Aug. 29, 1950 J. J. MUELLER 2,520,426

HYDRAULIC JACK

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Fig. 1.

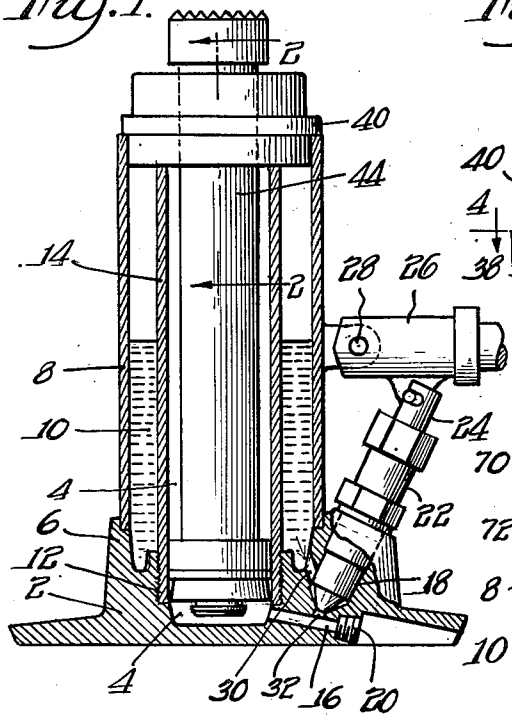


Fig. 2.

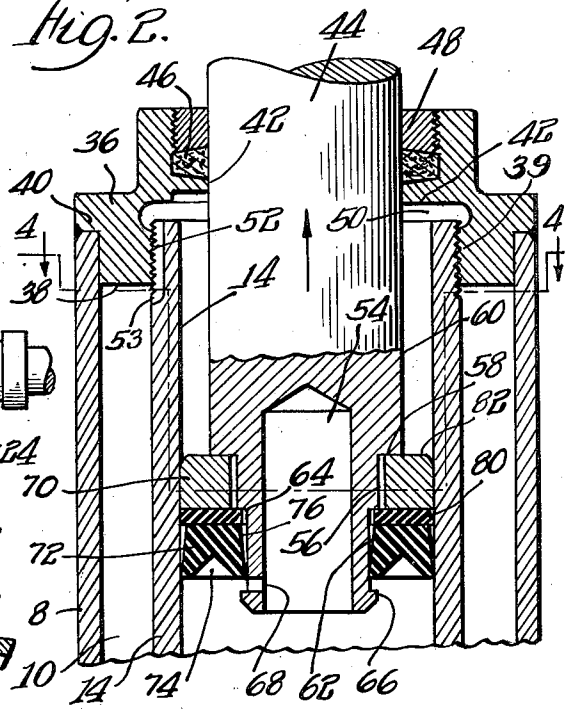


Fig. 4.

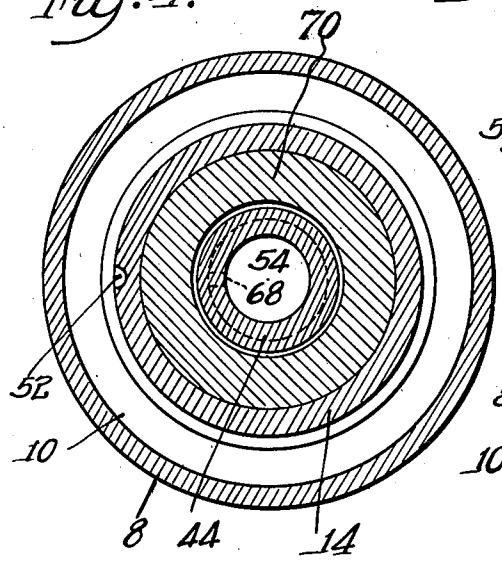
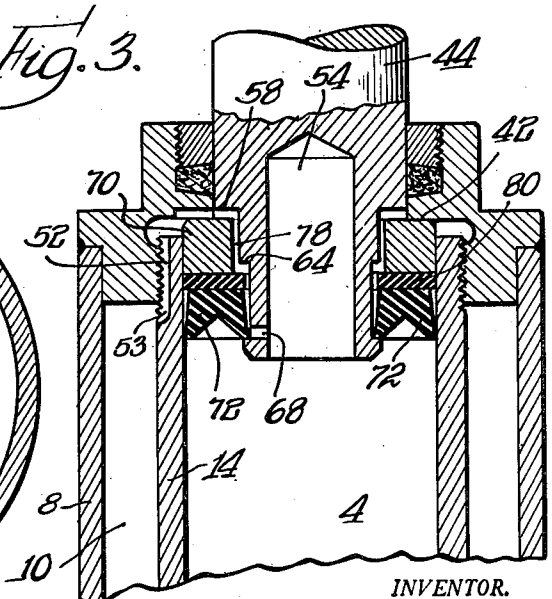


