May 23, 1944. P. L. ARNOLD 2,349,646

APPARATUS FOR RADIALLY CONTRACTING TUBULAR METAL BODIES

Filed June 21, 1941

Fig. 1.

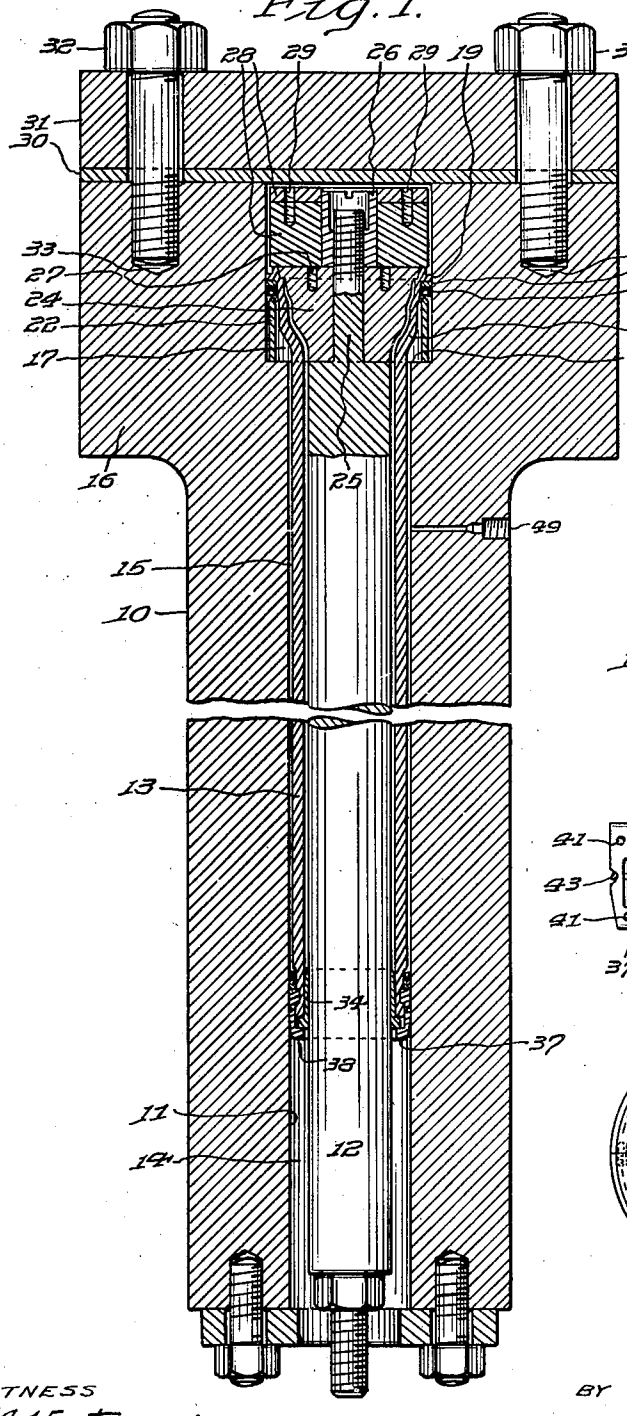


Fig. 2.

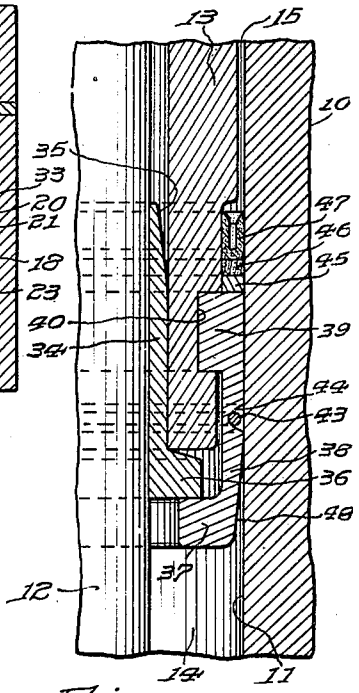


Fig. 3.

