Jan. 10, 1950 F. B. HUNTER 2,493,875

HYDRAULIC CYLINDER CONSTRUCTION

Original Filed Aug. 20, 1945

Fig. 1.

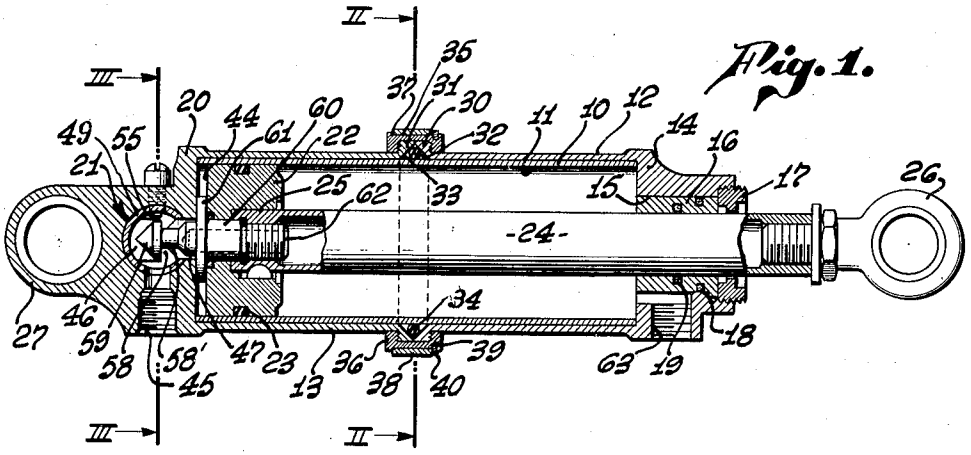


Fig. 2.

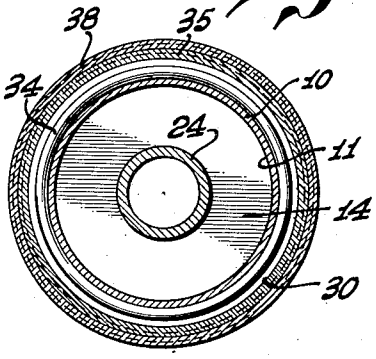


Fig. 3.

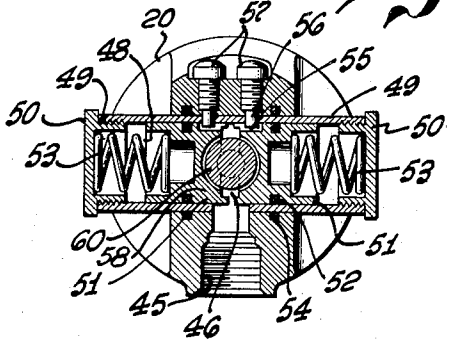
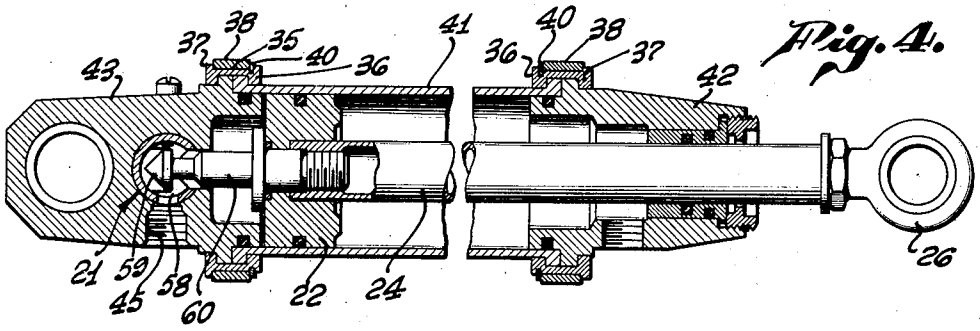


Fig. 4.



FRANK B. HUNTER,
INVENTOR.

BY

ATTORNEY.

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HYDRAULIC CYLINDER CONSTRUCTION

Frank B. Hunter, Van Nuys, Calif., assignor to Casimir A. Miketta

Original application August 20, 1945, Serial No. 611,623, now Patent No. 2,451,089, dated October 12, 1948. Divided and this application September 13, 1948, Serial No. 48,988

2 Claims. (Cl. 121—40)

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My invention relates to hydraulic cylinders and the construction thereof in a manner permitting a hydraulic cylinder assembly of relatively precise design to be constructed of parts which need not be held to a close tolerance during the fabrication.

