Nov. 5, 1935. M. S. BLACK 2,019,885

BLOW-OUT PREVENTER

Filed June 10, 1933

Fig. 1

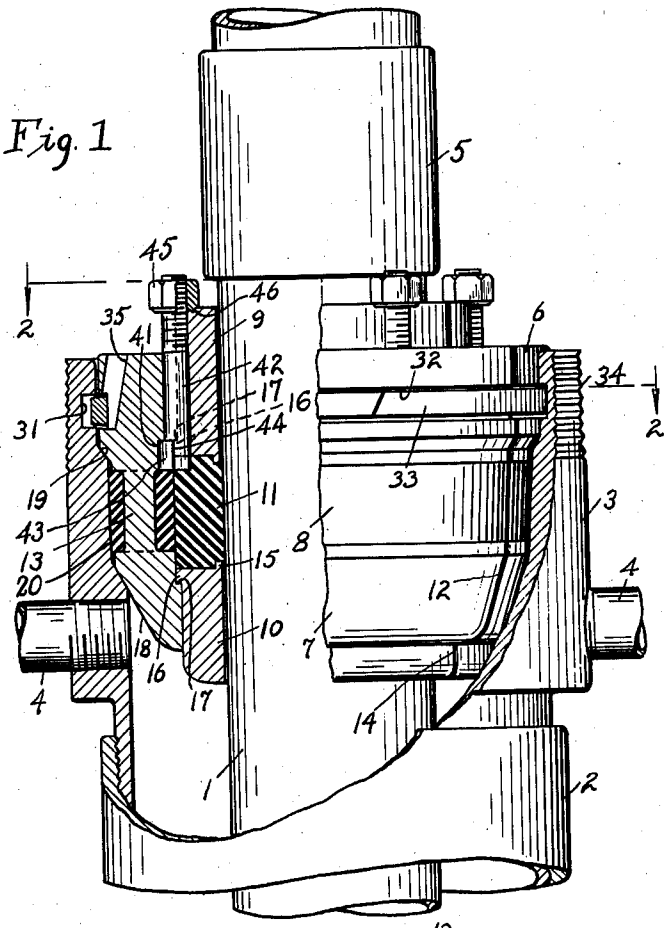


Fig. 4

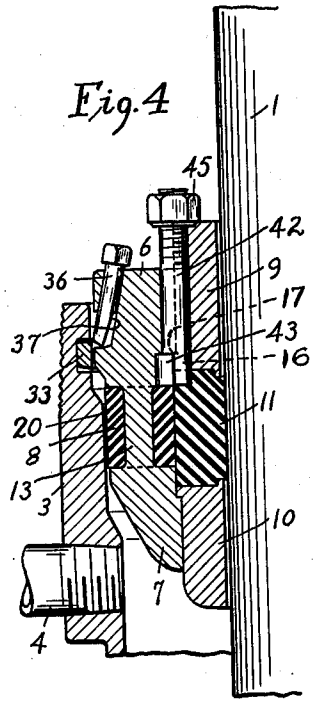


Fig. 2

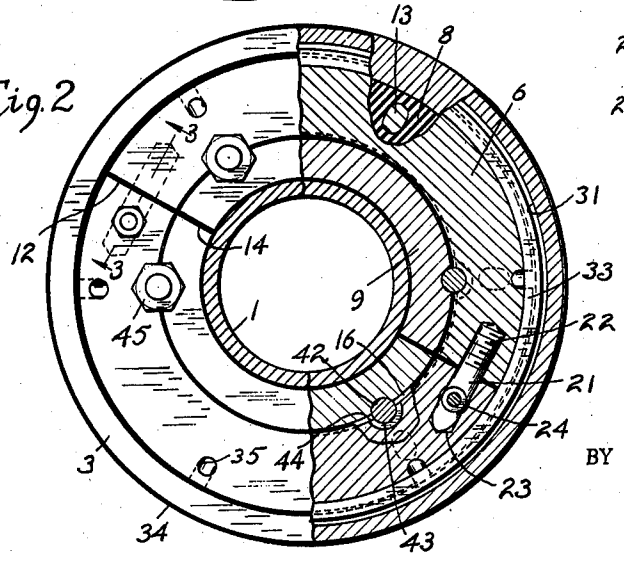
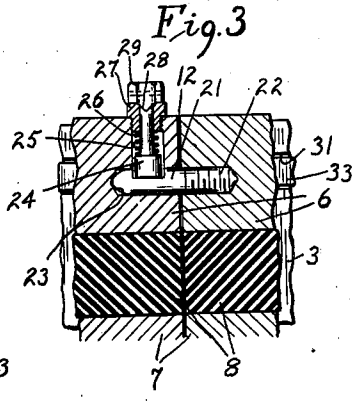