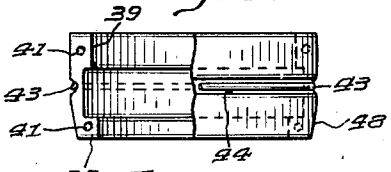
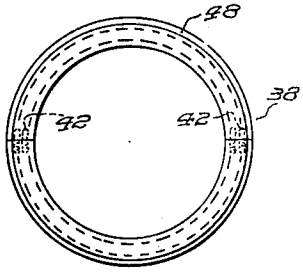


Fig. 4.



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APPARATUS FOR RADIALLY CONTRACTING TUBULAR METAL BODIES

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Application June 21, 1941, Serial No. 399,158

8 Claims. (Cl. 78—1)

The invention relates to apparatus for radially contracting tubular metal bodies and is disclosed herein in connection with apparatus for reclaiming cylindrical steel molds used for casting pipe centrifugally.

With certain procedure heretofore followed in reclaiming molds which have become damaged in use, it has been the practice to place such a mold upon a cylindrical mandrel having a diameter slightly less than the internal diameter of the mold, the difference in diameter depending upon the extent to which the mold is to be contracted or shrunk. The mandrel and mold are placed in the bore of a container for high pressure fluid, the outer surface of the mold being spaced from the wall of the bore to such extent as to enable a fluid under pressure to be admitted to the space thus provided. The ends of this space are suitably sealed to confine the fluid therein, and when fluid is introduced into the space and subjected to sufficient pressure, the mold may be contracted until its inner surface is forced into contact with the mandrel, and it simultaneously elongates by movement of one or both ends longitudinally of the mandrel.

In reclaiming molds in this manner, it has been the practice heretofore to shrink the mold transversely on the mandrel and elongate it longitudinally thereon without providing any support between the mold and the mandrel at the end or ends of the mold which are left free for longitudinal movement due to elongation of the mold. Inasmuch as some form of sealing means must be employed around the free or movable end of the mold, the contraction of the mold in a transverse direction has a tendency to weaken the sealing means or to permit it to break or be blown out during the shrinking operation. As a result, it has not been feasible heretofore to employ sufficient pressure to effect the desired contraction of the mold at one operation, and it has been necessary to replace the sealing means in case the seal is broken or blown out during the operation. The procedure just described is illustrated in Langenberg Patents 1,753,747, April 8, 1930; 1,834,128, December 1, 1931; and 1,856,874, May 3, 1932.

In attempting to overcome certain disadvantages in the procedure disclosed in the patents just referred to, the apparatus disclosed in Langenberg Patent 1,792,229, February 10, 1931, was devised. In the operation of the apparatus shown by Patent 1,792,229, it has been found that there is such resistance to the longitudinal movement of the free end of the mold as to interfere materially with the attainment of the desired radial contraction in many cases. This resistance not only reduces the amount of contraction which can be obtained with a given fluid pressure, but makes necessary the employment of more than one shrinking operation for reclaiming a used mold, and also results in reclaimed molds which are out of round and otherwise deformed. The procedure also requires pressures ranging up to 40,000 pounds per square inch in reclaiming steel molds used in centrifugal casting.

One of the main objects of the present invention is the provision of apparatus which will enable a tubular metal body to be contracted to the desired extent at one shrinking operation. Another object of the invention is the provision of apparatus by which the free or movable end of the tubular body may be rigidly supported on the mandrel and in spaced relation thereto throughout the contracting and elongating operation. A further object is the provision of apparatus whereby the desired contraction of the tubular metal body may be obtained with substantially lower pressure than that heretofore employed. It is also an object of the invention to provide greater contraction than heretofore obtainable, thus permitting the removal of more of the damaged surface on the inside of a used mold at the beginning of the reclaiming operation. It is a still further object of the invention to obtain greater elongation in the tubular body subjected to the radial shrinking operation. An additional object is a procedure for providing more perfect molds than can be obtained with the reclaiming procedure heretofore followed. The invention also has for an object a procedure which will, in some cases, dispense with the necessity for annealing the used molds before the shrinking operation. Still further objects and advanatges of the invention will be apparent from the following description, taken with the accompanying drawing wherein:

