Oct. 24, 1939. L. F. BAASH 2,177,164

BLOW-OUT PREVENTER

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Fig. 1.

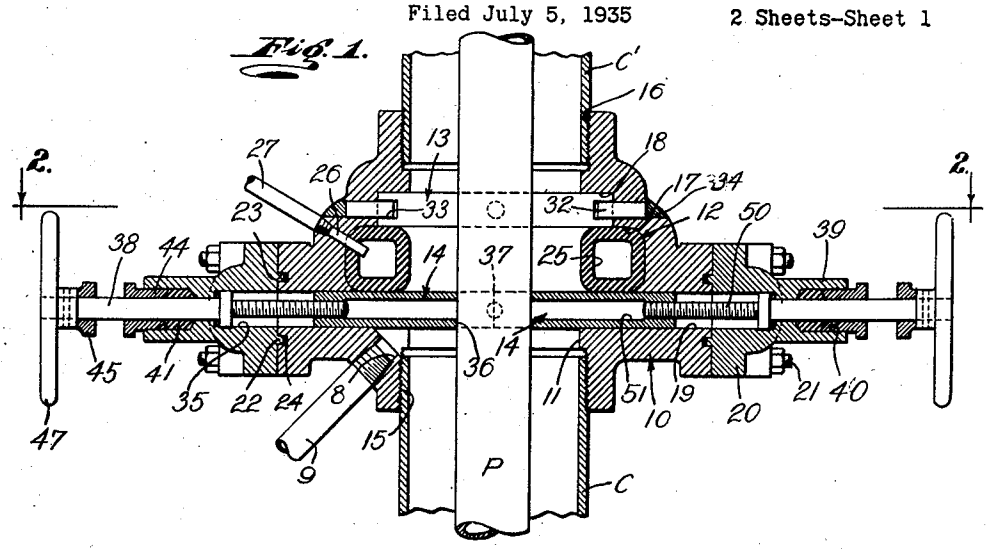
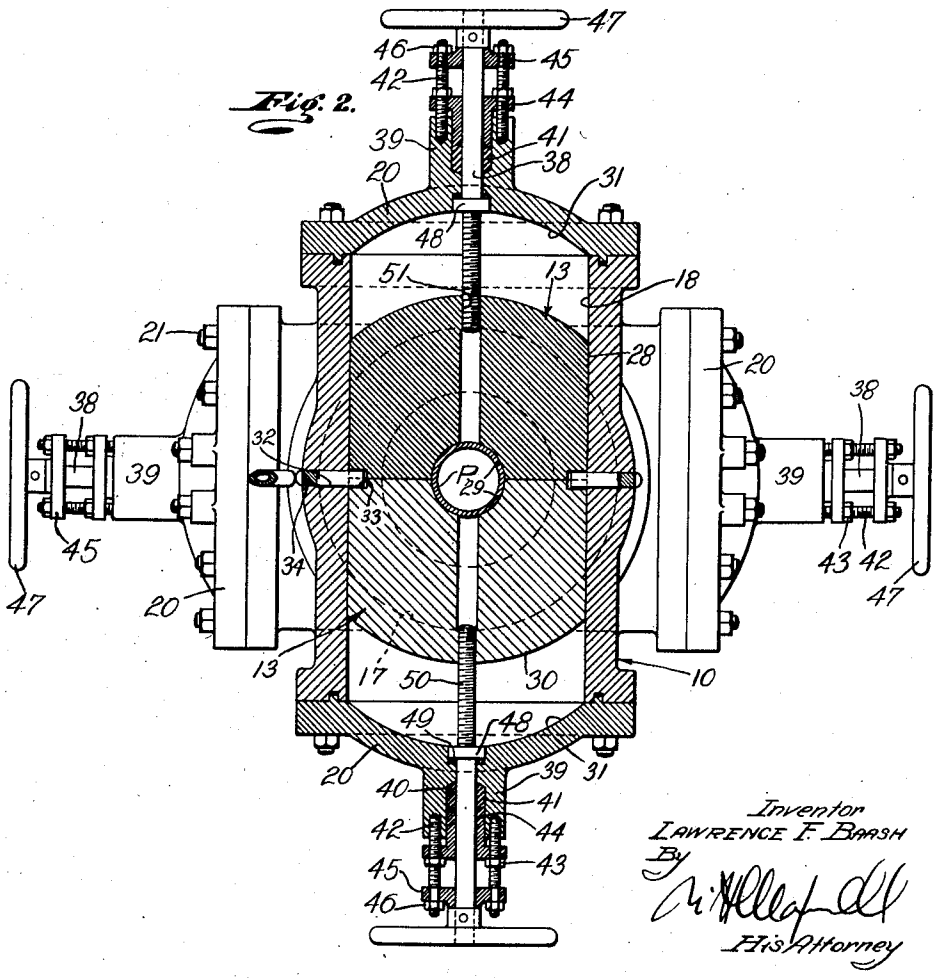


Fig. 2.



