

June 25, 1929.

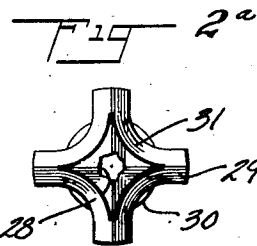
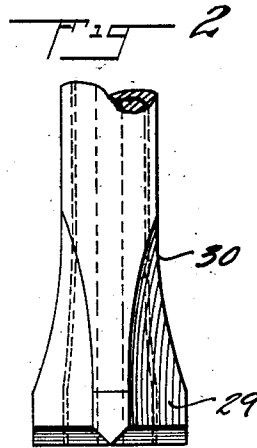
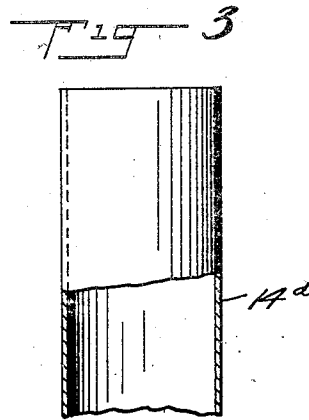
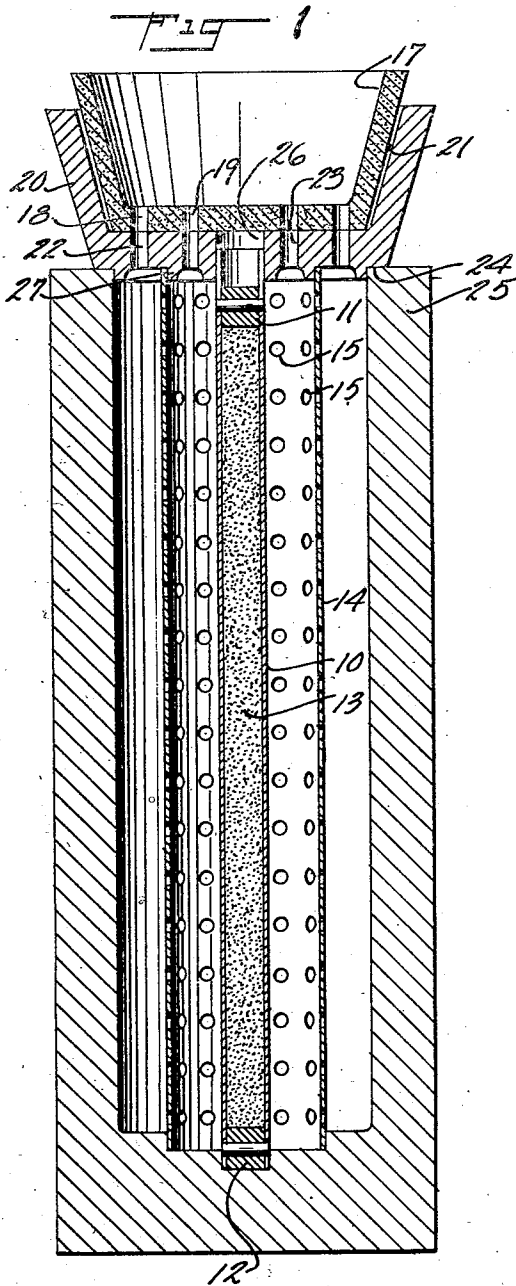
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1,718,210