Fig. 3



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BLOW-OUT PREVENTER

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17 Claims. (Cl. 286—16)

This invention is a blow-out preventer having expansible packing disposed between a well casing and a string of well tubing or the like; and it is an object of the invention to provide a construction whereby only a relatively small force need be exerted for operatively expanding the packing so as to exert a relatively heavy pressure against both the casing and tubing for insuring a tight pack-off.

It is a further object of the invention to adapt the blow-out preventer for convenient operative placement or removal, and to provide a simplified but practical means for releasably locking the blow-out preventer in operative position.

More particularly it is an object of the invention to provide a structure including an outer packing shell adapted for mounting in a well casing and an inner bushing adapted for mounting in the shell and surrounding the well tubing, with the outer shell comprising upper and lower retaining rings rigid with relation to one another and having interposed packing of relatively large area for radial engagement with the bore of the well casing, and the inner bushing comprising upper and lower glands longitudinally movable relative to one another and having interposed packing radially engaging the tubing and the packing of the outer shell, with the inner bushing of relatively small cross-sectional area so that a relatively small force exerted on the bushing for longitudinally compressing and thereby radially expanding its packing, is transmitted to the packing element of the outer shell for radially expanding the latter so that its relatively large engaging area exerts a relatively heavy pressure against the well casing.

It is a further object of the invention to form the shell and bushing as split structures adapted for relative displacement or assembly of their complemental parts for convenient removal or operative mounting of the blow-out preventer, with the upper and lower glands of the bushing relatively longitudinally movable but held against displacement from the shell, and the shell retained in the well casing by a readily releasable locking means which is positioned entirely within the bore of the casing so that the outer periphery of the casing is clear of obstructions and thus adapted for reception of a bonnet or an upwardly extending additional string of casing when such an assembly is desired.

The packing of the blow-out preventer is readily adjustable so that it is applicable to well tubing which varies in size, thereby providing a commercially practical device adapted to meet the varying conditions encountered in actual use.

Further object of the invention will be readily understood from the following description of the accompanying drawing, in which:

Fig. 1 is a front elevation of the blow-out preventer in operative position, and shown partly in axial section.

Fig. 2 is a transverse section on the line 2—2 of Fig. 1.

Fig. 3 is a longitudinal section on the line 3—3 of Fig. 2.

Fig. 4 is a fragmentary axial section showing the method of releasing and removing the blow-out preventer.

The blow-out preventer is adapted to pack-off the annular space between a string of tubing or the like shown at 1 and a surrounding well casing 2; and is preferably mounted in a cylindrical head 3 which is fixed to the upper end of the casing and which may be provided with usual lateral ports 4 communicating with the annular space between the tubing and casing. The lengths of tubing 1 are shown connected by usual coupling collars 5.

The blow-out preventer includes an annular outer shell which is adapted to seat in the bore of head 3 and an annular inner bushing which is received in the bore of the shell and surrounds the tubing 1. The outer shell comprises upper and lower retaining rings 6—7, rigid with relation to one another and having interposed annular packing 8 of compressible and expansible resilient material such as rubber, and presenting an outer peripheral surface of appreciable area adapted for radial engagement with the bore of head 3; and the inner bushing comprises upper and lower annular glands 9—10 adapted for relative longitudinal movement but held against displacement from the shell, and having interposed annular packing 11 of compressible and expansible resilient material such as rubber, the outer periphery of which radially engages the packing 8. The bushing is of relatively small cross-sectional area, so that a relatively small force exerted in the direction for longitudinally contracting the glands 9—10 and thereby longitudinally compressing and radially expanding the packing 11, is transmitted to the relatively large engagement area of packing 8 for exerting a relatively heavy radial pressure against the head 3 for insuring a tight pack-off between the blow-out preventer and the head, and at the same time the packing 11 exerts pressure radially against tubing 1 for insuring a tight pack-off between the blow-out preventer and the tubing.

