April 25, 1939. A. J. PENICK ET AL 2,155,837

BLOW-OUT PREVENTER

Filed Aug. 2, 1935 2 Sheets-Sheet 1

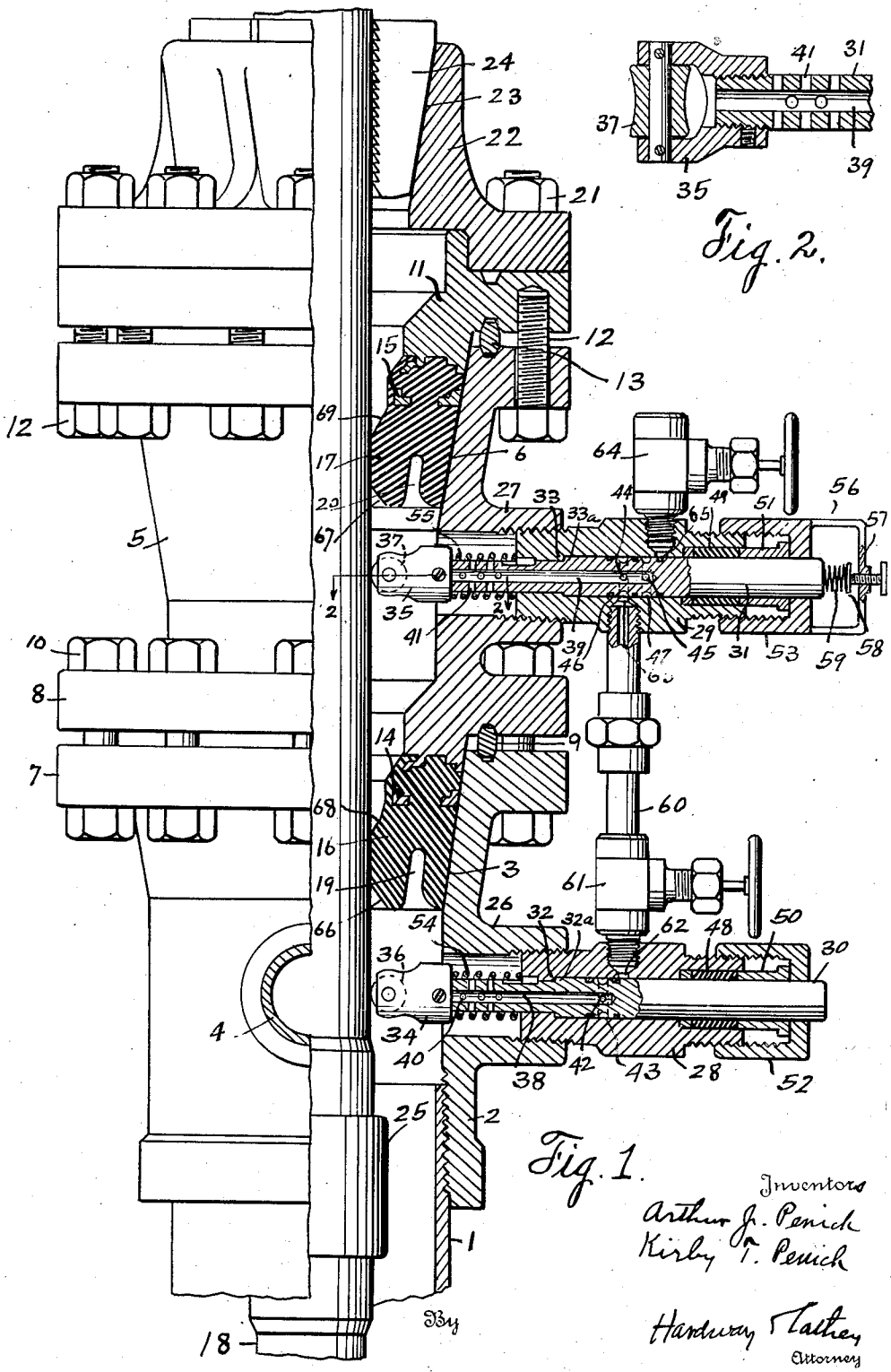


Fig. 1.