PROCESS OF MAKING HOLLOW DRILL RODS

Filed Jan. 12, 1922

3 Sheets-Sheet 1



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Fig 4

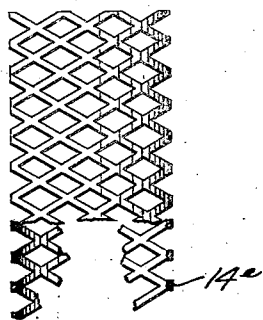


Fig 5

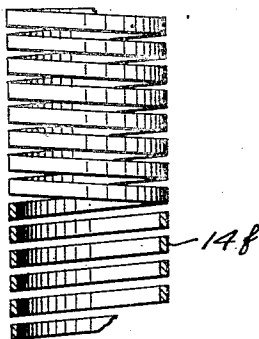


Fig 6

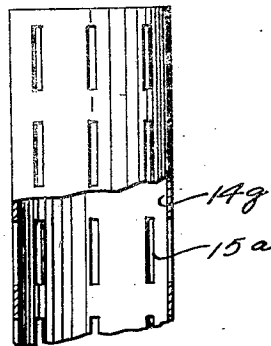


Fig 7

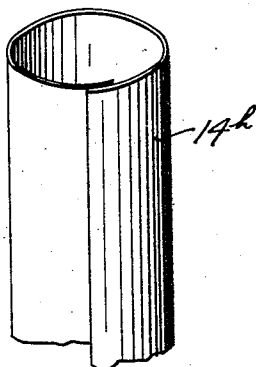


Fig 8

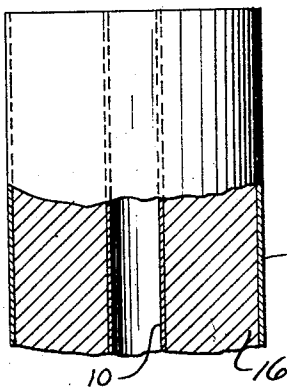


Fig 10

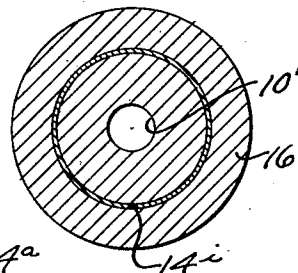


Fig 11

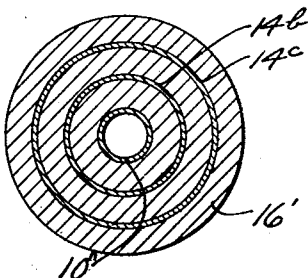
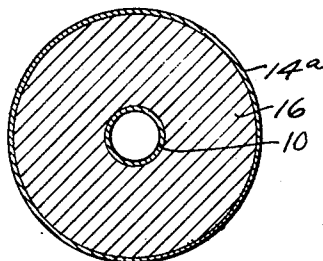