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Fig. 3.

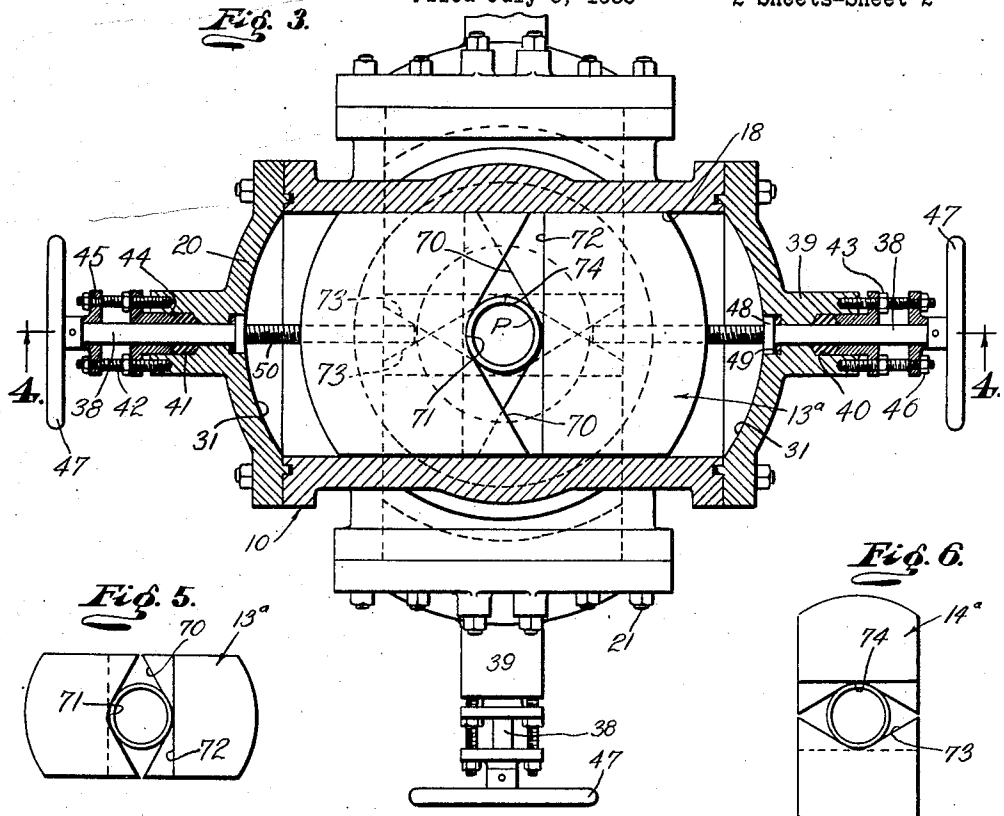
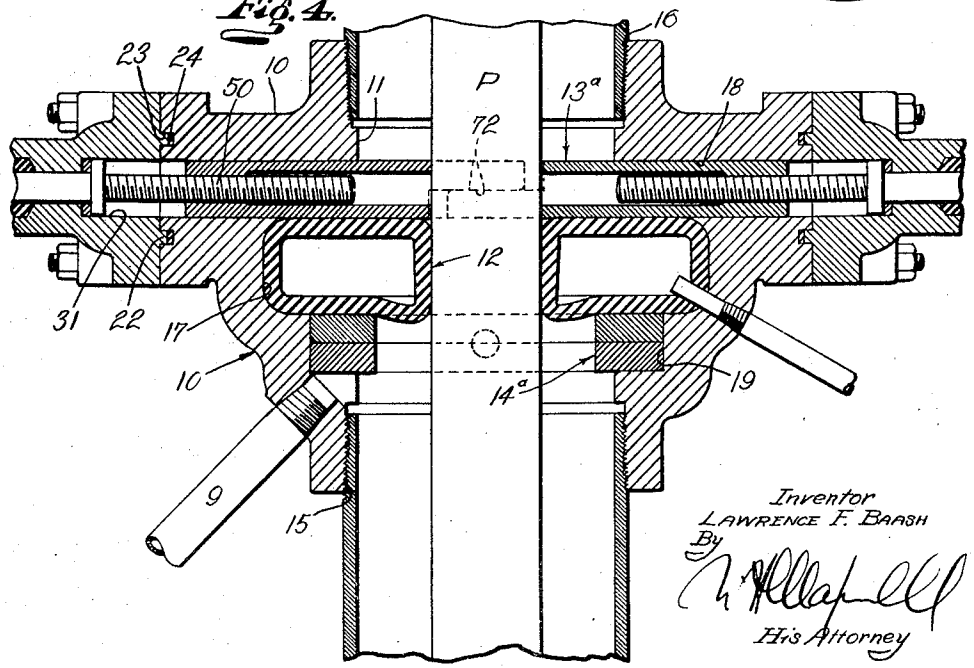