Fig. 2.

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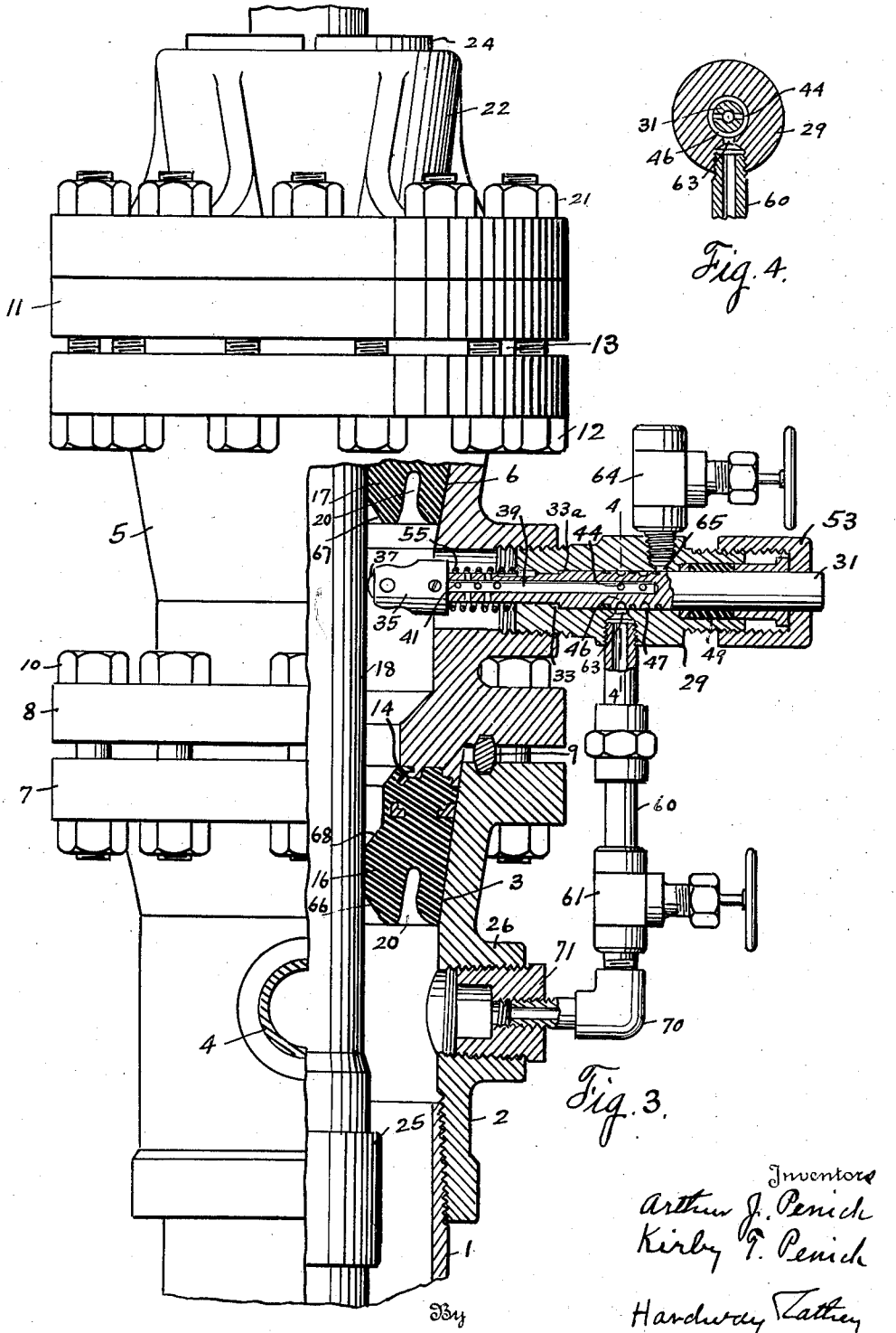


Fig. 3.