Fig 9



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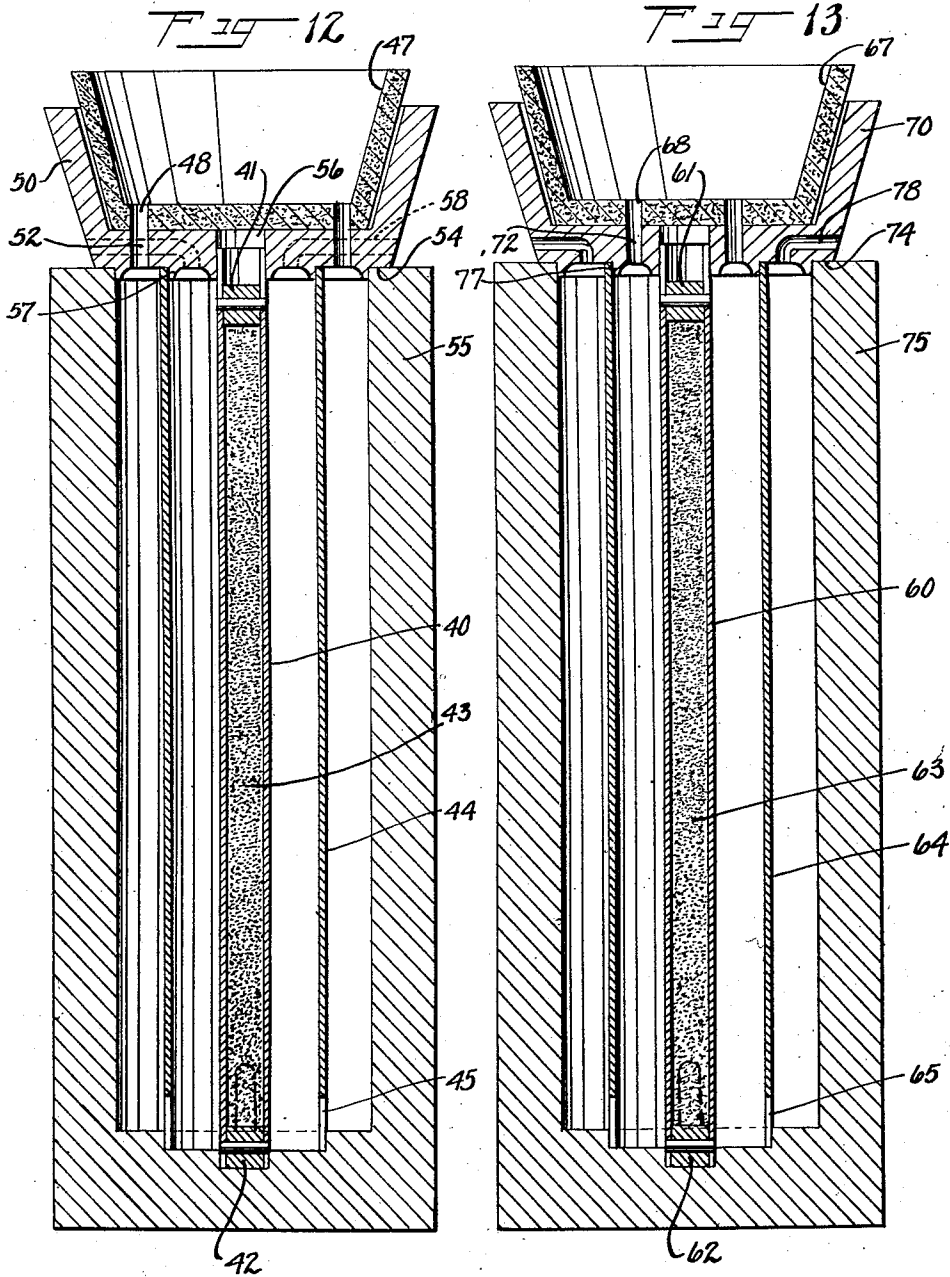
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PROCESS OF MAKING HOLLOW DRILL RODS

Filed Jan. 12, 1922

3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE.

PERCY A. E. ARMSTRONG, OF LOUDONVILLE, NEW YORK, ASSIGNOR TO LUDLUM STEEL COMPANY, OF WATERVLIET, NEW YORK, A CORPORATION OF NEW JERSEY.

PROCESS OF MAKING HOLLOW DRILL RODS.

Application filed January 12, 1922. Serial No. 528,753.

My invention relates to hollow drill rod and other hollow bar products, and will herein be described for affording an understanding of the invention with reference to hollow drill rod for mine drills. The material and process may also be employed in the construction of axles, steam hammer shafts and for many other purposes of like character where there has been experienced with materials hitherto available fatigue or progressive cracks starting from a transverse fissure.

Rock drills made of the hard steel required for rock penetration are subject to breakage from the tremendous vibratory stresses encountered in use. Such breakage may occur in various ways, as, for example, the drill shaft may break off, or the steel may crack or break radially out from the hollow center, etc.

According to my invention the hard steel of the rock drill is provided with a tough reenforce, as, for example, a reenforce of low carbon steel or other tough material, which serves to prevent breakage without substantial loss of cutting power, and in fact increased cutting power can be obtained, since the provision of the reenforce enables the use of harder steel than could otherwise be used. For example, steel containing over 1% and as high as 1.15% of carbon may be used for the body of the drill rod, while the reenforce may be of mild steel containing under .4% of carbon, as, for example, about .35% of carbon.

The tough reenforce is preferably of generally tubular form, which is best adapted to prevent shaft and radial breaks and give all around strength to the drill steel, but reenforces of various forms may be used.

In the accompanying drawings, Fig. 1 is a vertical sectional view of an ingot mold arranged for pouring an ingot to be rolled out into hollow drill steel. Fig. 2 is a side view and Fig. 2^a an end view of a drill head forged from hollow drill rod embodying my invention. Figs. 3, 4, 5, 6 and 7 are side views, partly in section, of variously formed reenforces for use in the manufacture of drill rod embodying my invention. Figs. 8 and 9 are respectively longitudinal and cross-sectional views of drill rod with an exterior reenforce, and Figs. 10 and 11 are cross-sectional views of drill rod with internal reenforces. Figs. 12 and 13 are vertical sectional views of modified forms of the ingot mold of Fig. 1.