Fig. 5.

Fig. 6.

Fig. 4.



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UNITED STATES PATENT OFFICE

2,177,164

BLOW-OUT PREVENTER

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Application July 5, 1935, Serial No. 30,034

22 Claims. (Cl. 166—15)

This invention relates to a device for use on the upper end of a well and relates more particularly to a blowout preventer to be applied to a well casing and operable to control or close off the well when high pressures develop during drilling, etc. A general object of this invention is to provide a practical effective and very dependable blowout preventer.

Another object of this invention is to provide a blowout preventer involving a member operable or contractible by fluid pressure to seal off about a drill pipe, drill stem or other object extending into the well and thus seal off the well and novel means for dependably supporting the member and confining it against the well pressures when in the sealing position.

Another object of the invention is to provide a blowout preventer of the character mentioned that includes gate sections operable to positions extending across the body opening and engaging about the drill pipe above and below the contractible member so that they effectively support and confine the member against vertical or axial expansion and thus insure the dependable, proper and effective sealing action of the sealing member.

Another object of the invention is to provide a blowout preventer of the character mentioned in which the sealing member may be subjected to high internal actuating fluid pressures to expand it against the body wall and confining gate sections and to contract it onto the drill pipe or other object extending into the well to form a tight seal without danger of bursting or destroying the sealing member.

Another object of the invention is to provide a blowout preventer of the character mentioned in which the gate sections are adapted to center or centralize the drill pipe, drill stem or the like, in the longitudinal opening of the device.

Another object of the invention is to provide a blowout preventer that may be easily and quickly operated to fully and tightly close off the well when high pressures suddenly develop in the well.

Another object of the invention is to provide a blowout preventer of the character mentioned that normally leaves the opening of the well casing entirely unobstructed and does not interfere with the free passage through or operation of tools in the casing.

A further object of the invention is to provide a blowout preventer of the character mentioned that is small and compact to occupy a minimum amount of space at the derrick or the upper end of the well.

The various objects and features of my invention will be fully understood from the following detailed description of typical preferred forms and applications of the invention, throughout which description reference is made to the accompanying drawings, in which:

Fig. 1 is a vertical or longitudinal detailed sectional view of one form of the blowout preventer provided by this invention illustrating the gate members in the actuated positions engaging about a drill pipe extending through the device and showing the sealing member in its normal unactuated state. Fig. 2 is a transverse detailed sectional view taken substantially as indicated by line 2—2 on Fig. 1.

Fig. 3 is a horizontal detailed sectional view of another form of the invention illustrating the gate sections in their closed positions. Fig. 4 is a vertical detailed sectional view taken as indicated by line 4—4 on Fig. 3 showing the gate sections and the contractible member in their actuated positions. Fig. 5 is a diagrammatic view illustrating the upper closure members engaging about a pipe and Fig. 6 is a view similar to Fig. 5 illustrating the lower closure members engaging about the pipe.

The device or blowout preventer provided by this invention and illustrated in Figs. 1 and 2 of the drawings includes, generally a body 10 to be applied to or interposed in a well casing and having an opening 11 forming a continuation of the opening in the casing C, a sealing member 12 in the body 10 adapted to be contracted or actuated to seal about an object P extending through the opening 11, and pairs of gate sections 13 and 14 operable to positions across the body opening 11 above and below the sealing member 12 to support and confine the same.

