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CONSTANT CIRCULATING COUPLING DEVICE

Original Filed Sept. 13, 1962

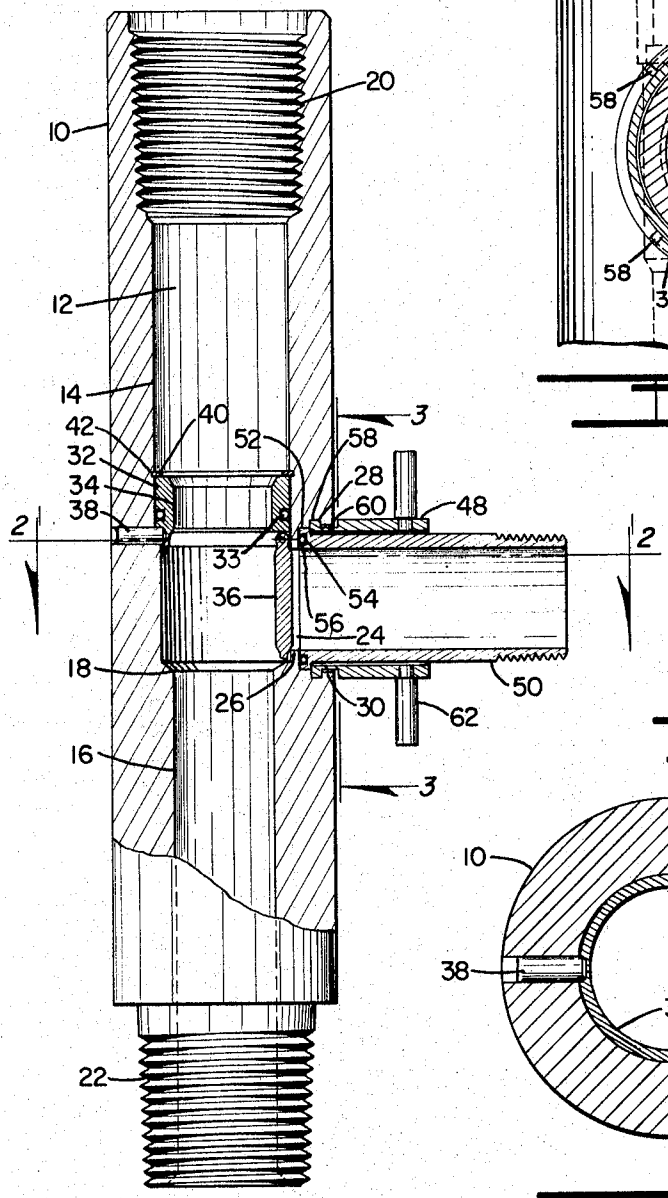


FIG. 1

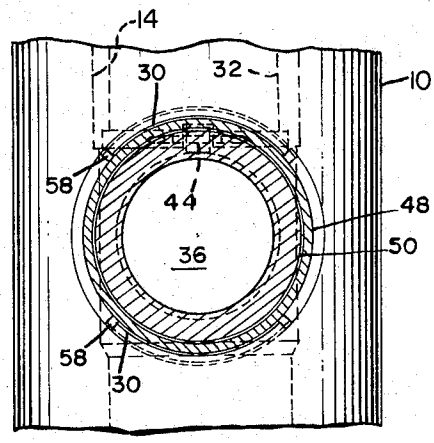


FIG. 3

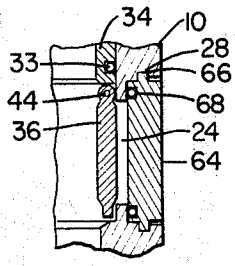


FIG. 4

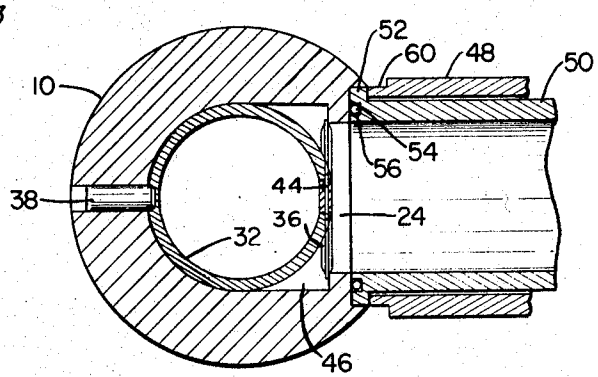


FIG. 2

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# CONSTANT CIRCULATING COUPLING DEVICE

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Continuation of application Ser. No. 223,343, Sept. 13, 1962. This application Sept. 22, 1965, Ser. No. 495,752
1 Claim. (Cl. 137—112)

This invention relates to coupling means for connecting pipe sections together to alter the passageway therethrough, more particularly, it relates to a constant circulating sub to serve both as a connection between sections of drill pipe for use in drilling oil wells and as a valving means to alternately open and close a passageway in one pipe section and a transverse opening in the other pipe section to provide for two alternate circuits for the circulation of drilling fluid.