The bore of the drill rod may be obtained in

any desired way within the scope of the present invention, but preferably the ingot to be rolled down to drill size comprises a central tube of mild steel welded in place in the casting of the ingot, as described and claimed in my Patent #1,565,771, dated December 15, 1925, and in Fig. 1 I have shown such central tube 10 plugged at its ends as indicated at 11 and 12, and filled with material 13 such as sand, hard burned magnesite, lime, talc, etc., but which may be herein referred to for convenience as sand. Reference numeral 14 represents the reenforcing member of tough material such as low carbon steel, for example, which is preferably placed in the ingot mold between the central tube and the outer wall of the mold. It may be placed elsewhere, as on the outside of the mold, if desired, as shown at 14^a, Figs. 8 and 9, and two or more reenforcing members may be provided, if desired, as shown at 14^b, 14^c, Fig. 11.

The form of the reenforcing member is preferably tubular so as to be well adapted to resist radial breakage extending out from the hollow center, as well as breakage across the shaft and in other directions, but considerable latitude is permissible in the form of the reenforcing members and several forms are shown herein as examples. Fig. 3 shows a simple form of tube reenforce 14^a without openings or perforations of any kind. Fig. 1 shows a similar tube 14, but provided with a plurality of round holes 15. Fig. 4 shows a reenforcing member 14^c of expanded metal, such as commonly used for metal lath, etc. Fig. 5 shows a coiled tubular reenforce 14^d, and the coiled material may be of any desired cross-section, as well as the flat section shown. Fig. 6 shows a tube 14^e with longitudinally extending slots 15^a. Fig. 7 shows a tubular member 14^b made by rolling up a piece of flat sheet metal. The meeting edges of the metal for reenforce 14^b may be arranged in various ways. For example, they may abut closely together at 14ⁱ as shown in Fig. 10, or they may be separated by a short distance, or may lap over one another, if desired, the last named arrangement being illustrated at 14^h in Fig. 7. In Figs. 8 and 9 the reenforce 14^a is placed on the outside of the drill rod.

In the cross sectional view of Fig. 10, I have shown a drill rod with the customary central opening 10ⁱ therein, and having a tubular reenforcing member 14ⁱ substantially midway

between the central opening 10' and the exterior wall of the drill rod 16'. In Fig. 11 the drill rod 16' has a lined opening 10'' formed by welding a tube 10 within the ingot in casting, and is provided with two substantially concentric reenforces 14^b, 14^c. In Figs. 8 and 9 the central opening has a wall 10 similar to the wall of Fig. 11, and the reenforce 14^a is provided about the exterior of the drill rod. When the reinforcing material is provided by the outside of the drill rod, as shown in Figs. 8 and 9, the removal of such softer material 14^a at the drill head, as by grinding it off either before or after forging the lands, enables the user to obtain a drill shank of the requisite strength and toughness, and at the same time to obtain a cutting edge free from soft material, and the outer ends of the cutting lands may be readily brought to correct gauge in grinding off the soft metal 14^a.

In pouring the ingot, the molten steel is preferably introduced by means of a pot 17 of graphite or the like, having outlet holes 18, 19 for the molten metal, and a holder 20 is preferably provided having a recess 21 to receive the pot 17, and having holes 22, 23 in alignment with the holes 18, 19 in the pot 17.

The holder 20 is preferably shouldered at 24 to set within the ingot mold 25, and has a central opening or recess 26 to receive the core tube 10, and is provided with a shoulder 27 to fit within and center the reinforcing tube 14. When the reinforcing member is apertured, as in several of the instances shown, round holes 15 being shown in Fig. 1, it may be sufficient to pour the molten ingot material through holes 18 and 22 outside the reenforce 14, and to depend on the passage of molten metal through holes 15 to the interior of reinforcing tube 14, but where a simple non-apertured reinforcing tube is used, or where the apertures are not extensive, it is preferable to make provision for entry of the molten metal from the pouring device direct into all the ingot spaces, as, for example, through holes 19 and 23 into the space within the reinforcing tube 14. Where a plurality of reinforcing tubes are made use of, as in Fig. 11, for example, additional pouring holes may be provided, as will be readily understood.