The outer shell preferably comprises a plurality of complemental segments adapting the shell for convenient displacement or assembly surrounding the inner bushing; and for this purpose the shell may be diametrically split throughout its length as shown at 12 so as to form cooperating halves. The ring segments 6—7 of each half may be connected by longitudinal pins 13 which may be integral with the ring segments, and the packing 8

may be molded around the pins 13 so that it fills and is retained in the annular space between the ring segments. The inner bushing which is received in the shell preferably also comprises a plurality of complemental segments adapting it for convenient displacement or assembly on the well tubing; and for this purpose the glands 9—10 and the packing 11 may be diametrically split throughout their lengths as shown at 14, so that the bushing comprises cooperating halves. The proximate ends of glands 9—10 may be formed with annular lips 15 overlying the ends of packing 11 for preventing excessive distortion of the packing. In order to longitudinally retain the inner bushing in the outer shell, the proximate ends of glands 9—10 may be provided with flanges 16 adapted to engage shoulders 17 of rings 6—7 for preventing longitudinal displacement of the glands from the bore of the shell while permitting relative longitudinal contraction of the glands responsive to longitudinal pressure, it being noted that a downward force exerted on upper gland 9 will longitudinally compress the packing 11 against the lower gland 10 which is held against downward movement by its flange 16 engaging its cooperating shoulder 17, while upward pressure on lower gland 10 is adapted to longitudinally compress the packing 11 against the upper gland 9 which is held against upward movement by its flange 16 engaging its cooperating shoulder 17. The packing 11 is thus longitudinally compressed and radially expanded by longitudinal force exerted in either of opposite directions, so that the packing 11 radially engages tubing 1 and pressure is transmitted from packing 11 to packing 8 whereby the latter radially engages the bore of head 3.

When the blow-out preventer is in operative position its outer shell is adapted to seat in head 3, and for this purpose the periphery of rings 6—7 may have a shoulder 18 adapted to engage a complemental shoulder 19 in the bore of the head, with the cooperating shoulders 18—19 preferably beveled to insure a tight seat and accurately center the blow-out preventer in the head. The periphery of packing 8 may have a slight taper as shown at 20 adapted to engage a complemental tapered bore of the head 3, so as to produce a tight wedging engagement when the packing 8 is operatively expanded.

The split outer shell is held against radial displacement of its segments by its reception in the bore of shell 3 and in turn prevents radial displacement of the segments of the split inner bushing; and before the blow-out preventer has been seated in the head 3 and while it is being lowered to operative position it is preferably detachably held against radial displacement of its segments. For this purpose dowel pins 21 may connect the segments of the outer shell, and are preferably threaded into one of the halves of ring 6 as shown at 22, and are releasably held in bores 23 in the other half of ring 6. The releasable engagement may comprise latch pins 24 which are slidable in longitudinal bores 25 formed in ring 6, with springs 26 positioned between the latch pins and suitable bushings 27 which are threaded into bores 25. The springs yieldably project the latch pins for locking engagement with dowel pins 21; and the latch pins are adapted to be rotated so that tapering ribs 28 which are formed on their heads 29 are moved out of engagement with cooperating tapering grooves which are formed in the ends of the bushings 27, thereby causing the heads of the latch pins to ride upwardly relatively to the bushings and thus retracting the latch pins 24 so that they disengage the dowel pins 21.