Fig. 4.

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BLOW-OUT PREVENTER

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Application August 2, 1935, Serial No. 34,315

6 Claims. (Cl. 166—14)

This invention relates to a blowout preventer.

An object of the invention is to provide apparatus of the character described adapted to be attached to the upper end of a casing, or pipe, in a well, and through which an inner pipe may be lowered, or elevated, and which will at all times maintain a seal around the inner pipe to prevent the escape of well fluid, under pressure, from the well.

A further object of the invention is to provide a blowout preventer of the character described having sealing means around the inner pipe through which the couplings of the inner pipe may readily pass when said inner pipe is lowered, or elevated, without injury to the sealing means.

A still further object of the invention is to provide a blowout preventer of the character described having a packing, or sealing, means around the inner pipe, with means for equalizing the pressure above and beneath the sealing means to the end that said sealing means will not grip or engage the inner pipe so closely that the couplings of the inner pipe will not pass therethrough without injury to said sealing means.

The sealing means employed is of such shape that the inner pipe and the couplings thereof may readily pass down through the said sealing means, or packing, without substantial injury thereto, but it has been found to be desirable to relieve the pressure of the well fluid against said sealing means, or packing, from beneath when the pipe is elevated through the blowout preventer so that the sealing means, or packing, will not engage, or grip, the inner pipe so closely that the same will be injured by the couplings upon withdrawal of the inner pipe from the well. The invention herein disclosed has been provided for that purpose.

With the above and other objects in view, the invention has particular relation to certain novel features of construction, operation, and arrangement of parts, an example of which is given in this specification and illustrated in the accompanying drawings wherein:

Fig. 1 shows a side view of the blowout preventer, partly in section.

Fig. 2 shows a fragmentary, sectional view, taken on the line 2—2 of Fig. 1.

Fig. 3 shows a side view, partly in section, of a slightly modified form of the preventer, and

Fig. 4 shows a fragmentary, cross-sectional view taken on the line 4—4 of Fig. 3.

In the drawings, the numeral 1 designates a casing adapted to be set in a well bore, and attached to the upper end thereof is the lower casing head 2 whose upper end is provided with an inside seat 3 which is preferably upwardly flared.

An outflow line 4 leads out from the casing head 2 beneath the seat 3. Seated on the lower casing head 2 there is an upper head 5, having an inside seat 6 which is preferably upwardly flared. The upper and lower heads have registering flanges 7, 8, having the annular gasket 9 between them, and said flanges may be secured together by suitable bolts 10.

There is a ring mounted on the upper head 5, and bolted thereto by the bolts 12 with an annular gasket 13 between said ring and the upper end of said head. The lower end of the head, and likewise, the lower end of the ring 11 are shaped to fit in the corresponding seats 3, 6, respectively, and are formed with respective open-work cages 14, 15, into which the upper end of the lower and upper packing rings 16, 17, respectively are moulded. These packing rings are formed of suitable resilient material such as tough rubber, and are annular in general contour so as to fit around and form a close seal with the inner pipe or tubing 18. The lower ends of these packing rings have the deep annular grooves 19, 20, forming the outer and inner lips, and the pressure of the well fluid normally presses these lips outwardly against the seat, and inwardly against the inner pipe, respectively, to form close seals therewith so as to prevent the escape of the well fluid under normal conditions. The packings, or sealing means, 16, 17 form the subject matter of applicants' copending application, Serial No. 74,923, filed April 17, 1936.

Bolted upon the ring 11, by the bolts 21, there is a slip bowl 22 having the upwardly flared slip seat 23 therein to receive the wedge-shaped slips 24 of conventional construction which, when seated in the bowl, will engage and hold the inner pipe suspended in the usual way.