Referring to Fig. 12, there is shown an ingot mold arranged for pouring an ingot to be rolled out into hollow drill steel. The bore of the drill rod may be obtained in any desired way, but preferably the ingot to be rolled down is formed around a central tube 40, and this tube is positioned within the mold, as clearly shown in the drawing. The ends of the tube 40 are plugged by means of suitable plugs 41, 42 and its interior filled with a material 43, such as sand, hard burned magnesite, lime, talc, or the like, but which is herein referred to for convenience as sand. The reinforcing member of tough material comprises a tube 44 formed of low carbon

steel, for example, which is placed in the ingot mold between the central tube 40 and the outer wall of the mold. The lower extremity of the tube 44 is provided with a plurality of notches, such as 45, forming passages between the spaces in the mold on either side of the tube 44.

For pouring the ingot there is provided a pot 47 made of graphite or the like, having outlet holes, such as 48, each of which is in alignment with a corresponding aperture 52 in a pot holder 50. The holder 50 preferably is shouldered at 54 to set within the ingot mold 55 and has a central opening or recess 56 to receive core tube 40. It is also provided with a shoulder 57 to fit within and center the reinforcing tube 44. The holder 50 is provided with a plurality of vent passages, such as 58, interconnecting the interior of the mold with the atmosphere.

In pouring the ingot the molten steel is introduced into the mold by means of the pot 47 and flows through the apertures 48 and 52 into the space between the tube 44 and the outer wall of the mold 55. The molten material passes through the passages 45 and upwardly in the space between the tubes 44 and 40. Thus it will be seen that the ingot is formed and when cooled takes the shape desired. The ingot may subsequently be elongated to desired dimensions in any appropriate manner, as for example, by rolling.

In the modified form of the invention shown in Fig. 13, there is provided a mold similar to that of Figs. 1 and 12, in which there is positioned a central tube 60 having its ends plugged by suitable plugs 61 and 62, and its interior filled with suitable material 63, such as sand or the like. A tube 64 of tough material, such as mild carbon steel, is positioned in the space between the central tube 60 and the outer wall of the mold. The lower end of the tube 64 is provided with a plurality of notches 65 forming passages between the spaces within the mold, partitioned off by the tube 64. A pot 67 formed of graphite or the like is provided for the molten metal. A pot holder 70 is positioned on the upper extremity of the mold and has an annular shoulder 74 for maintaining it in position. The holder 70 is provided with a second shoulder 77 arranged to fit within the tube 64 and maintain the tube 64 in position. The pot 67 is provided with a plurality of passages, such as 68, through its bottom, each of which is in alignment with a passage 72 extending through the holder 70 and connecting with the space between tubes 60 and 64. A plurality of vents, such as 78, extend through the holder 70 and connect one of the spaces in the mold with the atmosphere.

In pouring an ingot the molten metal is introduced by means of the pot 67 and flows

through the passages 68 and 72 into the space within the mold between the tubes 60 and 64. It then flows through the passages 65 and upwardly into the space between the

got mold, and at such distance from the ingot mold walls as to be surrounded on all sides by the cast metal and elongating and reducing the cross-section of the resulting ingot.

Thus the ingot is formed within the mold and after having been cooled may be elongated to desired dimensions in any suitable manner.

It is to be understood that various materials, such as carbon steels and alloy steels, may be used both for the body of the ingot and the reinforcing means, so long as the body thereof is adapted to give the cutting or other qualities desired, and the reenforce to give adequate toughness and freedom from breakage.