The body 10 may be varied somewhat in shape and construction without departing from the broader spirit of the invention. In the simple form of the invention illustrated in the drawings the body 10 is an integral or one-piece member having the opening 11 extending through it from one end to the other. The body 10 is adapted to be applied to or connected in the well casing C so that its opening 11 forms a continuation or part of the opening in the casing. The lower portion 15 of the opening 11 may be threaded to receive the threaded upper portion of the casing C and the upper portion 16 of the opening 11 may be similarly threaded to receive the threaded lower portion of an upper section C^1 of casing. The opening 11 is preferably at least as large in diameter as the opening in the well casing. In

accordance with the invention an annular groove or recess 17 is provided in the wall of the body opening 11 to carry or receive the sealing member 12. The upper and lower walls of the recess 17 may be flat and horizontal and the outer wall of the recess may be vertical, it being understood that the recess 17 may have rounded or concaved walls if desired. One or more pipes 9 communicate with ports 8 in the lower portion of the body joining the opening 11 above the upper end of the casing C.

The body 10 is provided with a transverse opening or slot 18 above the recess 17 and a similar transverse opening or slot 19 below the recess 17. The slots 18 and 19 are transversely elongated and are substantially rectangular in cross section having flat parallel upper and lower walls. The upper slot 18 is preferably immediately above the recess 17 having its lower wall in the same transverse plane as the upper wall of the recess. The lower opening or slot 19 is preferably immediately below the recess 17 and may have its upper wall in the same transverse plane as the lower wall of the recess. In the preferred construction the longitudinal or major axis of the slot 18 is substantially at right angles to the major axis of the slot 19. The horizontal or transverse width of the slots 18 and 19 is preferably greater than the diameter of the body opening 11 as clearly illustrated in the drawings. Caps 20 close the outer ends of the slots 18 and 19. The caps 20 are attached to the body 10 by screws or bolts 21. Means is provided for sealing between the caps 20 and the body 10. Ribs 22 on the inner sides of the caps 20 fit grooves 23 in the body 10 to engage packing 24 in the grooves and form effective seals between the caps and body.

The sealing member 12 normally occupies the recess 17 where it does not obstruct the body opening 11 and is contractible by fluid pressure or expansible inwardly by fluid pressure to seal about the pipe P or other object extending through the opening to tightly close or seal off the annular space or opening between the pipe P or object and the wall of the body 10. Where I employ the terms "contract" or "contractible" in describing the sealing member 12 and its action I mean the capability of or the action of the member 12 in expanding inwardly under the influence of internal fluid pressure to seal about the pipe P or other object extending into the well, it being understood that the sealing member 12 may also expand outwardly and axially under the influence of internal fluid pressure to seal with the wall of the recess 17 and the closure or gate sections 13 and 14.

The sealing member 12 is annular and tubular being in the form of a receptacle for receiving fluid under pressure. The member 12 is tubular or annular in cross section, having a continuous or circular internal opening 25. In accordance with the invention the sealing member 12 is formed of elastic and resilient material such as rubber or a rubber composition to be expansible by fluid pressure admitted to its opening 25. If desired or found necessary the sealing member 12 may be reinforced with fabric or the like. The sealing member 12 is shaped and proportioned to normally fit or conform to the recess 17 and to normally have its internal periphery flush with or inset from the wall of the body opening 11 so that it does not obstruct the opening and is not injured by tools operated through the device. Where the recess 17 is flat walled as described above, the sealing member 12 may be substantially rectangular in cross section.

Means is provided for passing or introducing fluid under pressure into the opening 25 of the sealing member 12 to contract the member into the pipe P or other object extending through the opening 11 and to expand it into tight sealing cooperation with the wall of the recess 17 and the closure or gate sections 13 and 14. A tube 26 extends through an opening in the wall of the body 10 and projects through an opening in the wall of the sealing member 12 to have communication with the opening 25. A pipe 27 is provided to carry fluid under pressure to the tube 26 for the purpose of actuating the sealing member 12. The flow or passage of fluid under pressure into and through the pipe 27 and may be controlled by a suitable valve (not shown).