The present application is a continuation of our copending patent application Serial No. 223,343, filed on September 13, 1962, now abandoned.

The coupling means of this invention has a specific application in the drilling of oil wells; accordingly, it will be described in connection therewith but it is, of course, not limited to this application.

As is well known in the oil drilling art, the shaft which transfers power from the power source above the well to the drill bit is comprised of hollow drill pipe sections joined together by couplings. The top section of the pipe string is connected to a rectangular-shaped, hollow driving member called a "kelly" which cooperates with a rotatable table or other power source to drive the pipe string. As the bore hole increases in depth it is necessary to insert new pipe sections between the kelly and the top pipe section of the drill string. The manner of accomplishing this is, of course, well known.

In accordance with standard procedures in the oil well drilling art, a drilling fluid, such as, drilling mud, air or other fluid is continuously circulated through the bore hole during drilling. Ordinarily the inlet path of the fluid is through the hollow drill string and the outlet path is between the drill string and the casing or the surface of the bore hole. The drilling fluid is ordinarily pumped through a swivel joint into the upper end of the drill string, the swivel joint being located at the top of the kelly so that drilling fluid travels down through the hollow kelly and the hollow pipe string.

The main purpose of the drilling fluid is to remove borings and other foreign matter from the bore hole. However, the drilling fluid, which is normally under pressures from 500 to 1500 pounds per square inch, performs important auxiliary functions. One of these functions is to support the surfaces of the bore hole to prevent caving when the well is being drilled through strata such as heaving shale, which has a tendency to cave. The high pressure drilling fluid further serves to prevent blowouts where drilling is being performed in high pressure gas areas. Accordingly, it is important in the interest of drilling operations that a continuous flow of drilling fluid be maintained without stoppage and that it is maintained under substantially high pressures at all times. Therefore, it is essential to provide a means for maintaining continuous flow of drilling fluid in an oil well while new pipe sections are being inserted in the drill string as the drilling progresses.

The expedient which has been used to provide for continuous circulation of fluid through the well as pipe sections are added to the drill string is the use of a combination connector and valving device known as a "continuous circulating sub," such as, that disclosed in U.S. Patent 2,158,356. The circulator sub of this invention



is of the general type as that disclosed in this patent and operates to shut off the flow of fluid from the kelly to the drill string while a pipe section is inserted and simultaneously establish the flow through a transverse opening in the sub into the drill string. The specification of the patent discloses the method of using a continuous circulating sub of the type disclosed herein maintaining a continuous flow of drilling fluid during the addition of pipe sections.

The continuous circulating sub of this invention is a combination connection and valving device to be inserted between pipe sections in which a gate valve is movable between two positions to alternately open and close both the passageway of an upper pipe section, such as a kelly, and an outlet between the passageway of the lower pipe section and the atmosphere.

As explained in the specification of the above-referred-to patent, in order to maintain constant circulation of drilling fluid while inserting new pipe in the drill string, a circulating sub of this type is connected between the upper pipe section of the drill string and the kelly. Drilling fluid is, of course, flowing into the drill string from its point of introduction at the top of the kelly. In order to maintain a continuous flow of fluid while the kelly is being removed and a new pipe section placed between it and the upper pipe section of the drill string, fluid under pressure is introduced into the circulating sub through its transverse opening so that the gate valve is held in its upper position to close off the passageway of the kelly and at the same time establish a passageway from the atmosphere or source of fluid into the upper pipe section for the continuous circulation of fluid through the well by a new circuit until the new pipe section has been inserted between the kelly and the upper pipe section of the drill string. When the new pipe section has been inserted, introduction of fluid into the circulating sub is halted to permit the gate valve to return to its former position thus opening the passageway between the newly inserted pipe section and the top pipe section of the drill string and simultaneously closing off the transverse opening to reestablish the former circuit for the drilling fluid as introduction of fluid at the top of the kelly is resumed. Fluid is introduced simultaneously at the top of the kelly and through the transverse opening during the change-over period.

There are a number of disadvantages inherent in the continuous circulating subs of the prior art which it is the principal objective of this invention to overcome. Prior subs of this type are quite complicated in structure due to the fact that their bodies are usually comprised of an assembly of a minimum of three parts. This complicated structure results in high manufacturing costs, make the device more susceptible to breakdown and makes repair and replacement of parts more difficult. Further, in prior art devices the gate valve was ordinarily made integral with the remainder of the device making it necessary to disassemble the entire device to repair or replace the gate valve or associated parts.