Figure 1 is a vertical sectional view of mold reclaiming apparatus for practicing the invention, a part thereof being broken away;

Fig. 2 is a detailed sectional view of the improved sealing and backing means devised for use at the spigot end of the mold;

Fig. 3 is a side elevational view, partly broken away, of the packing sleeve devised for use with the sealing means at the spigot end of the mold; and

Fig. 4 is an end elevational view of the packing sleeve shown in Fig. 3.

In general the apparatus which I have devised for practicing the present invention is an adaptation of that disclosed in Langenberg Patent 1,792,229 referred to above. The apparatus comprises a container 10 which is preferably cylindrical in form and is provided with a bore 11 for receiving a steel mandrel 12. The tubular metal body 13 which is to be contracted is positioned within the space 14 between the mandrel and the wall of the bore. The mandrel utilized with a particular tubular body should be of a diameter

to permit the tubular body to be contracted to the extent desired, and it will be understood that a space 15 is provided between the outer surface of the tubular body 13 and the wall of the bore 11 to admit the water or other fluid by means of which pressure upon the tubular body 13 is exerted.

The container 10 may be a forging and should be provided with a thick wall in order to withstand the high pressures utilized in practicing the invention. When it is employed for shrinking molds used for casting bell and spigot pipe, as illustrated in the drawing, the apparatus is preferably positioned vertically, and the upper end of the container may be provided with a head 16 within which the bore 11 may be enlarged as shown at 17. The bell 18 of such a mold is usually provided with a circumferential flange 19 around its open end, and the bore enlargement 17 is of a diameter to receive this flange.

A fluid seal is provided between the bell end of the mold and the wall of the enlargement 17. This seal comprises a metal ring 20 surrounding the bell 18 and fitting against the inner face of the flange 19 and the wall of the enlargement, and a ring 21 of leather or other suitable sealing material, U-shaped in cross section, surrounding the bell 18, with the bottom of the U in contact with the metal ring 20. A filler ring 22 having its inner edge resting upon the shoulder 23 serves to retain this seal in position when the apparatus is being assembled.

For convenience in using the apparatus and to adapt the mandrel 12 to different forms of tubular bodies, the end 24 may be made separable from the body of the mandrel. A reduced extension 25, which may be integral with the mandrel or threaded in the upper end thereof, passes through a central opening in the separable part 24 and is threaded on its outer end to receive a nut 26 to hold the separable part on the body of the mandrel. The separable part 24 may be provided with threaded openings 27 to receive eye-bolts or the like for use in handling this portion of the mandrel.

One or more filler blocks 28 are placed in the enlargement 17 in contact with the open end of the bell 18, the exposed face of the outermost block being spaced slightly from the upper end of the head 16. These blocks may likewise have threaded holes 29 therein to receive eye-bolts for use in handling the blocks. The outer end of the enlargement 17 is closed by means of a steel plate 30 in contact with the end of the head 16, and by a thick cover plate 31 supported thereon and secured to the head by bolts 32 extending through the cover plate 31 and the steel plate 30 into threaded holes 33 in the head 16. The arrangement of these parts is preferably such that the bolt holes 33 do not extend inwardly in the head beyond the seal surrounding the bell of the mold in order that the part of the wall of the container which is subjected to fluid pressure may not be substantially weakened by the holes.

The structure and operation of the parts of the apparatus described above are well understood in the art. In accordance with the present improvement the spigot end of the mold 13 is spaced from the mandrel 12 by means of a rigid backing ring 34, preferably made of hard steel. This ring fits closely between the mold and the mandrel. It is fixed against movement with respect to the mold and is free for movement with respect to the mandrel. On its outer surface, the inner edge of the backing sleeve 34 is beveled inwardly toward the mandrel, as shown at 35, for the purpose of avoiding the formation of an abrupt shoulder on the mold 13 during the contracting operation. It will be understood, however, that other conformations of the inner end of the backing sleeve may be employed. The outer end of the backing sleeve 34 is provided with an outwardly extending flange 36 which engages over the end edge of the mold 13 to limit inward movement of the backing sleeve in the mold.