The pairs of gate sections 13 and 14 are operable to positions where they extend across the body opening 11 to form closure like supports above and below the recess 17 and define a chamber or space into which the sealing member 12 may be expanded to contract about and seal with the pipe P and to seal with the wall of the recess 17 and the gate sections and thus tightly close off the opening 11 against the outflow of fluid from the well. The gate sections 13, which are the upper closure parts, are shiftable in the body slot 18 from positions at opposite sides of the opening 11 to positions such as illustrated in Fig. 2 of the drawings where they extend into the opening 11 to engage about the pipe P or other object extending through the casing. In practice the gate sections 13 may be flat plate-like members having flat parallel upper and lower surfaces slidably engaging or bearing on the upper and lower walls of the slot 18. The opposite longitudinal edges 28 of the sections 13 may be flat and straight to slidably cooperate with the side walls of the slot 18. The inner edges or ends of the gate sections 13 may be straight and are provided with notches 29 which receive the object or pipe P when the sections are in their closed or actuated positions. The notches 29 may receive the pipe P with suitable clearance. The outer ends 30 of the sections 13 may be substantially cylindrically curved.

The gate sections 13 normally occupy positions where they are entirely clear of the opening 11. The caps 20 closing the ends of the slot 18 may be provided with openings 31 which form continuations of the slot 18 to receive the outer end portions of the sections 13 when the sections are in their normal retracted positions. Stop pins 32 extend through openings in the wall of the body 10 to project into the slot 18 to limit the inward travel of the sections 13. Notches 33 may be provided in the inner corners of the sections 13 to receive the stop pins 32 whereby the inner edges or ends of the sections may come into contact when the sections are in their closed positions. The stop pins 32 may be welded to the body 10 as at 34.

The closure sections or gate sections 14 are arranged in the lower body slot 19 for movement between positions clear of the body opening 11 and positions where they extend across the openings 11 to engage about the pipe P or other object extending through the opening. The gate sections 14 may be similar to or identical with the sections 13 being flat plate-like members having flat upper and lower surfaces for bearing on the upper and lower walls of the slot 19 and having straight parallel opposite longitudinal sides.

The outer ends of the sections 14 may be curved in the same manner as the ends 30 of the sections 13 and the outer portions of the sections 14 are received in openings 35 in the caps 20 when the sections are in their out or retracted positions. The inner ends of the gate sections 14 are adapted to contact or engage when the sections are in their closed positions and notches 36 are provided in the inner ends of the sections 14 to receive the pipe P or other object extending into the well. Stops 37 similar to the stop pins 32 project into the slot 19 to limit the inward travel of the gate sections 14.

Means are provided for operating or shifting the pairs of gate sections 13 and 14 between their open and closed positions. In the simple, preferred embodiment of the invention illustrated, a separate or individual manually operable screw means is provided for shifting each of the sections 13 and 14. The operating means each include a stem 38 extending through an opening in the outer end of a cap 20. The caps 20 have bosses 39 provided with sockets 40 which carry packing 41 for sealing about the stems 38. Studs 42 project from the outer ends of the bosses 39 and nuts 43 on the studs urge glands 44 inwardly against the packing 41. Stop members 45 are held on reduced outer portions of the studs 42 by nuts 46. Hand wheels 47, or their equivalents, are fixed on the outer end portions of the operating stems 38 to facilitate the operation or turning of the stems. The hubs of the wheels 47 are adapted to cooperate with the stop members 45 to hold the stems 38 against inward movement. Enlargements or collars 48 on the stems 38 are adapted to cooperate with bushings or bearings 49 recessed in the inner sides of the caps 20 to prevent outward movement of the stems 38. The inner portions of the stems 38 are provided with threads 50 which cooperate with threads in radial openings 51 in the gate sections 13 and 14. Upon rotation of the hand wheels 47 the cooperation of the threads 50 with the threads on the walls of the openings 51 causes the gate sections 13 and 14 to be moved or shifted.

It is believed that the operation of the blowout preventer of the present invention will be readily understood from the foregoing detailed description. When the parts are in their normal positions, prior to actuation, the opening 11 is entirely unobstructed allowing the free operation of tools through the casing C. The sealing member 12 is normally received in the recess 17 where it does not project into the opening 11 and is not subject to engagement by tools or objects operated through the casing C. The closure sections or gate sections 13 and 14 are also normally clear of the opening 11. When it is desired or when it becomes necessary to actuate the blowout preventer to seal off the upper end of the well the hand wheels 47 are turned to shift the gate sections 13 and 14 inwardly across the opening 11. The gate sections 13 and 14 may be readily operated to positions where their inner ends come into contact. The notches 29 and 36 in the inner ends of the sections are adapted to receive a drill stem, the pipe P or other object that may be extending through the blowout preventer.