Fig. 3.



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HYDRAULIC JACK

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9 Claims. (Cl. 60—52)

1

This invention relates to hydraulic jacks or pushing and pulling devices generally, wherein an hydraulic cylinder is utilized to contain a ram and wherein the liquid under pressure is pumped into the cylinder to force the ram outwardly to exert a pushing or lifting action.

Among the objects of the present invention is to provide a construction of the foregoing nature wherein a very simple means is provided in association with the ram, which is the piston operating within the hydraulic cylinder, wherein upon the outermost portion of the lifting or pushing stroke of the ram-like piston, a by-pass will be mechanically operated to permit the liquid under pressure within the ram cylinder to pass around the piston into the reservoir whereby to remove the pressure within the ram cylinder so that the ram piston cannot travel beyond a predetermined lifting or pushing distance, and wherein if the pumping is continued after such a distance has been travelled by the ram piston the liquid will be by-passed so as to prevent breakage.

Another object of the invention resides in providing a construction wherein a ram piston head is constructed and arranged to cooperate with the internal walls of the ram cylinder so that as the ram is being pushed along its lifting or pushing path of travel by the pressure of the liquid in the hydraulic cylinder, a leak-proof connection is formed between the piston parts, the piston, and the internal walls of the ram cylinder, and however when the ram piston reaches a predetermined position at the end of its travel it automatically encounters a stationary member which, contacting a part of the piston, shifts the piston with relation to the piston stem or ram, whereby to form a by-pass for the liquid in the ram cylinder to pass the liquid back to the reservoir and thus relieve any further pressure.

Yet another object of the present invention resides in providing the lower portion of the ram-like piston with more or less loosely formed and relatively shiftable parts which are capable of shifting with respect to the stem or ram of the piston and are arranged so that under pressure of the hydraulic liquid in the cylinder for raising or pushing the ram, a tight connection is effected which maintains the pressure in the ram cylinder and yet when the ram reaches its outermost stroke the relatively shiftable parts of the piston will contact an abutment, thereby shifting the parts and causing a by-pass passageway to be formed between said parts and the ram or piston stem to permit the liquid in the ram cylinder to by-pass therethrough into the reservoir.

2

Yet another object of the invention resides in providing a ram having a lower portion formed with stepped cylindrical portions upon which loosely fit a three-part piston for the ram head comprising a metallic ring, a packing disk, and an outermost ring of relatively hard non-metallic material which clamps the packing ring between the two relatively harder rings and wherein these three elements make a loose fit with respect to the stepped portions of the ram itself and in association with the ram form a by-pass so that when the ram piston reaches the uppermost portion of its travel it will contact an abutment whereby to shift these relatively loosely fitting annular members with respect to the ram itself to form a by-pass passage to permit the liquid under pressure in the ram cylinder to pass the piston and escape to the reservoir whereby to relieve the pressure.

Another object of the invention is to provide a pressure relief device for an hydraulic jack wherein the relief device is formed by slidably mounting the ram piston on the ram in a manner to provide a rather loose fit between the inner walls of the piston and the external walls of that portion of the ram on which the piston is mounted, the loose fit forming a liquid relief passage which is normally closed on the working stroke of the ram by intercontacting surfaces between the inner walls of the piston and the external walls of the ram embraced by the piston, and in providing means at the outer portion of the working stroke of the piston for shifting the piston relatively to the ram so as to cause said relief passage to open and permit the liquid to pass from the working side of the ram to the relief side of the ram, and which relief side of the ram is always in communication with the reservoir.