The backing sleeve 34 is retained in position in the mold by means of an inwardly turned flange 37 on the outer end of a packing sleeve 38 surrounding the spigot end of the mold 13, with its inner end between the mold and the wall of the bore 11. The inner end of the packing sleeve 38 is provided with an inwardly turned flange 39 which engages in an annular groove 40 formed on the reduced spigot end of the mold. The arrangement of the parts is preferably such that the inner end of the flange 39 is substantially opposite the outer termination of the beveled portion 35 of the backing sleeve 34, and the thickness of the packing sleeve through the flange 39 is such that the packing sleeve forms a close fit on the wall of the bore 11 when the parts are assembled. For convenience in assembly the packing sleeve 38 is in the form of a divided ring, and is preferably made in two parts as shown in Figs. 3 and 4, one part, or one half the sleeve, being provided with dowel openings 41 in its ends to receive dowel pins 42 in the adjacent ends of the other half. The two parts of the separable sleeve may be held in position by means of a clamping ring 43 in a groove 44 extending circumferentially of the sleeve.

The inner end of the packing sleeve 38 provides a support for a fluid seal around the reduced spigot end of the mold 13 between the mold and the wall of the bore 11. This seal comprises a steel ring 45 in contact with the inner end of the packing sleeve, a fibre ring 46 in contact with the steel ring 45, and a leather ring 47, U-shaped in cross-section, with the bottom of the U supported against the fibre ring 46. With the construction shown, the cross-sectional area of the space within which this seal is located may be determined by the extent to which the spigot end of the mold is reduced, it being understood that the larger this cross-sectional area, that is, the larger the cross-sectional area of the sealing ring 47, the greater will be the end thrust or pull on the spigot end of the mold to assist in elongating the mold during the contracting operation.

In some cases it may be desirable to utilize a ring made of substantially equal parts of lead and tin in place of the fibre ring 46. A ring of this composition is sufficiently soft to flow slightly under the high pressure utilized and fill any crevices formed between the mold and the ring 45. The outer end of packing sleeve 38 may be beveled as shown at 48 to facilitate assembly of the mandrel and mold, with the parts thereon, in the container.

In the operation of the apparatus disclosed herein, fluid under pressure is admitted, through an opening 49 in the wall of the container, to the space 15 surrounding the mold. As the pressure is increased, the mold is gradually forced into contact with the mandrel. This contracting action results in a simultaneous elongation of the mold. A suitable lubricant on the mandrel facilitates the contracting and elongating action,

also the movement of backing sleeve 34 on the mandrel.

Inasmuch as the bell end of the mold is fixed against elongating movement, the elongation of the mold is manifested at the spigot end where an endwise elongating thrust is provided by the arrangement of the fluid seal as described. The rigid backing sleeve between this end of the mold and the mandrel is thus forced longitudinally on the mandrel and retains the spigot end of the mold out of contact with the mandrel throughout the operation. As the spigot end of the mold is not permitted to contract, the seal between this end of the mold and the wall of the bore will not be weakened or broken during the contracting operation.

With this apparatus, it is therefore possible, at a single operation, to contract the mold to a much greater extent than heretofore, and with lower fluid pressure than that heretofore employed. It has been found that the new apparatus also makes it possible in certain cases to contract a mold or other tubular body without annealing prior to the contracting operation. It has also been found that the present improvement produces a reclaimed mold which is of more uniform physical structure than those produced by former practices.