Hydraulic cylinders and rams have long been used in order to utilize the pressure exerted by hydraulic liquids for moving some mechanical device or other. If the stroke of the hydraulic cylinder need be long the simplest means of effecting the long stroke is to provide a correspondingly long hydraulic cylinder. Obviously, when a great deal of care is necessary in order to hold close tolerances in a long bore, the operation becomes correspondingly expensive. If the price of devices of this kind, particularly when made in large sizes, is to be held within an economical range, the cost of producing cylinders with a long bore need be held to a reasonable minimum.

Generally stated this invention not only relates to a power cylinder combination whereby ease of manufacture is attained but also relates to a construction whereby the power piston operating in a pressure fluid cylinder may be held at one end of its stroke in an automatic manner and then released by the pressure fluid when the pressure fluid reaches a desired operating pressure, thereby allowing the power piston to most effectively perform the functions for which it is intended. The latter phase is the subject matter of this application, which is a division of Serial No. 611,623, filed August 20, 1945, now Patent No. 2,451,089.

It is therefore among the objects of my invention to provide a hydraulic cylinder construction which will permit the assembly of a hydraulic cylinder of precise dimensions from parts where a relatively greater latitude is permitted in holding the critical dimensions.

Another object of my invention is to provide a fluid pressure cylinder including a head provided with pressure fluid-actuated and spring-biased means for holding a piston in position adjacent such head, against accidental displacement, until such time as adequate pressure fluid is available to release and operate the piston during a working stroke.

Still another object of my invention is to provide a hydraulic cylinder of relatively long stroke in proportion to its diameter which is adapted to operate efficiently upon a sudden demand so that hydraulic liquid under relatively high pressure, when released by operation of a suitable

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trip, will be utilized at high efficiency in order to operate the cylinder throughout the full length of its stroke.

With these and other objects in view, my invention consists in the construction, arrangement and combination of the various parts of my device whereby the objects contemplated are attained, as hereinafter more fully set forth, pointed out in my claims, and illustrated in the accompanying drawing, in which:

Fig. 1 is a longitudinal sectional view of the hydraulic cylinder assembly showing the piston in initial position.

Fig. 2 is a cross section taken on the line II—II of Fig. 1 through a connection.

Fig. 3 is a section taken on the line III—III of Fig. 1 showing details of a trip operable with the device.

Fig. 4 is a longitudinal sectional view of a modified form of my device.

In machining out the bores of cylinders of any kind, the operation customarily consists of an initial rough bore followed by one or more finished bores so that the inside wall may be perfectly smooth and in a true cylindrical shape. Practical difficulties invariably arise, making it impossible to make a perfectly cylindrical shape. For various uses different tolerances may be permitted. In hydraulic cylinders wide tolerances may sometimes be permissible if the hydraulic pressure is not high. In other instances where the hydraulic pressure is relatively high or where it is undesirable to have even a slight leak past the piston within the cylinder, much closer tolerances are desirable and even necessary. To hold close tolerances when the bore is relatively long necessitates the use of expensive machinery and expensive machine setups.

It will also be appreciated that almost any machining operations are expensive as compared with casting operations. In view, however, of the relatively cheapness of casting operations, where they can be utilized to good advantage, they permit a sufficient saving of machining operations so that a device utilizing some casting operations has a great advantage over a corresponding device which is made entirely by those machining operations.

In the embodiment chosen to illustrate my invention there is shown a hydraulic cylinder assembly which consists of a full length tubular liner 10, the inside wall 11 of which forms the bore of a hydraulic cylinder. The tubular liner may be of suitable commercial tubing drawn to dimensions within permitted tolerances and cut

to length as desired. Since the wall of the tubular liner may be of relatively thin gauge and incapable of providing sufficient strength to withstand hydraulic pressures customarily used, it is reinforced by the provision of a casing 12 at one end and a corresponding casing 13 at the other. The inside wall of the respective casings may be formed by either rough boring or, on occasions, may be cast, since the dimensions need not be held to a close tolerance so long as the liner is adapted to be readily inserted into the casing. The casing 12 is provided with an end 14 having an axial aperture 15 in which is positioned a packing sleeve 16 retained in place by a packing nut 17. Ring seals 18 and 19 are provided in order to make a fluid-tight fit.

The casing 13 is provided with an end portion or head 20 of special construction in order to accommodate a hydraulic release indicated generally by the reference character 21.