Following the actuation of the gate sections 13 and 14 to their closed positions fluid under pressure is admitted to the opening 25 of the sealing member 12 through the pipe 27 and tube 26. Fluid under pressure admitted to the opening 25 of the sealing member 12 expands the sealing member inwardly or contracts it about the pipe P or other object extending through the opening 11. This expansion of the sealing member 12 by the internal fluid pressure is accompanied by outward expansion and axial expansion of the member. The pairs of gate sections 13 and 14 when in their actuated positions constitute closures extending across the opening 11 at points spaced longitudinally thereof to effectively support the sealing member 12 against vertical pressures and to confine or limit the axial expansion of the member 12. Due to the presence of the closed or actuated gate sections 13 and 14 the sealing member 12 may be subjected to high internal fluid pressures to fully occupy the space defined by the pair of sections 13 and 14, the pipe P and the wall of the recess 17 to effectively and tightly seal off the opening 11 against the discharge of fluid from the well. The member 12 is being confined in the space just referred to is adapted to have sealing engagement with the adjacent surface throughout substantially its entire external surface so that it is not liable to rupture or burst. The fluid under pressure in the opening 25 forces the sealing member 12 into tight sealing engagement with the pipe P or other object extending through the casing C as well as maintaining it in effective sealing engagement with the sections 13 and 14 and the walls of the recess 17.

The gate sections 13 and 14 constitute rigid abutments or supports and dependably support the expanded sealing member 12 against fluid pressures from the well. The fluid pressure from the well may be discharged from the pipes or pipe 9 if desired under the control of a valve or valves. Mud or other liquid may be introduced into the casing C through the pipes or pipe 9 to kill the pressure in the well. The blowout preventer of the present invention may be easily and quickly operated to seal off the upper portion of the well casing when high pressures suddenly develop in the well. The blowout preventer is simple and inexpensive of manufacture and is in the form of a small compact unit.

Figs. 3 to 6, inclusive, of the drawings illustrate a form of the invention in which the pairs of closures or gate sections 13a and 14a operate to automatically center the object or pipe P in the body opening 11 when they are moved to their in or closed positions. With the exception of the gate sections 13a and 14a the various elements and parts of the device shown in Figs. 3 to 6 may be the same as the corresponding elements and parts of the device illustrated in Figs. 1 and 2 and the corresponding reference numerals will be employed.

The upper gate sections 13a of the blowout preventer shown in Figs. 3 to 6, inclusive, are shiftable in the body recess 18 and are provided at their inner ends with substantially V-shaped notches 70. The walls of the notches 70 diverge inwardly so that their engagement with the pipe P may center or assist in centering the pipe in the body opening, in the event that the pipe is off center, when the blowout preventer is actuated. The inner ends or bottoms of the notches 70 are preferably rounded or concave as at 71 to substantially conform to the smaller sizes of pipe, etc. The notches 70 may occupy the entire inner ends of the closures or gate sections 13a, that is their walls may extend outwardly to the longitudinal edges of the gate sections. The notched inner portions of the gate sections 13a are preferably formed and related to overlap

when the sections are in their inner or active positions. The inner portions of the gate sections 13a are reduced in thickness and are shouldered as at 12 to lap one over the other as illustrated in Fig. 4 of the drawings when engaging about the pipe P.

The lower gate sections 14a which operate in the body recesses 19 have V-shaped notches 73 in their inner ends similar to the notches 70. The walls of the notches 73 diverge to the longitudinal edges of the sections and their engagement with the pipe P may center or assist in centering the pipe in the body opening 11. The bottoms or inner ends 74 of the notches 73 may be rounded or substantially cylindrically concaved to conform to the smaller sizes of pipe, etc. The inner portions of the gate sections 14a are preferably reduced in thickness and are shouldered in the same manner as the inner portions of the gate sections 13a so as to overlap when the sections 14a are in their actuated positions.

The operation of the form of the invention illustrated in Figs. 3 to 6 of the drawings is substantially the same as that of the blowout preventer illustrated in Figs. 1 and 2. When pressures develop in the well the gate sections 13a and 14a may be operated to their in or actuated positions by means of the hand wheels 47. The walls of the notches 70 and 73 engage the pipe P to center the same in the body opening 11 as the gate sections move to their inner positions. Fluid under pressure is then admitted to the interior of the sealing member 12 to cause the member to contract onto the pipe P and tightly seal with the pipe and the walls of the recess 17. The gate sections 13a and 14a confine the sealing member 12 and cause it to effectively seal with the pipe and the body walls. The pipe P being centered by the walls of the notches 70 and 73 is more effectively sealed about by the contractible sealing member 12 and is more readily engaged by tools, etc. that may be employed to engage the pipe above the blowout preventer.