While the invention is disclosed herein in connection with the reclaiming of used molds, it will be understood that it is not limited to this particular use and that it may readily be employed for other metal working operations such as shrinking other kinds of tubular metal bodies, or elongating them where that is desirable. It will also be understood that the invention is not limited to a procedure where one end of the tubular body is held stationary during the shrinking operation. Both ends of the tubular body may be supported for elongating movement on the mandrel by employing at each end of the tubular body the arrangement of backing sleeve, packing sleeve, and fluid seal herein disclosed for use at the spigot end of a mold.

While a preferred form of apparatus for practicing the invention has been disclosed herein, it is to be understood that the invention is not intended to be limited to the precise apparatus disclosed. The above description and the accompanying drawing are therefore to be regarded as illustrative only, and it is to be understood that the invention is susceptible of other forms and arrangements so long as they come within the scope of the appended claims.

What I desire to claim is:

1. In apparatus for working a tubular metal body, a container having a cylindrical bore therein for holding fluid under pressure, a cylindrical mandrel arranged in said bore to provide a space to receive said tubular body between the wall of said bore and said mandrel, means for restraining one end of said tubular body against elongating movement, a fluid seal between said end and said wall, a rigid backing sleeve within the opposite end of said tubular body and movable longitudinally on said mandrel for spacing said opposite end from said mandrel, and a fluid seal between said opposite end of said tubular body and said wall.

2. In apparatus for radially shrinking a tubular metal body, a container having a cylindrical bore therein for holding fluid under pressure, a cylindrical mandrel arranged in said bore to provide a space to receive said tubular body between the wall of said bore and said mandrel, means for restraining one end of said tubular body against elongating movement, a fluid seal between said end and said wall, a rigid backing sleeve slidable on said mandrel and fixed in the opposite end of said tubular body for spacing said opposite end of said tubular body from said mandrel, and packing means forming a fluid seal between said opposite end of said tubular body and said wall and providing an elongating thrust on said opposite end.

3. In apparatus for radially shrinking a tubular metal body on a mandrel within a container for high pressure fluid, a rigid backing sleeve fitting within said body and slidable on said mandrel for spacing one end of said tubular body from said mandrel, a rigid packing sleeve fixed on the said end between said tubular body and the wall of said container and movable with respect to said container, and a fluid seal between said tubular body and said wall and supported upon said packing sleeve for movement therewith.

4. In apparatus for radially shrinking a tubular metal body on a mandrel within a container for high pressure fluid, a rigid backing sleeve fitting within said tubular body for spacing the same from said mandrel and having a flange thereon for engagement with the end edge of said tubular body, a packing sleeve fitting between said tubular body and the wall of said container with one end thereof fixed against longitudinal movement on said tubular body and a flange on its opposite end for engaging over the flange on said backing sleeve, and a fluid seal between said tubular body and said wall and supported upon said packing sleeve for movement therewith.

5. In apparatus for working a tubular metal body on a mandrel within a container for high pressure fluid, a rigid backing sleeve fitting within one end of said body and slidable on said mandrel for spacing said end from said mandrel, a rigid packing sleeve slidably fitting within said container around said end, cooperating means on said body and said sleeves for locking said sleeves against movement longitudinally of said body, and a fluid seal abutting against the inner end of said packing sleeve between said body and said container.

6. Apparatus for working a tubular metal body on a mandrel, comprising a backing sleeve adapted to fit on said mandrel within one end of said tubular body, means on said backing sleeve to limit inward movement of said backing sleeve in said tubular body, a divided packing sleeve adapted to surround said tubular body and said backing sleeve, means on said packing sleeve to limit outward movement thereof on said tubular body, and means on said packing sleeve to limit outward movement of said backing sleeve in said tubular body.

7. The apparatus defined by claim 6, in which the outer surface of the backing sleeve is beveled at its inner edge to avoid the formation of an abrupt shoulder on the metal body.

8. In apparatus for radially shrinking a tubular metal body on a cylindrical mandrel within a container for high pressure fluid, the improvement which comprises a fluid seal between one end of said body and the wall of said container, and rigid means surrounding said mandrel within said end of the body to maintain said end spaced from said mandrel and thereby preserve said seal upon radial contraction of said body.

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