Within the liner is positioned a piston 22 which has a sliding fit within the inner wall 11 of the liner and which is provided with a ring packing 23 which has a sliding friction fit against the wall of the liner. A piston rod 24, here shown tubular in section, is anchored at one end 25 to the piston and extends outwardly past the packing gland 16 and packing nut 17 within which it has a sliding fit. At the outer end of the piston rod is provided a ring 26 or other suitable connection which may be connected to a work member of the machine or other apparatus with which the cylinder is to be used. Head 20 at the opposite end of the hydraulic cylinder assembly is provided with an apertured boss 27 by means of which it may be secured to some stationary portion of the machine.

The casings 12 and 13 are designed to be connected together by some means other than threading. As here shown, the casings are provided respectively with flanges 30 and 31 which are shown abutting against each other and which have their respective inner corners 32 and 33 beveled so as to provide a recess therebetween within which may be inserted a packing ring 34.

For holding the flanges in abutted relation there is provided a pair of split rings 35 having lateral flanges 36 overlying the sides of the flanges on the ends of the casings. When a ring such as 35 is used, it is usually split along a plane passing along the axis (diametrically) so as to form two halves, thereby giving rise to a pair of semi-circular split ring portions.

On the outer surfaces of the split rings is provided a rim portion 37. For holding the split rings in position there is provided a continuous ring 38 which surrounds the split rings in assembled position and which bears at one edge against the rim 37. So that the continuous ring will remain in place, the split rings are provided with a recessed portion 39 into which may be positioned a snap ring 40.

When the split ring assembly is applied to the flanges of the casing in order to hold them together, the packing ring 34 is compressed between the inside beveled faces of the flanges and the adjacent outside wall of the liner so as to be fluid-tight and prevent any hydraulic pressure within the interior of the liner from escaping at this connection. A construction of this kind makes it unnecessary to have a snug fit between the outside wall of the liner and the interior of the casing.

A similar construction is shown in the modified form in Fig. 4 wherein the ring assembly is

adapted to the connection of a hydraulic cylinder 41 to the respective end sections 42 and 43.

In order to operate the hydraulic cylinder of Fig. 1, hydraulic fluid is admitted through a port 45 at one end of the hydraulic cylinder assembly from which it passes into a chamber 46. From the chamber the fluid is adapted to flow through a passage 47 into the interior of the hydraulic cylinder where its force can be exerted upon a face 44 of the piston 22.

Inlet port 45 is shown entering chamber 46 at right angles thereto. Chamber 46 may be the central portion of a longer chamber 48 extending transversely of the axis of the attached cylinder, while passage 47 is axial with respect to the cylinder.

The piston, however, is normally locked in the initial position shown in Fig. 1 so that although pressure exerted by the hydraulic fluid may be present upon the piston, there will be no movement of the piston until the pressure exceeds a certain predetermined figure.

Held in the head 20 and extending from either end thereof is a sleeve 49, said sleeve being provided with a port in alignment with port 45 and another port in alignment with the transverse passageway 47. This sleeve is provided with a cap 50 at each end to thereby form chamber 48. A pair of opposing release pistons 51 is slidably positioned within the sleeve 49, these pistons being spring pressed in the direction of the central chamber by means of coiled springs 53. Suitable packing rings 52 are carried by each of the release pistons and external packing rings 54 completely seal the sleeve in position.

In order to prevent the release pistons 51 from rotating and in order to keep the ports of the sleeve 49 in alignment with the passageways 45 and 47, each of the pistons is provided with a longitudinal slot 55 adapted to slidably receive dog ends 56 of set screws 57. These dog screws also prevent the release pistons from coming into complete contact.

The end of each release piston is specially shaped in that it is provided with a semicircular flange 58 which is designed to engage with a portion of an annular recess 58' located beneath a conical head 59 of a pin 60, said head being slightly smaller than pin 60. It will be noted that the pin has a flange 61 resting against the face 44 of the piston. The pin extends through the piston and into a threaded engagement 62 with the piston rod 24. The pin is thus securely anchored in place upon the piston. Ample space is provided around the outside end of the pin so that hydraulic fluid may pass freely along its sides through passage 47 and into the hydraulic cylinder wherein it presses against the face 44 of the piston. At the other end 14 of the cylinder there is provided a second port 63.