Yet another object of the invention resides in providing a pressure relief mechanism for an hydraulic jack which eliminates cup washer scoring in devices which relieves the ram cylinder of excessive pressure at the outermost working stroke of the ram in the ram cylinder, and this is accomplished by providing a ram piston which is shiftable bodily relatively to the ram and automatically provides a liquid relief passage between the connection of the piston and the ram.

These and other objects of the invention will be apparent from a perusal of the following specification when taken in connection with the accompanying drawing, wherein:

Figure 1 is a sectional view of one type of jack to which the invention is applied;

Figure 2 is an enlarged view of a portion of

Figure 1, taken on the line 2—2 of Figure 1, showing the ram moving upwardly with the piston ram parts arranged to hold the pressure within the ram cylinder;

Figure 3 is a section following Figure 2 but showing the ram piston at the upper end of its travel with the piston parts shifted to provide a liquid passage therethrough to the reservoir; and

Figure 4 is a section taken on the line 4—4 of Figure 2.

Referring now to the drawing in detail, it will be understood that the exemplification of the invention herein is disclosed and illustrated as applying to any type of hydraulic pushing and pulling device involving a ram cylinder and a ram operated hydraulically, and wherein the ram moves within the cylinder over a predetermined length of travel and wherein means is provided at the end of the travel for effecting relief of the pressure in the ram cylinder, through the ram piston, back into the reservoir so as to preclude any breakage of parts after a predetermined length of travel has been effected.

I have shown the invention as applied to a simple type of jack comprising a metallic base 2 formed to provide a ram well 4 and an upstanding wall 6 to which fits an outer sleeve 8 forming a reservoir 10 therewithin. The base 2 is threaded about the well 4 as at 12 to receive the lower threaded walls of a ram cylinder 14. Also, the base is provided with the downwardly extending passage 16 and the diagonally disposed counterbore 18. The passage 16 is closed by the plug 20 and the usual type of high pressure pump cylinder 22 is disposed in the bore 18. Within the pump cylinder 22 there operates a piston 24 operated by means of an actuator 26 pivoted to the side wall 8 as at 28.

Any type of release valve, not herein shown, may be utilized for relieving the pressure from the ram cylinder 4 into the reservoir 10. In addition to the passageway 16 I likewise provide another passageway 30 which connects a port in the side wall of the pump cylinder 18 with the reservoir 10. It is to be understood that in accordance with the usual custom an additional reservoir, not shown, and a controlling, manually actuated valve for the same, is provided in the base for connecting the ram cylinder 4 with the reservoir 10 in a manner independently of the passageways 30 and 16. It is also to be understood that the bottom of the pump cylinder 18 connects as by means of an additional passageway 32 with the passage 16 connecting with the ram cylinder 4.

The outer ends of the cylinders 8 and 14 are closed by means of a head 36 having downwardly extending portion 38 suitably threaded as at 39 to engage the outer threads of the ram cylinder 14, and this ring-like head 36 is provided with a shouldered portion 40 which engages the outer ends of the cylinder 8 and clamps tightly thereagainst when the threads 39 are drawn up tightly. In addition, the head 36 is provided with an inwardly extending flange 42 through which a ram piston or stem 44 passes. A packing 46 held in position by an externally threaded ring 48 holds the packing in place about the ram stem 44. It is noted that the diameter of the ram stem 44 is considerably less than the internal diameter of the ram cylinder 14. At the upper end of the ram cylinder a chamber 50 is provided, and this chamber communicates by means of an elongated passage 52 which terminates as at 53 in open communication with the reservoir 10 so that there is a constantly open passage at the upper end of

the ram cylinder via the chamber 50, the passage 52, and the port 53.