Having described only typical preferred forms and applications of my invention I do not wish to be limited or restricted to the specific details herein set forth, but wish to reserve to myself any variations or modifications that may appear to those skilled in the art or fall within the scope of the following claims:

Having described my invention, I claim:

1. A device for use on a well casing including a body adapted to be connected with the casing and having an opening forming a continuation of the opening in the casing, closures operable to positions where they extend across the opening in planes spaced longitudinally thereof, and a sealing member in the body operable to occupy the space defined by said closures and the wall of the opening.

2. A device for use on a well casing including a body adapted to be connected with the casing and having an opening forming a continuation of the opening in the casing, closures operable to positions where they extend across the opening in planes spaced longitudinally thereof, the closures being shaped to extend about an object extending through the opening, and a sealing member in the body operable to occupy the space defined by said closures, the wall of the opening and the object to seal off the opening.

3. A device for use on a well casing including a body adapted to be connected with the casing and having an opening forming a continuation of the opening in the casing, closures operable to positions where they extend across the opening in planes spaced longitudinally thereof, an expansible sealing member in the body between the closures, and means for expanding the sealing member to fill the space defined by said closures and the wall of the opening to seal off the opening.

4. A device for use on a well casing including a body adapted to be connected with the casing and having an opening forming a continuation of the opening in the casing, closures operable to positions where they extend across the opening in planes spaced longitudinally thereof, an annular tubular member in the body between the closures expansible by internal pressure, and means for admitting fluid under pressure to the interior of the member to expand the member to fill the space defined by the said closures and the wall of the body.

5. A device for use on a well casing including a body adapted to be connected with the casing and having an opening forming a continuation of the opening in the casing, closure means carried by the body and operable to extend across the opening and receive an object extending through the opening, an expansible sealing member in the body adapted to seal against the closure means and the body and seal about the object, and fluid pressure means for expanding the sealing member.

6. A device for use on a well casing including a body adapted to be connected with the casing and having an opening forming a continuation of the opening in the casing, closure means carried by the body and operable to extend across the opening and engage about an object extending through the opening, an expansible sealing member in the body below the closure means adapted to seal against the under side of the closure means and the body and seal about the object, and fluid pressure means for expanding the sealing member.

7. A device for use on a well casing including a body adapted to be connected with the casing and having an opening forming a continuation of the opening in the casing, closures operable to positions where they extend across the opening in planes spaced longitudinally thereof, the closures being shaped to receive an object extending through the opening, a hollow expansible member in the body between the closures, means for operating the closures to said positions, and means for passing fluid under pressure into the member to expand it into sealing contact with the body and closures and contract it about said object.

8. A device for use on a well casing including a body adapted to be connected with the casing and having an opening forming a continuation of the opening in the casing, sets of gate sections operable into positions extending across the opening at longitudinally spaced points to receive an object extending through the opening, a hollow expansible sealing member in the body expansible to contract about said object and seal against the opposing surfaces of the sets of gate sections and the adjacent body surfaces, means for operating the gate sections, and means for passing fluid under pressure into the sealing member to expand the same.

9. A device for use on a well casing including a body adapted to be connected with the casing and having an opening forming a continuation of the opening in the casing, sets of gate sections operable into positions extending across the opening at longitudinally spaced points to engage about

an object extending through the opening, a hollow expansible sealing member in the body expansible to contract about said object and seal against the opposing surfaces of the sets of gate sections and the adjacent body surfaces, the gate sections and the sealing member normally being clear of the opening, mean for operating the gate sections, and means for passing fluid under pressure into the sealing member to expand the same.

10. A device for use on a well casing including a body adapted to be connected with the casing and having an opening forming a continuation of the opening in the casing, an expansible sealing member normally lying against the wall of the body and expansible inwardly to seal about an object extending through the opening, and gate sections operable to positions above and below the sealing member to support and confine the member.