The sections of the inner pipe are usually connected by couplings 25 of greater diameter than that of the pipe itself, and the packing rings 16, 17, are of such construction as to yield to permit the couplings to pass through them as the inner pipe is lowered into, or withdrawn upwardly from, the well. However, in case of strong internal well pressure, the inner lips of the inner packing rings 16, 17, may be held so closely against the inner pipe that said rings will be injured by the couplings upon passage of said couplings upwardly therethrough. Means have been provided to relieve this pressure while the coupling is passing through a packing ring so as to reduce the wear of the ring. To accomplish this purpose, a con-

struction has been provided which will now be described.

The lower and upper heads **2**, **5**, are provided with the connections **26**, **27**, into which the respective cylinders **28**, **29**, are threaded. Plungers **30**, **31** are mounted in these cylinders and the inner ends of said cylinders and plungers are reduced, forming the co-acting annular shoulders **32**, **32***a*, **33**, **33***a*, arranged to inter-engage to limit the inward movement of the plungers. The inner ends of these plungers carry the yokes **34**, **35**, in which are mounted the rollers **36**, **37**, each having an external contour to correspond to the outside contour of the pipe **18**, against which said rollers ride. The cylinder **28** is located beneath the lower packing ring **16**, and the cylinder **29** is located between the lower and upper packing rings **16**, **17**. Each plunger **30**, **31**, has an axial channel, as **38**, **39**, whose inner ends communicate with the interior of the lower and upper heads, respectively, through the ports **40**, **41**, the inner end of the channel **38** terminates in lateral ports, as **42**, which lead into an external, annular groove **43**, around the plunger **30**. The inner end of the channel **39** terminates in the inner and outer series of ports **44**, **45**, which lead into the respective annular grooves **46**, **47**, which surround the plunger **31**.

Within the outer ends of the cylinders **28**, **29**, are the stuffing boxes **48**, **49**, which include the glands **50**, **51**, and these glands are retained in place by the caps **52**, **53**, which are screwed onto the outer ends of the cylinders. Surrounding the inner ends of the plungers and interposed between the inner ends of the cylinders and the corresponding yokes **34**, **35**, are the strong coil springs **54**, **55**, which hold the rollers **36**, **37**, yieldingly against the inner pipe **18**. If desired, a cage, such as **56**, may be formed on the outer end of each cylinder cap, and the outer end of this cage may have an adjusting screw **57** threaded therethrough, whose inner end works against the plate **58**, and a coil spring **59** may be interposed between said plate and the outer end of the corresponding plunger. The spring **59** assists the corresponding spring around the inner end of the plunger to hold the corresponding roller yieldingly against the inner pipe, and the tension on the spring **59** may be adjusted as desired.

A pipe **60** connects the cylinders **28**, **29**, and is provided with a gate valve **61**. This pipe **60** is connected into the cylinder **28** by means of the port **62** and is connected into the cylinder **29** through the port **63**. When the rollers **36**, **37**, are pressing against the pipe **18**, the port **62** is out beyond and out of alignment with the groove **43**, and the port **63** is in alignment with the groove **46**.

There is a relief valve **64** which is connected into the cylinder **29** through the port **65**, and this last-mentioned port is located out beyond the groove **47** when the plunger **31** is in its normal position.

