said hinge axis is near alignment between said pivotal connection between said link and said flap valve member, and said engagement between said link and said spring in open position of said flap valve member.

5. The structure of claim 1 and including a yoke pivotally supported to the intermediate portion of said valve body on an axis parallel to said hinge axis,

said yoke including generally parallel arms and a connecting portion straddling said flap valve member,

a cam surface on said flap valve member engaging said straddling portion of said yoke, whereby

when sufficient pressure is exerted on said flap valve member tending to open the same, said cam surface will swing said yoke out of engagement with said flap valve member.

6. The structure of claim 5 and in which said straddling portion of said yoke includes a roller supported on an axis parallel to said yoke axis engaging said cam surface.

7. The structure of claim 5 and including spring means urging said yoke toward flap valve member engaging position.

8. The structure of claim 7 and in which said spring means comprises an arcuate spring engaged in said link and operable, upon movement of said link in a direction in which said flap valve member is open to swing said yoke toward flap valve member disengaged position.

9. A valve including:

a valve body having an axial passage therethrough,

a flap valve member hingedly connected to the outlet end of said valve body and pivotal from a position closing said passage to a position out of alignment with said passage,

resilient means urging said flap valve member toward closed position,

a yoke pivotally supported by said valve body on an axis parallel to the hinge axis of said flap valve member,

said yoke including a pair of arms on opposite sides of said valve body and a connecting portion straddling said flap valve member,

a rounded cam surface on said flap valve member and means on said connecting portion of said yoke engaging said cam means,

resilient means urging said yoke into flap valve member engaging position,

said flap valve member operating, upon the exertion of sufficient pressure on said flap valve member tending to open the same, to force said cam surface against said flap valve member engaging means and to swing said yoke out of flap valve member engaging position.

10. The structure of claim 9 and in which said flap valve member engaging means comprises a roller having an axis parallel to the axes of said yoke and said flap valve member.

* * * * *