A further disadvantage of prior art devices is the manner in which the conduit for introduction of fluid into the sub is connected to the sub. It is quite evident that time is of the essence in inserting an additional pipe section into the pipe string and that it is highly important that a fast and effective coupling technique be available for connecting a conduit for fluid to the sub. In the past, this was ordinarily effected by screwing the conduit into a threaded opening in the sub or attaching it by means of an adapter, a union or other means. These expedients were quite time consuming and did not always provide a reliable connection. The means for closing the transverse opening into the sub after removal of the conduit were

quite time consuming in that closure was usually effected by screwing a plug into the threaded opening or otherwise securing it in place by means of a screw threaded attachment.

Accordingly, it is an object of this invention to provide a continuous circulating sub having a valving element which is replaceable without disassembly of the entire sub.

It is another object of this invention to provide a continuous circulating sub which a conduit can be quickly and effectively attached to without the use of threaded pipes, hose couplings or other coupling devices.

It is still another object of this invention to provide a continuous circulating sub constructed so that the transverse opening therein for attachment of a conduit can be quickly and effectively closed after the conduit is removed.

The objectives of the invention are accomplished by a structure which provides a removable gate valve for the sub and a bayonet-type lock between the fluid conduit and the sub and between a plug for the transverse opening and the sub.

The construction of the invention will now be explained by referring to the accompanying drawings hereby made a part of this specification and in which like parts are represented by like numerals, the various figures being described as follows:

FIG. 1 is a sectional view of the continuous circulating sub assembly with the removable gate valve in operating position and the conduit locked to the sub;

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

FIG. 3 is a cross sectional view taken on line 3—3 of FIG. 1; and FIG. 4 is a partial section in the area of the gate valve showing the closure for the transverse opening in the sub in place.

Referring to the figures, the body member or coupling device of the invention is represented by the numeral **10** and is of cylindrical form with a bore or passageway **12** extending axially therethrough. The bore **12** is comprised of an upper section **14**, and lower section **16** of reduced diameter, the internal annular shoulder **18** being formed at the juncture of the two sections. The upper end of the body member is provided with internal threads **20** for direct connection with a kelly or pipe section to form a tool joint and the lower end of the body member is provided with threaded reduced section **22** for direct attachment also to a pipe section to form a tool joint.

In order to permit introduction of fluid into the passageway of the sub from an external source of fluid in a manner to be described later a transverse opening **24** is formed in the wall or body member **10**. The periphery of the transverse opening **24** is machined or cut away to form a mating structure with a tool or plug to be described later to permit a bayonet-type connection or lock therewith. This structure comprises an internal annular flange **26**, an annular groove **28** and depending locking elements or ears **30** which are particularly identified by reference to FIG. 3.

A removable flapper float valve assembly **32** comprising hollow base number **34** and flapper gate valve element **36** is seated concentrically in the upper bore section **14** between shoulder **18** and removable snap ring **40** seated in annular groove **42** in the surface of the bore of section **14**. It will be seen that the flapper valve assembly is readily insertable and removable axially through the box end of the sub by removal of snap ring **40**.

To prevent leakage of fluid between body **34** and the surface of bore **12** a sealing element in the form of an O-ring **33** is seated therebetween as shown.

To permit proper seating of the flapper valve element **36** against shoulder **26** by axial positioning of body **34**, a notch is provided in the outer surface of hollow base member **34** into which the end of a pin **38** fits. The pin **38** is threadedly introduced into the body of the sub as shown in FIG. 2 but may be welded in place. The pin



**38** may be welded in place in the body **10** as shown in FIGURE 1.

The flapper valve element **36** is rounded at the bottom as shown in FIG. 3 and is hingedly attached to the base member **34** by means of hinge pin **44** to swing between positions alternately closing opening **24** and the axial passageway through the bore **12** and base member **34** which fits concentrically in the bore **12** of the body member **10**. The hinge pin and associated structure is more readily observed by reference to FIG. 2.

The invention is not restricted to the described structure for seating the removable valve assembly in the body member but other expedients for accomplishing this may be used. The internal surface of the bore **12** is flattened at **46** as shown in FIG. 2 to accommodate the flapper valve **36** in its downward position closing the opening **24**. It will be noted that the flapper valve assumes this position through gravity when the sub is mounted in its correctly oriented position for operation.

The structure of the tool for locking a conduit over transverse opening **24** for the introduction of fluid into the passageway **12** and the manner in which it forms a bayonet-type lock in the opening will now be described. The tool is represented at **48** and is of hollow cylindrical form fitting concentrically over conduit **50** which is provided with external rim **52** at its end and is seated against internal flange **26** in sealing arrangement by means of O-ring **54** in groove **56**. The outer diameter of transverse opening **24** is somewhat larger than the diameter of conduit **50** so that the conduit **50** may be inserted against internal flange **26** with space remaining between its outer surface and the opening **24** to permit insertion of tool **48**.