The stem 44 is formed on its lowermost end with an internal bore 54 which is of considerable diameter and is likewise formed with a first annular wall 56 of smaller diameter than the outer diameter of the stem 44, thereby forming a shoulder 58. In addition, below the wall 56 which runs parallel with the outer cylindrical wall 60 of the ram 44, the lower portion of the ram is provided with a parallel wall such as 62 which is of even smaller diameter than the wall portion 56, thereby creating a second shoulder 64 which is disposed below the shoulder 58. The lower end of the ram 44 is rolled over to provide a retaining shoulder 66 which serves to retain or hold the piston proper thereon. In addition, the lower end of the ram, just above the shoulder 66, is provided with a port 68, as seen best in Figures 2 and 3. The piston is preferably formed of three parts, a metallic ring 70, and a hard rubber ring or ring of other relatively hard material 72, which has an annular cutout on its under side of substantially V-shaped form, as shown at 74. The inner wall of this ring flares inwardly as at 76 so that at its top portion of the ring 72 is of lesser cross section than at its bottom, and this taper is so arranged in magnitude that when in the position shown in Figure 3 there is a passageway 78 formed between the inner wall of this washer 72 and the outer reduced wall 62 of the lower portion of the ram stem. The lower portion of the relatively hard annulus 72, as shown in Figure 3, is adapted to contact and abut the rolled over flange 66 of the ram stem 44.

Disposed between the two relatively hard annuli 70 and 72 is a relatively soft packing 80 which may be of any semi-resilient or yieldable material which will not deteriorate and will hold its form. It may be of leather or any usual or desirable material. The inner wall of this ring is of substantially the same diameter as the upper portion of the inner wall 76 of the lower annulus 72 so that it forms a continuation of the passage 78 hereinbefore described.

The combined dimension from top to bottom of the upper annulus 70, the washer 80, and the lower annulus 72, is less than the distance between the shoulder 58 and the top edge of the rolled abutment or flange 66, so that the three annuli 70, 80 and 76 may have a shifting movement between the shoulder 58 and the shoulder 66. It is to be noted that the upper wall 82 of the annulus 70 projects beyond the outer wall 60 of the ram 44 but lies within the projection of the flanges 42 on the head 36 so that when the ram 44 has moved upwardly to the position shown in Figure 3, the upper surface 82 of the annulus 70 will strike the lower surface of the portion 42 of the head 36 so that on still further outward movement of the ram the annulus 70, the packing 80 and the lower annulus 72 will be shifted downwardly to the position shown in Figure 3 thereby permitting liquid to flow from the ram cylinder 4 from a continuation of the well through the port 68, thence via the passage 78, this passage being formed between the inner wall of the annulus 72, the inner wall of the packing 80 and the inner wall of the upper annulus 70, so that the liquid will thence flow from the continuation passage 78 to the upper chamber 58, thence via the passage 52 into the reservoir 10 to relieve the pressure in the ram cylinder 4. It is to be noted that when the ram is in position as shown in Figure 2 and is

moving upwardly under the pressure within the ram cylinder, the pressure in the ram cylinder will force the annuli **70**, **80** and **72** upwardly against the shoulder **58** and likewise against the shoulder **64**, thereby blocking off the liquid passage **78** to prevent the escape of the liquid to the chamber above the piston so that the piston in this position will remain a liquid seal not only with the ram stem **44** but also with the internal walls of the ram cylinder **14** and it is only when the upward travel has been reached that the upper annulus **70** strikes the shoulder **42** and the annuli are shifted downward to form a fluid connection with the chamber **50** and channel **52** to cause liquid to pass therethrough to the reservoir **10**, thereby relieving further pressure in the ram cylinder and preventing breakage in the parts.

It will be noted from the foregoing that by reason of this loose connection or loose fit between the annuli on the lower end of the ram stem, the formation of the port therein and the lower stepped shoulders on the bottom of this ram stem, in combination with the abutment at the upper end of the ram cylinder to contact the annuli and force them downwardly, plus the disposition of the upper channel **50**, the passage **52**, and the port **53** back to the reservoir, I have provided a very simple, inexpensive means for relieving the pressure in the ram cylinder at the outermost portion of the lifting or pushing stroke, and which construction at the same time provides a liquid seal of the piston against the ram stem and the inner walls of the ram cylinder. By means of this construction I eliminate the heretofore present scoring of the walls of relief valves by the passage of liquid therethrough under the heavy pressure of the liquid in the ram cylinder as it by-passes the ram and is passed into the reservoir. Under the present construction I have eliminated the necessity of expensive shiftable valves, ball valves, springs, and other constructions which generally include a scoring of the valve parts under the terrific strain of the liquid in the ram cylinder escaping, and provide a simple type of mechanism for relieving pumping pressure when the ram has reached its outermost position. By means of the construction I have provided a loose fit between the ram piston and the ram stem by means of the shouldered construction of the ram stem on its lower end and have utilized the loose fit to provide shiftable parts of the piston providing a liquid passageway to pass the escaping liquid from the ram cylinder therethrough at the proper time and in a manner to prevent the scoring of the walls which would otherwise tend to increase the size of the passage and ultimately prevent correct passage, while at the same time there has been assured a complete sealing of the liquid under proper working conditions.