As shown in Fig. 1, the pressure of the fluid in the well is exerted against the lower packing ring **16**, and will hold its outer lip closely against the seat **3**, and its inner lip closely against the pipe **18**. Any fluid escaping up past the lower packing ring **16** will act against the upper packing ring **17**, in the manner above explained, to hold the packing ring **17** closely against the said inner pipe. Upon upward movement of the inner pipe **18**, when the coupling **25** engages the roller **36**, the plunger **30** will be moved outwardly and the groove **43** will be brought into registration with the port **62**, and the fluid under pressure will be permitted to pass through the pipe **60** into the groove **46**, and thence through the ports **44**, the channel **39**, and the ports **41**, into the upper head **5**, between the packing rings **16** and **17**. The pressure on opposite sides of the packing ring **16** will thereby be equalized but the pressure against the packing ring **17** will be maintained and said packing ring will be held closely against the inner pipe **18**. The lower ends of said packing rings are downwardly flared as at **66**, **67**, and the coupling **25** will readily enter the packing ring **16**, as said coupling moves upwardly and the pressure on opposite sides of said packing ring will be equalized, and said coupling will readily pass therethrough without injury to said packing ring. When the coupling **25** clears the roller **36**, the plunger **30** will move inwardly, carrying the groove **43** out of registration of the port **62**, and the pressure of the well fluid against the lower end of said packing ring **16** will be resumed. When the coupling **25** reaches the roller **37**, the plunger **31** will be moved outwardly, carrying the groove **47** into registration with the port **65** and the pressure in the upper head **5** between the packing rings **16**, **17**, will be relieved and the coupling **25** may then pass on up through the packing ring **17** without injury thereto.

It will be noted that the inner sides of the packing rings **16**, **17**, converging inwardly and downwardly, as at **68**, and **69**, and it has been found in practice that as the pipe **18** is lowered into the well, the couplings **25** thereof will pass through said packing rings without substantial injury thereto, irrespective of the pressure of the well fluid against said packing rings, and it is only during the upward movement of the inner pipe that injury to the packing rings is likely to occur.

Only two packing rings, **16**, **17**, have been shown, but any number of said packing rings found to be practical may be used, and provision should be made for equalizing the pressures above and below each ring, as herein explained, when the inner pipe is moved upwardly when withdrawing it from the well.

In Fig. 3, a slight modification has been shown wherein the pipe **60** is connected into an elbow **70**, which, in turn, is connected into the head **2**, beneath the packing ring **16** by means of the gland **71** which is screwed into the lower connection **26**. In this form, under normal conditions, the pressure beneath the packing ring **16** and between the packing rings **16**, and **17**, is equalized at all times so that upon upward movement of the pipe **18**, the coupling **25** will readily pass through the packing ring **16** without injury thereto, and when a coupling reaches the roller **37**, the plunger **31** will be forced outwardly to register the groove **47** with the port **65**, and thereupon the pressure of the well fluid against the lower end of the packing ring **17** will be relieved out through the valve **64** so that the coupling will readily pass through said packing ring **17** without injury thereto. The valves **61**, **64**, may be closed, if desired, when lowering the pipe **18** into the well, or at any other time it may be desired to render the pressure-relieving and equalizing mechanism inoperative.

The drawings and description disclose what is now considered to be preferred forms of the invention by way of illustration only, while the broad principle of the invention will be defined by the appended claims.

What we claim is:

1. A blowout preventer comprising a tubular body adapted to be secured to the top of a pipe in a well and shaped to permit the passage of an inner pipe therethrough, annular sealing members on the body shaped to fit closely around the inner pipe and close the space between said body and inner pipe, a cylinder attached to the body, a plunger in the cylinder whose inner end extends into the body between said sealing members, a by-pass pipe connected at one end into the body beneath the lower sealing member and connected at its other end into the cylinder, said cylinder having a relief port and said plunger having a passageway, said passageway and port being arranged to permit relief of the pressure of the well fluid flowing through said by-pass pipe when the plunger is in one position and to conduct said fluid into the body between the sealing members when the plunger is in another position.

2. A blowout preventer comprising a tubular body adapted to be secured to the top of a pipe in a well and shaped to permit the passage of an inner pipe therethrough, annular sealing members on the body shaped to fit closely around the inner pipe and close the space between said body and inner pipe, a cylinder attached to the body, a plunger fitted closely in the cylinder whose inner end extends into the body between said sealing members, a by-pass pipe connected at one end into the body beneath the lower sealing member and connected at its other end into the cylinder, said cylinder having a relief port and said plunger having a passageway, said passageway and port being arranged to permit relief of the pressure of fluid flowing through said by-pass pipe when the plunger is in one position and to conduct said fluid into the body between the sealing members when the plunger is in another position, and valves for controlling said by-pass pipe and said relief port.