In operation, the piston, in initial position, is located at the end of the cylinder member as shown in Fig. 1 wherein the pin is locked by reason of the fact that the springs 53 press the release pistons inwardly so that the ends engage beneath the head 59 of the pin. Fluid under pressure is then admitted into the port 45 from which it is enabled to pass through the bore 47 into the cylinder where it sets up a pressure against the piston. As the pressure builds up the piston will not move but will remain fixed in position so long as the release pistons engage the pin. After fluid pressure has built up to an amount sufficient to overcome the pressure of the springs 53, the release pistons will be pushed out-

wardly out of engagement with the head of the pin. When this is accomplished, the pin will be released and the piston **22** will be moved from the position shown in Fig. 1 to a position adjacent the other end of the cylinder member. Meanwhile, should there by any fluid within the cylinder on the opposite side of the piston, it may be exhausted outwardly through the port **63**.

By the means described, it is not possible for piston **22** to creep or partly move; the piston will only move when adequate pressure fluid is available to complete the working stroke. This is an important feature since it insures that an adequate amount of power is available before initiating the power stroke.

To return the piston to its initial position it is necessary only to reverse the flow of the pressure fluid so that it enters the port **63**, driving the piston from the right hand end of the cylinder as viewed in Fig. 1 to the lefthand end. As the piston is pushed against the lefthand end, the head **59** of the pin penetrates into the space left remaining between opposite ends of the release pistons forcing them far enough apart so that the head of the pin may be completely inserted in order for the annular recess adjacent the head to be re-engaged by the appropriate portions of the release pistons. It will be noted from this that the cylinder may be set to operate at a high, siddenly released, instantaneous pressure, even though the piston stroke is long.

It will be noted from the description given that the cylinder (or cylinder portions) are free from threads cut thereto. In the modification shown in Fig. 1 the end pieces are an integral part of the cylinder. In the modification shown in Fig. 4, the end pieces are simply but effectively connected to the cylinder. Here two split rings **35** are used. By eliminating threaded ends, the problems ordinarily encountered in cutting threads precisely so that an engaging cap will be in proper alignment with the axis of the cylinder are eliminated. The boring of the cylinder and the cutting off of the ends of such cylinder may be accomplished upon the same machine tool and result in end faces which are perpendicular to the axis of the cylinder. Any slight misalignment of the cylinder sections **12** and **13** is nullified by the continuous inner liner.

It will also be evident that cylinders constructed in accordance with this invention may be dismantled while one end of the cylinder is still attached to the structure which carries the cylinder. It is only necessary to remove the snap ring **40** and slip the retaining ring **38** off the split ring sections **35** in order to remove one of the cylinder portions **12** or **13**.

In actual practice it has been found that the construction shown is of lighter weight than that available heretofore. Although specific reference has been made to hydraulic cylinders, it will be obvious that the construction here shown may be used not only with hydraulic liquids but also with pneumatic fluids.

I claim:

1. In a hydraulic cylinder assembly comprising a cylinder member providing a smooth-surfaced bore, a piston slidable therein, a valve device for controlling the flow of hydraulic fluid to the cylinder member comprising an axial bore at one end of the cylinder, a transverse bore intersecting the axial bore forming a chamber at the intersection, a locking pin on the piston adapted to extend into the intersection having an annular recess adjacent the end thereof, a spring pressed release piston having a sealed sliding fit in the transverse bore on each side thereof and having an inner end of each shaped to engage a part of the annular recess on the pin in initial position, and an inlet for hydraulic fluid in communication with the inside faces of said last pistons whereby said last pistons are moved to a second position released from engagement with the pin when the pressure exceeds a predetermined amount.

2. In a hydraulic cylinder assembly comprising a cylinder member providing a smooth-surfaced bore, a piston slidable therein and a work rod attached to the piston extending from the cylinder member, a valve device for controlling the flow of hydraulic fluid to the cylinder member comprising an axial bore at the end of the cylinder member remote from the work rod, a transverse bore intersecting the axial bore forming a chamber at the intersection, a locking pin on the piston adapted to extend into the intersection having an annular recess adjacent the end thereof, capped sleeves adapted to close each side of the transverse bore, a spring pressed release piston having a sealed sliding fit in each sleeve and having an inner end shaped to engage a part of the annular recess on the pin in initial position, guides for maintaining movement of the release pistons in a fixed direction and an inlet for hydraulic fluid in communication with the inside faces of said last pistons whereby said last pistons are moved to a second position released from engagement with the pin when the pressure exceeds a predetermined amount.

FRANK B. HUNTER.

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