It is apparent that many widely different embodiments of this invention may be made without departing from the spirit and scope thereof, and therefore it is not intended to be limited except as indicated in the appended claims.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. In combination, a base, a ram cylinder formed on the base and a reservoir associated with the base and the ram cylinder, a ram operable in the cylinder and having a portion of smaller diameter than the cylinder, pump means for drawing liquid from the reservoir and for forcing liquid into the ram cylinder, the lower

portion of the ram being of reduced diameter and a piston shiftably mounted on said portion of the ram reduced diameter, said piston being of an external diameter snugly fitting the interior wall of the ram cylinder, means including the internal walls of said piston in association with the external reduced surface of the ram providing a pressure release passage connecting portions of the ram cylinder on opposite sides of the piston, and means disposed in the path of travel of the piston as it approaches its extreme limit of outward travel for shifting the piston on the ram to open said release passage to allow the liquid in one end of the cylinder to flow therethrough to the opposite end of the cylinder, and a normally open passageway connecting the opposite side of the ram cylinder with the reservoir.

2. An hydraulic jack comprising a base having a ram cylinder and a reservoir, a ram in the ram cylinder, said ram being of less diameter than the ram cylinder, said ram having its lower end formed of decreased diameter, a piston mounted on said ram portion of decreased diameter and capable of shifting movement therealong in the direction of the longitudinal axis of the ram, the external wall of said piston forming a liquid-tight fit with the inner wall of the ram cylinder, and means associated with the internal walls of the ram piston and the outer wall of the ram stem along which the ram piston is movable forming a liquid by-pass passage through the ram piston, means at the upper end of the ram cylinder forming an unobstructed liquid passage therefrom to the reservoir, said piston when subjected to the pressure of the ram cylinder in the raising of the load forming a liquid seal with the walls of the ram stem which are of reduced diameter, and said piston having means thereon causing the same to be shifted longitudinally of the ram stem when said piston reaches the outermost portion of its working stroke whereby the piston is shifted longitudinally of the ram stem to form a passageway between the inner walls of the piston and the reduced portion of the ram stem which it surrounds to permit the liquid to pass therethrough and into the reservoir.

3. An hydraulic jack comprising a base, a ram cylinder thereon and a reservoir thereon, means for creating hydraulic pressure in the ram cylinder, a ram in the ram cylinder, said ram including a piston operable by the pressure in the ram cylinder to raise the ram, said ram being of lesser diameter than the internal walls of the ram cylinder, the lower portion of the ram being of reduced diameter and providing shoulders thereon, a piston mounted on said portion of reduced diameter of the ram, the internal walls of the piston being of lesser diameter than the external walls of the reduced diameter of the ram whereby to provide a liquid by-pass between the internal walls of the piston and the external walls of reduced diameter of the ram, said piston being shiftable along the ram portion of reduced diameter in a direction longitudinally of the longitudinal axis of the ram, and said piston and portion of reduced diameter of the ram and said shoulders formed in said portion of reduced diameter being operable under the pressure in the ram cylinder to shift said piston against said shoulders to close said by-pass passageway to prevent passage of liquid therethrough, and means disposed at the outer end of the ram cylinder adapted to contact said piston to shift

it longitudinally of the ram portion of reduced diameter to open said by-pass passageway to permit the passage of liquid therethrough to relieve the pressure in the ram cylinder.