3. A blowout preventer comprising a tubular body adapted to be secured to the top of a pipe in a well and shaped to permit the passage of an inner pipe therethrough, annular sealing members on the body spaced apart and shaped to fit closely around the inner pipe and close the space between said body and inner pipe, a cylinder attached to the body between said sealing members, a cylinder attached to the body beneath the lower sealing member, a plunger in each cylinder extended into the body and whose inner ends are arranged to engage the inner pipe whereby the plungers will be moved outwardly, successively, by the coupling of the inner pipe, upon upward movement of said inner pipe, each cylinder having an outlet and each plunger having a passageway, a by-pass pipe connecting the outlet of the lower cylinder into the passageway of the plunger of the upper cylinder, the passageway of the lower plunger being arranged to communicate with the outlet of its cylinder upon outward movement of said lower plunger and to close said outlet upon inward movement of said plunger, the passageway of the upper plunger being arranged to communicate with the by-pass pipe when the upper plunger is in its inner position and to communicate with the outlet of the upper cylinder when said upper plunger is in its outer position.

4. A blowout preventer comprising a tubular body adapted to be secured to the top of a pipe in a well and shaped to permit the passage of an inner pipe therethrough, annular sealing members on the body shaped to fit closely around the inner pipe and close the space between said body and inner pipe, a cylinder attached to the body between said sealing members, a cylinder attached to the body beneath the lower sealing member, a plunger fitting closely through each cylinder and extended into the body and whose inner ends are arranged to engage the inner pipe whereby the plungers will be moved outwardly, successively by the coupling of the inner pipe, upon upward movement of said inner pipe, each cylinder having an outlet and each plunger having a passageway therethrough, a by-pass pipe connecting the outlet of the lower cylinder into the passageway of the plunger of the upper cylinder, the passageway of the lower plunger being arranged to communicate with the outlet of its cylinder upon outward movement of said lower plunger and to close said outlet upon inward movement of said plunger, the passageway of the upper plunger being arranged to communicate with the by-pass pipe when the upper plunger is in its inner position and to communicate with the outlet of the upper cylinder when said upper plunger is in its outer position and yieldable means normally holding the respective plungers in their inner positions.

5. A blowout preventer comprising a tubular body adapted to be secured to the top of a pipe in a well and shaped to permit the passage of an inner pipe therethrough, upper and lower annular seals between the body and the inner pipe, a cylinder on the body, a plunger in the cylinder, a by-pass pipe connected at one end into the body beneath the lower seal and connected at its other end into the cylinder, said cylinder having a relief outlet and the plunger having a passageway, said outlet and passageway being arranged to permit relief of the pressure of the well fluid flowing through said by-pass pipe when the plunger is in one position and to conduct said fluid into the body between said seals when the plunger is in another position.

6. A blowout preventer comprising a tubular body adapted to be secured to the upper end of a pipe in a well and shaped to permit the passage of an inner pipe therethrough, upper and lower annular seals, spaced apart, between said body and the inner pipe therethrough, a cylinder on the body between the seals, a cylinder on the body beneath the lower seal, a plunger in each cylinder movable inwardly into engagement with the inner pipe whereby the plungers may be moved outwardly successively by an enlargement of the inner pipe upon longitudinal movement of the inner pipe, each cylinder having an outlet and there being a passageway in each cylinder, a by-pass pipe connecting the outlet of the lower cylinder into the passageway of the upper cylinder, the passageway of the lower cylinder being arranged to communicate with the corresponding outlet upon outward movement of the lower plunger and to close said outlet upon inward movement of said plunger the passageway of the upper cylinder being arranged to communicate with the by-pass pipe when the upper plunger is in its inner position and to communicate with the outlet of the upper cylinder when the upper plunger is in its outer position.

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