Means are provided for releasably locking the blow-out preventer against longitudinal displacement when in operative position, and the locking means is so disposed as to clear the outer periphery of head 3 in order that a bonnet or additional length of casing may be mounted on the head when so desired. As an instance of this arrangement the bore of head 3 and the outer periphery of retaining ring 6 have complemental annular grooves 31—32 adapted for transverse alinement when the blow out preventer is seated in the head, and a resilient split ring 33 is received in groove 31 and is of a normal diameter whereby its inner periphery extends into the groove 32 as shown at Fig. 1, thereby locking the blow-out preventer against longitudinal displacement from head 3. When lowering the blow-out preventer into the head 3, the inner periphery of the ring 33 projects into the bore of the head and is thus engaged by the beveled shoulder 18 of retaining ring 7, whereby the resilient locking ring is radially expanded and forced back into groove 31 to permit lowering of the blow-out preventer to its operative position with groove 32 transversely alining with groove 31; so that through its inherent resiliency the locking ring may then contract to its normal diameter seating partly in the groove 32. The blow out preventer is thus securely locked in place, with its locking means completely enclosed for protection against accidental distortion or injury during handling the device; and the outer periphery of head 3 is clear of obstructions and may thus be adapted for detachable mounting of a bonnet or the like (not shown), as for example by threading the exterior of head 3 as shown at 34.

The locking means is adapted for ready release by radially expanding and holding the resilient ring 33 in its inoperative position retracted entirely within the groove 31; and the releasing means is arranged so that it does not form a protuberance or projection at the outer periphery of head 3 where it would be liable to be struck and broken-off or injured. For this purpose a plurality of inclined bores 35 may extend downwardly through ring 6 and open into the groove 32, and keys 36, the lower ends of which are cut away at one side as shown at 37, are adapted for insertion in bores 35 when the blow-out preventer is to be released and withdrawn with the cut away lower ends of the keys clearing the normally contracted locking ring 33. By then rotating the keys 36 as shown at Fig. 4, the sides of their lower ends which are not cut away are moved into engagement with and exert radial pressure against ring 33 for expanding the same and holding it in its inoperative position contracted entirely within groove 31, whereupon the blow-out preventer may be withdrawn from head 3.

The packing engagement which is made by the blow-out preventer may be tightened by the weight of tubing 1, and means are preferably also provided for manually tightening the packing engagement, the tightening action in either case being by relatively longitudinally contracting glands 9—10 so as to longitudinally compress packing 11 and thus radially expand the packing elements 8—11 into tight engagement with both the tubing 1 and the bore of head 3. In order to operatively expand the packing by the weight of the tubing string, the tubing is adapted to be lowered relative to the blow-out preventer until a collar 5 of the tubing string rests upon

upper gland 9, thereby transmitting the weight of the tubing string to the upper gland for forcing the latter downwardly relative to the anchored lower gland 10.

The means for manually tightening the packing engagement comprises adjusting means between the outer shell and the inner bushing. As an instance of such adjusting means longitudinal bores 40 may be formed in the proximate peripheral surfaces of gland 9 and ring 6, with that part of each bore which extends into the inner peripheral surface of ring 6 counterbored at the underside of said ring so as to form an abutment shoulder 41; and bolts 42 are received in the bores 40 with the heads 43 of the bolts received in the counterbores and longitudinally abutting the shoulders 41 at one side of the heads, and having the opposite sides of the heads cut away as shown at 44 so that the gland 9 is free for downward movement relative to the bolts which are held against rotation by their cut away heads abutting the peripheral surface of gland 9 as shown at Fig. 2. Nuts 45 are threaded onto the upper ends of the bolts so as to engage the upper end surface of gland 9, and the under side of each nut preferably has an annular rib 46, V-shaped in cross section, and adapted to seat in a complemental groove in the end surface of gland 9 for maintaining alinement of the parts while the nuts are being tightened. It will thus be seen that by screwing down the nuts 45 the gland 9 is forced downwardly relative to the outer shell, and the gland 9 is thus longitudinally contracted relative to the anchored lower gland 10 so as to radially expand the packing 8—11.

The invention as thus described provides for readily assembling and locking the blow-out preventer in operative position and as readily withdrawing and removing the blow-out preventer, with the locking means completely enclosed when the device is in operative position, and a tight pack-off assured by a relatively small force exerted longitudinally against the inner bushing of the device.