4. An hydraulic jack comprising a base, a ram cylinder thereon and a reservoir, a ram in the ram cylinder of less diameter than the internal walls of the ram cylinder, the lower end of the ram having a wall of reduced diameter to provide an upper shoulder disposed normally to the longitudinal axis of the ram and having a second portion of greater reduced diameter than the first mentioned portion to provide an intervening shoulder extending normally to the longitudinal axis of the ram, the outer end of the lower portion of the ram being provided with a retaining shoulder and an annular piston disposed about that portion of the ram of reduced diameter between the upper shoulder and the retaining shoulder, the length of the piston between said shoulders being less than the distance apart of said shoulders, the internal walls of said piston being of greater diameter than the external walls of the portion of reduced diameter of the ram whereby to provide a liquid by-pass passage through the piston, means at the upper end of the ram cylinder forming a liquid passage therefrom to the reservoir, and means disposed in the path of travel of the ram piston as it reaches its outermost limit of travel along the ram cylinder adapted to contact said piston to shift the same relatively to the ram on which it is mounted for opening said by-pass passage to permit liquid under pressure in the ram cylinder to pass to the end of the ram cylinder and through said liquid passage and into the reservoir.

5. A device as set forth in claim 4 wherein the piston is composed of three parts, an upper metallic annulus, a lower annulus of hard material, and an intermediate packing annulus or washer, the upper surface of the metallic annulus being adapted to contact the first shoulder and the upper surface of the packing annulus being adapted to contact the second shoulder, and the lower inner wall of the third annulus being adapted to contact the retaining shoulder in the alternate movements of the piston relatively to the ram, and the outer walls of at least one of said annuli making a liquid-tight seal with the inner walls of the ram cylinder.

6. In combination, a base, a ram cylinder and a reservoir, a ram in the ram cylinder, said ram having a reduced diameter compared with the diameter of the internal walls of the ram cylinder, a piston on the lower end of the ram, the outer walls of the piston making a liquid-tight seal with the internal walls of the ram cylinder, the internal walls of the piston and the external walls of the lower part of the ram being formed to provide a loose fit therebetween to provide a liquid by-pass passage therebetween, said piston being shiftable along the lower end of the ram in a direction parallel to the longitudinal axis of the ram, and said lower portion of the ram providing shouldered means in one position to engage the piston to form a liquid-tight seal therewith to close the liquid passage between the inner walls of the piston and the reduced portion of the ram, means forming a liquid connection between the upper end of the cylinder and the reservoir, means disposed in the path of travel of the piston at the outer portion of the path of travel of the ram in the ram cylinder for contacting the piston to shift it longitudinally whereby to open the passage formed between the internal walls of the piston and the external walls of the lower portion of the ram to permit liquid under pressure in the ram cylinder to pass therethrough and escape to said passages and into the reservoir.

7. In an hydraulic device, the combination of a ram cylinder and a ram shiftable therealong under liquid pressure in the ram cylinder, the ram having a piston shiftably mounted thereon and forming a loose fit therewith to provide in one position a liquid by-passage between the ram and the piston and in another position and under the pressure of the liquid in the ram cylinder to press the piston against a portion of the ram to block said passage, and means disposed at the outermost path of travel of the ram in the ram cylinder for shifting the piston relatively to the ram to open said passage to permit the passage of liquid through the piston.

8. An hydraulic jack comprising a base and a ram cylinder, a ram in the cylinder of less diameter than the internal diameter of the cylinder, a piston slidably mounted on said ram and having external walls snugly fitting the cylinder, the internal walls of the piston being of larger diameter than that portion of the external walls of the ram which are surrounded by the piston to form a liquid relief passage, and said external walls of the ram having portions engageable by said piston to close said passage, said piston when subjected to working pressure in the ram cylinder being shiftable to a position along said ram so as to close said relief passage, and means operated by said movement of the piston as it arrives substantially at the end of the working stroke of the ram for shifting the piston along the ram for opening the relief passage between the internal walls of the piston and the walls of the ram embraced thereby.

9. In combination with a ram cylinder, a ram in the cylinder, liquid sealing means disposed on the ram and slidably and continuously engaging the inner wall of the ram cylinder and forming a liquid-tight seal with the inner wall of the cylinder, said sealing means being shiftably mounted on said ram and under pressure created by the pressure in one end of the ram cylinder being operable for sealing against said ram, said sealing means cooperating with said ram to form a liquid passage operable when said passage is not sealed to pass liquid under pressure through said passage only when the ram approaches one end of the cylinder, and means operable in the path of said sealing means as said ram approaches its extreme movement in one direction with respect to the cylinder and operable on said sealing means for shifting said sealing means relatively to the ram to open said liquid passage for relieving the pressure in said working pressure end of said cylinder.

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