11. A device for use on a well casing including a body adapted to be connected with the casing and having an opening forming a continuation of the opening in the casing, a hollow expansible member arranged in the body to normally leave the opening unobstructed, and expansible inwardly to seal about an object extending through the opening, means for admitting fluid pressure into the member to expand it, and gate sections operable to positions where they extend across the opening to support the expanded member.

12. A device for use on a well casing including a body adapted to be connected with the casing and having an opening forming a continuation of the opening in the casing, a hollow expansible member arranged in the body to normally leave the opening unobstructed, and expansible inwardly to seal about an object extending through the opening, means for admitting fluid pressure into the member to expand it, gate sections carried by the body and operable to positions where they extend across the opening to support the said member, and screw means for operating the gate sections.

13. A device for use on a well casing including a body adapted to be connected with the casing and having an opening forming a continuation of the opening in the casing, a recess in the wall of the opening and transverse slots intersecting the opening above and below the recess, an annular tubular member normally in the recess and expansible by internal pressure to seal about an object extending through the opening, gate sections operable in the slots to positions where they extend across the opening to support and confine the said member, and means for passing fluid pressure into the member to expand it.

14. A device for use on a well casing including a body adapted to be connected with the casing and having an opening forming a continuation of the opening in the casing, a recess in the wall of the opening and transverse slots intersecting the opening above and below the recess, an annular tubular member normally in the recess and expansible by internal pressure to seal about an object extending through the opening, gate sections operable in the slots to positions where they extend across the opening to support and confine the said member, screw means for operating the gate sections, and means for passing fluid pressure into the member to expand it.

15. A device for use on a well casing including a body adapted to be connected with the casing and having an opening forming a continuation of the opening in the casing, closures operable to positions where they extend across the opening in planes spaced longitudinally thereof, faces on the inner ends of the closures adapted to engage an object extending through the opening to center the object in the opening, an expansible sealing member in the body expansible to occupy the space defined by said closures to seal about the object and the wall of the opening, and means for expanding the member.

16. A device for use on a well casing including a body adapted to be connected with the casing and having an opening forming a continuation of the opening in the casing, closures operable to positions where they extend across the opening in planes spaced longitudinally thereof, there being notches in the inner ends of the closures adapted to center an object extending through the opening, a member in the body expansible to occupy the space defined by said closures to seal about the obpect and seal with the wall of the opening, and means for expanding the member.

17. In combination, a packer adapted for mounting between a string of pipe and a surrounding casing, means for radially distorting the packer so as to contact both the pipe and the casing, the radially distorted packer being subject to pressure tending to longitudinally distort the packer, an abutment for the end of the longitudinally distorted packer adapted for displacement for projection and retraction relative to the space between the pipe and the casing, and actuating means for displacing the abutment irrespective of force exerted by distortion of the packer.

18. A device for use on a well casing including, a body to be connected with the casing and having an opening forming a continuation of the opening in the casing, a member in the body expansible by fluid pressure to seal between the body and an object extending through the body opening, and means in the body movable into the body opening in a plane at an angle to the longitudinal axis of the opening to support the member against pressure exerted longitudinally of the body opening.

19. A device for use on a well casing including, a body to be connected with the casing and having an opening forming a continuation of the opening in the casing, a packing member in the body expansible by fluid pressure to seal between the body and an object extending through the body opening, and an abutment shiftable bodily in a plane transverse of the body opening to reinforce the packing member against forces exerted longitudinally of the body opening.

20. A device for use on a well casing including, a body adapted to be connected with the casing and having an opening forming a continuation of the opening in the casing, a packing member in the body operable inwardly and expansible by internal fluid pressure to seal with an object extending through the body opening, means for applying such internal pressure to the packing member, and means for supporting the packing member against axial pressures in the body opening, the last mentioned means including a part normally clear of the body opening and bodily movable inwardly in a plane transverse of the body opening to a position where it forms an abutment for an end of the packing member.

21. In combination, a body having an opening therethrough, a member in the body operable inwardly and expansible by internal fluid pressures to seal with an object extending through the opening, and means normally retracted in the body

and slidably guided inwardly to support the member against pressures exerted longitudinally of the opening.

22. In combination, a body adapted to be mounted on well casing and having an opening therethrough communicating with the bore of the casing, means associated with the body and expansible for sealing contact with an object extending through the opening, means for directing fluid pressure against the expansible sealing means for expanding the same, and means projectible into the opening for supporting the expanded sealing means against pressure exerted longitudinally of the opening, the plane of projection of the supporting means being angular to the axis of the opening.

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