Tool **48** is provided with externally extending locking elements or ears **58** and exterior annular groove **60**. In assembly of a joint the conduit **50** is positioned against internal annular flange **26** and the tool **48** inserted and rotated so that extending locking elements **58** of the tool cooperate with depending locking elements **30** on the periphery of the opening **24** to provide a bayonet-type lock clamping rim **52** on the conduit **50** between annular flange **26** and locking elements **58** of tool **48**. It is readily seen that this joint can be assembled in a minimum of time without the use of hose couplings or adapters to join the conduit **50** to the opening **24**. The disassembly of the joint can likewise be effected in a minimum of time. The tool **48** is provided with handles **62** to permit application of axial force to lock the conduit into place; however, the use of handles is not critical as other means for performing their function may be used.

The plug or cap **64** for sealing the opening **24** when the conduit has been removed is illustrated in FIG. 4. The plug is circular in cross section and is provided with locking elements **66** which lock into annular groove **28** of the periphery of opening **24** with a bayonet-type joint. The plug **64** is provided with a seated O-ring **68** to effect a seal.

The operation of the continuous circulating sub in its application in oil well drilling is as follows. When the drilling has progressed to the point where it is necessary to insert a new pipe section between the upper pipe section of the drill string and the kelly, the drill string is raised and supported in a position to permit insertion of the new pipe section, at which position the continuous circulating sub joining the kelly and the upper pipe section will be above ground. At this point drilling fluid is being introduced at the top of the kelly and will be continuously circulating down through the drill string and out of the well at the casing head. The plug **64** is removed from the opening **24** and the conduit **50** is attached by means of tool **48** forming a bayonet-type joint with the opening **24** as explained above to hold the conduit **50** in place. Fluid under pressure is now introduced into the passageway of the sub through conduit **50** and the introduction of fluid at the top of the kelly is halted. The gate or flapper valve **36** under the pressure of fluid

being introduced through conduit **50** will swing to its upward position closing off the section **14** of passageway **12** so that fluid will be continuously circulated through the well by a new circuit including conduit **50**. The kelly is then removed from the sub hereinbefore described which is attached to the top pipe section. A new pipe section having a constant circulating sub attached to its upper end is attached thereby to the lower end of the kelly and is attached by its lower end to the sub attached to the top pipe section of the drill string. Drilling fluid is again introduced at the top of the kelly and the flow shut off at conduit **50** so that flapper valve **36** is returned to its original position closing off the transverse opening **24** and fluid again travels from the top of the kelly down through the new pipe section and through the passageway of the sub on through the drill string and circulates out of the casing. The conduit **50** is removed from the transverse opening **24** and plug **64** is inserted in the opening and locked in place by axial movement to form a secure and fluid type seal. Drilling then proceeds in a normal fashion.

While the coupling means of this invention has been disclosed in its application to oil well drilling it is not limited to this application as obviously the coupling could be used in other applications wherein the performance of its function is required.

It is thus seen from the above description that the invention provides a continuous circulating sub for use in drilling which is simple in construction thus permitting economically feasible manufacturing techniques and which is simple, fast and effective in operation. The flapper float valve assembly is removable so that a malfunctioning valve assembly can be replaced or repaired with a minimum of time and effort and no major disassembly is required. The structure providing for a bayonet-type clock with tool **48** or plug **64** to secure the conduit **50** or the plug to the opening **24** permits quick assembly and disassembly and provides an effective seal and a secure lock.

It is to be understood that various modifications and changes may be made in the construction and arrangement of parts of the present invention without departing from the spirit and scope thereof as defined by the appended claim.



What is claimed is:

A circulating sub assembly for connecting two pipe sections and altering the course of fluid circulation therethrough, comprising: in combination, a cylindrical body member having an axial passageway therethrough with two sections of different diameters which form an internal shoulder at their junction, said passageway having an annular internal groove in its wall above said shoulder, said body member having a transverse opening leading into the large diameter section of said passageway and the passageway being flattened at the internal terminus of said opening to receive a gate valve; a snap ring in said annular groove; a cylindrical hollow base member seated concentrically in said passageway with its top rim against the bottom of said snap ring; at least one pin extending through the wall of said body member with its internal end in contact with said hollow base member to seat the base member axially with respect to said opening; sealing means between said base member and said passageway; and a flapper gate valve element hinged to the lower rim of said base member adjacent said internal terminus and adapted to swing from a position closing said opening to a position closing said passageway.

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