A reinforcing tube of nickle, for example, gives good results in making hollow drill rod. The reinforcing tube is preferably quite thin, as compared with the body of the metal, and the molten metal of the ingot is preferably poured fairly hot, so that the reinforcing material becomes welded to the material of the body of the ingot during the formation of the ingot, or during the rolling down of the ingot to the drill rod size, or both.

In the making of the drill rod, the heated ingot is rolled to the desired dimension and the sand removed in known manner, leaving the bore 28 for supplying water to the drill head. When the reenforce or reenforces are arranged intermediate the central bore and the exterior of the drill rod and the drill head is forged out to gauge, the reinforcing material will appear to some extent in the lands 29 of the drill gauge 30, as indicated at 31, Fig. 3, but due to deformation in forging and the relatively slight thickness of the wall of reinforcing material, which is sufficient to prevent breakage, no substantial loss of cutting power is encountered and in fact cutting power can be increased as harder steel can now be used for the body of the drill rod, without being subject to cracks or breaks.

A heat treatment may now be given, either wholly or only on the bit end, the opposite end or both ends, as desired. A heat treatment which I have found advantageous comprises heating the part or parts to be treated to a temperature above that of the transformation point, and rapidly cooling in a cooling medium, such as water or the like.

It is to be understood that the various forms shown in the drawings are for illustration only, and that changes and modifications may be resorted to without departing from my invention.

I claim:

1. The process of making hollow tubular bodies, such as hollow drill rod and the like, which comprises casting a hollow ingot with a metallic tubular member in place in the in-

2. The process of making hollow tubular bodies, such as hollow drill rod and the like, which comprises casting a hollow ingot about a central core with a relatively thin reinforcing metallic substantially tubular member of tougher material than the ingot material in place in the mold, so as to be surrounded on all sides by the cast metal, whereby the reinforcing material is welded within the ingot, elongating and reducing the cross-section of the ingot and core, and removing the

3. The process of making hollow tubular bodies, such as hollow drill rod and the like, which comprises placing in an ingot mold an axially arranged tube, containing a sand core, and a substantially tubular member surrounding said tube and spaced away therefrom, casting a metallic ingot in said mold with said tube and member in place therein, whereby said member is surrounded on all sides by the cast metal, elongating and reducing the cross-section of the ingot and core, and removing the sand from the tube.

4. The process of making hollow drill rod, which comprises casting an ingot of hard steel about a tube of soft steel containing a sand core and an apertured substantially tubular member of soft steel arranged substantially concentrically with said tube by introducing the molten material outside the apertured tubular member and permitting it to pass through the openings therein to fill the space about the tube, whereby tubular member and tube become welded within the ingot, elongating and reducing the cross-section of resulting ingot and core, and removing the sand core.

5. The process of making hollow drill rod and the like, which comprises casting an ingot of hard steel about a tube of soft steel containing a sand core and a substantially tubular member of soft steel arranged substantially concentrically with said tube, by introducing the molten material outside the tubular member and permitting it to pass under the bottom of the tubular member and then rising up to fill the space about the tube, whereby the tubular member and the tube become welded within the ingot, elongating and reducing the cross-section of resulting ingot and core, and removing the sand core.

6. The process of making hollow drill rod and the like, which comprises casting an ingot of hard steel about a tube of soft steel containing a sand core and a substantially tubular member of soft steel arranged substantially concentrically with said tube, by introducing the molten material into the space about the tube, whereby the tubular member and the tube become welded within

the ingot, elongating and reducing the cross-section of resulting ingot and core, and removing the sand core.

7. Process of making hollow drill rod, 5 which comprises arranging an ingot mold with a sand-filled central tube of substantially unhardenable steel, and with an apertured larger substantially concentric tube of substantially unhardenable steel around the 10 central tube and spaced therefrom and from the ingot walls, casting hardenable steel in the

space within the ingot mold about the central tube so that the larger tube is embedded in the cast metal, rolling the ingot, and removing the sand core, whereby a hollow drill rod is 15 obtained which when made into drills can be hardened and given persisting sharp cutting edges and at the same time be reinforced by the substantially unhardenable steel portions. In testimony that I claim the foregoing, I 20 have signed my name hereto.

PERCY A. E. ARMSTRONG.