I claim:

1. A blow-out preventer comprising radially outer and inner packing, each consisting of expansible and compressible material, means for longitudinally compressing and thereby radially expanding the inner packing, the outer packing being in transverse alinement with the inner packing whereby radial expansion of the inner packing radially expands the outer packing, the outer packing comprising a plurality of complemental segments, and releasable connecting means for said complemental segments.

2. A blow-out preventer comprising an outer shell including end retaining means and interposed packing, and an inner bushing including end glands and interposed packing, each of the packings consisting of expansible and compressible material, the glands being adapted for relative longitudinal contraction for longitudinally compressing and thereby radially expanding their interposed packing, and the packing of the outer shell being in transverse alinement with the packing of the inner bushing whereby radial expansion of the packing of the bushing radially expands the packing of the shell.

3. A blow-out preventer comprising an outer shell including end retaining means and interposed packing, the end retaining means being longitudinally fixed relative to one another, and an inner bushing including end glands and interposed packing, each of the packings consisting of expansible and compressible material, the glands being adapted for relative longitudinal contraction for longitudinally compressing and thereby radially expanding their interposed packing, and the packing of the outer shell being in transverse alinement with the packing of the inner bushing whereby radial expansion of the packing of the bushing radially expands the packing of the shell.

4. A blow-out preventer comprising an outer shell including end retaining means and interposed packing, and an inner bushing including end glands and interposed packing, each of the packings consisting of expansible and compressible material, the glands being held against longitudinal displacement from the outer shell and being adapted for relative longitudinal contraction for longitudinally compressing and thereby radially expanding their interposed packing, and the packing of the outer shell being in transverse alinement with the packing of the inner bushing whereby radial expansion of the packing of the bushing radially expands the packing of the shell.

5. A blow-out preventer comprising an outer shell including end retaining means and interposed packing, the end retaining means being longitudinally fixed relative to one another, the end retaining means and the interposed packing comprising a plurality of complemental segments, releasable connecting means for the complemental segments of one of the end retaining means, and an inner bushing including end glands and interposed packing, each of the packings consisting of expansible and compressible material, the glands being adapted for relative longitudinal contraction for longitudinally compressing and thereby radially expanding their interposed packing, and the packing of the outer shell being in transverse alinement with the packing of the inner bushing whereby radial expansion of the packing of the bushing radially expands the packing of the shell.

6. A blow out preventer comprising an outer shell including end retaining means and interposed packing, an inner bushing including end glands and interposed packing, longitudinal bolts between one of the end retaining means and the proximate end gland, the heads of the bolts longitudinally abutting the inner end of the retaining means and clearing the proximate gland, and nuts on the outer ends of the bolts engaging the outer end of the gland for longitudinally adjusting the gland relative to the outer shell so as to longitudinally compress and thereby radially expand the packing of the inner bushing, the packing of the outer shell being in transverse alinement with the packing of the inner bushing whereby radial expansion of the packing of the bushing radially expands the packing of the shell.

7. In combination, a head for well casing, a blow out preventer adapted for reception in the head so that the head and blow-out preventer constitute interfitting elements, a releasable locking means carried by the head and adapted for radial movement so as to engage the blow-out preventer for securing the interfitting elements against relative longitudinal displacement, and means insertable through the end of said interfitting elements for engaging and radially retracting the locking means completely within the head so as to clear the blow-out preventer and thus release the locking means.

8. In combination, a head for well casing, a

blow out preventer adapted for reception in the head so that the head and blow-out preventer constitute interfitting elements, a locking means carried by the head and adapted for normal radial contraction so as to engage the blow-out preventer for securing the interfitting elements against relative longitudinal displacement, the locking means being adapted for release by radial expansion and retraction completely within the head so as to clear the blow-out preventer, and means insertable through the end of the interfitting elements for engaging and releasing the locking means.

9. In combination, a head for well casing, a blow out preventer adapted for reception in the head so that the head and blow-out preventer constitute interfitting elements, a locking means carried by the head and adapted for normal radial contraction so as to engage the blow-out preventer for securing the interfitting elements against relative longitudinal displacement, and means insertable through the end of the blow-out preventer for engaging and radially retracting the locking means completely within the head so as to clear the blow-out preventer and thus release the locking means.

10. In combination, a head for well casing, a blow-out preventer adapted for reception in the head so that the head and blow-out preventer constitute interfitting elements, an annular groove in each of the interfitting elements, a split resilient locking ring of normal diameter adapting it to seat partly in each of the grooves for securing the interfitting elements against relative longitudinal displacement, and means insertable through one of the interfitting elements and operable to engage the split ring for radially expanding and completely retracting it within the groove of the head so as to clear the blow-out preventer for relative longitudinal displacement of said elements, the blow-out preventer having means at its forward end adapted to engage the locking ring upon insertion of the blow-out preventer in the head, so as to radially expand and retract the ring within the groove in the head to permit alinement of the grooves of the interfitting elements for locking engagement by the ring.

11. In combination, a head for well casing, a blow-out preventer adapted for reception in the head so that the head and blow-out preventer constitute interfitting elements, and a releasable locking means, a part of which is adapted to seat in each of the interfitting elements for securing said elements against relative longitudinal displacement, the blow-out preventer comprising radially outer and inner packing and means for longitudinally compressing and thereby radially expanding the inner packing, the outer packing being in transverse alinement with the inner packing whereby radial expansion of the inner packing radially expands the outer packing.

12. A blow-out preventer comprising cooperating radially outer and inner packing means, and an operating connection supported entirely by said cooperating packing means and operable to exert longitudinal pressure against one of said cooperating packing means, the cooperating packing means being arranged whereby said longitudinal pressure against one of said packing means is adapted to radially expand the other of said packing means.

13. In combination, a head for well casing, a blow-out preventer adapted for reception in the head so that the head and blow-out preventer constitute interfitting elements, and a releasable locking means, a part of which is adapted to seat in each of the interfitting elements for securing said elements against relative longitudinal displacement, the blow out preventer comprising cooperating radially outer and inner packing means, and means for exerting longitudinal pressure against one of said cooperating packing means, the cooperating packing means being arranged whereby said longitudinal pressure against one of said packing means is adapted to radially expand the other of said packing means.

14. In combination, a head for well casing, a blow-out preventer adapted for reception in the head so that the head and blow out preventer constitute interfitting elements, a releasable locking means for securing said elements against relative longitudinal displacement, the blow-out preventer comprising radially outer and inner packing, each consisting of expansible and compressible material, and means for longitudinally compressing and thereby radially expanding one of said packings, the packings being in transverse alinement whereby radial expansion of said one of the packings radially expands the other packing.

15. In combination, a head for well casing, a blow-out preventer adapted for reception in the head so that the head and blow-out preventer constitute interfitting elements, a releasable locking means for securing said elements against relative longitudinal displacement, radially outer and inner packing means for the blow-out preventer, and means for exerting longitudinal pressure against one of said cooperating packing means, the cooperating packing means being arranged whereby said longitudinal pressure against one of said packing means is adapted to radially expand the other of said packing means.

16. In combination, a head for well casing, a blow-out preventer adapted for reception in the head so that the head and blow-out preventer constitute interfitting elements, an annular groove in each of the interfitting elements, a split resilient locking ring of normal diameter adapting it to seat partly in each of the grooves for securing the interfitting elements against relative longitudinal displacement, and means for engaging and distorting the split ring through its inherent resiliency for retraction completely within the groove of one of the interfitting elements so as to permit relative longitudinal displacement of the interfitting elements, the other of said interfitting elements having means for engaging the split ring during telescoping of the interfitting elements so as to distort the ring to its retracted position to permit alinement of the grooves for locking engagement by the ring.

17. In combination, a head for well casing, a blow-out preventer adapted for reception in the head so that the head and blow-out preventer constitute interfitting elements, an annular groove in each of the interfitting elements, a split resilient locking ring of normal diameter adapting it to seat partly in each of the grooves for securing the interfitting elements against relative longitudinal displacement, and means for engaging and distorting the split ring through its inherent resiliency for retraction completely within the groove of one of the interfitting elements so as to permit relative longitudinal displacement of the interfitting elements.

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