

Feb. 15, 1927.

1,618,142

T. S. WHEELWRIGHT
METHOD OF MAKING HOLLOW BARS

Filed May 12, 1926

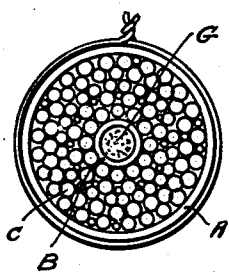


Fig. 1.

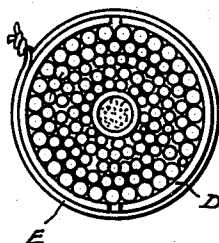


Fig. 2.

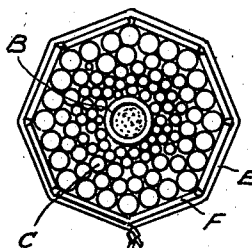


Fig. 3.

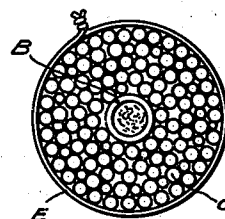


Fig. 4.

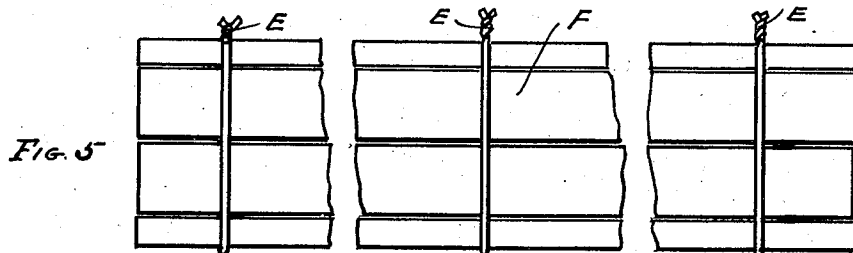


Fig. 5.

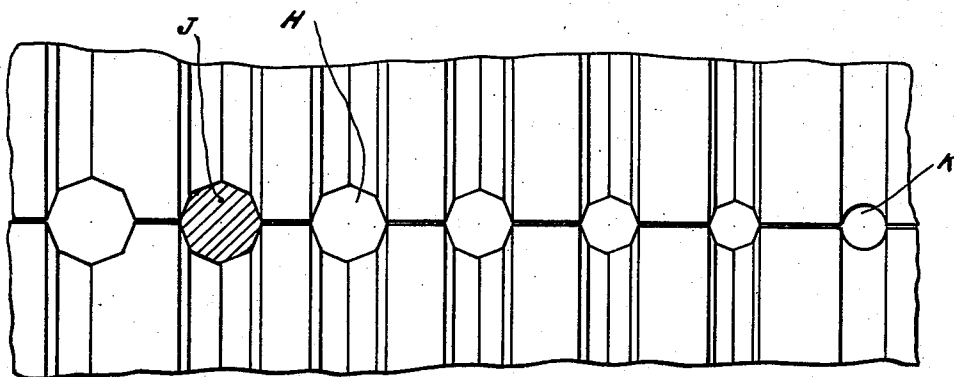


Fig. 6.

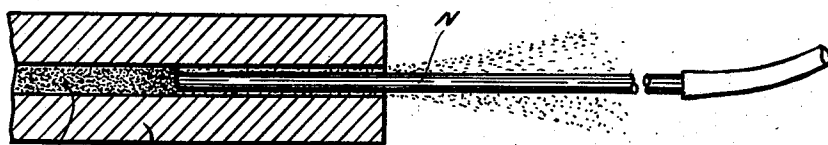


Fig. 7.

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METHOD OF MAKING HOLLOW BARS.

Application filed May 12, 1926. Serial No. 108,603.

This invention relates to the manufacture of rolled or drawn hollow articles; and is especially applicable for making stay-bolt iron, although it may be applied to many other purposes.

Heretofore long hollow bars have been made by taking a solid billet and drilling it from end to end, and then rolling down to size. Stay-bolt iron has usually been rolled; then cut to length; and then drilled. This is a costly operation because of the loss of metal, and the labor incident to the drilling. There has also been difficulty in producing a bar with a straight hole through its length.

My invention consists essentially in the economical production of hollow bars by building up a hollow fagot by arranging rods or bars around a hollow metal core, heating the built-up fagot to a welding and rolling temperature, rolling the heated fagot down to the required size and section, at the same time preserving the desired direction of the hole through the axis of the bar.

A fagot may be built up of plates, flat bars, and even of scrap; but the resulting bar would not be suitable for the manufacture of staybolts, in which great strength and reliability are essential. I have found that by building up my fagot of bars of small section, and themselves of good quality, and then by rolling down by steps to the required size, I obtain a finished bar of unusual strength and soundness.

I use my process particularly for the production of hollow staybolt iron, from end to end of which runs a tell-tale hole; but I do not limit my process to the production of hollow iron bars, for by the same process I can produce hollow bars of other weldable materials such as low carbon steel.

In describing my process I use, for the sake of brevity and simplicity, terms applicable to the rolling of iron.

Referring to the accompanying drawings which form a part of this specification:

Figure 1 shows in end elevation a method of building up a fagot.

Figures 2, 3, and 4 show other methods of building up the fagot.

Figure 5 shows a fagot in side elevation.

Figure 6 shows a detail of the rolls.

Figure 7 shows in detail the manner in which the bore of the finished bar is cleaned.

In carrying out my invention I produce

a fagot by assembling iron bars or rods around a hollow central core, as shown in Figures 1, 2, and 3. In Figure 1 the fagot is formed by setting up a wrought iron pipe A; and concentrically with this pipe I set up another second and smaller wrought iron pipe B of the same length. The space between these pipes I then pack with iron bars or rods C, with the axes of the bars lying approximately parallel to the axes of the two pipes. The sizes of the two pipes will depend very much upon the length of stay-bolt iron which it is desired to roll; but for usual lengths the size of the outer pipe A may be from 4 inches to 6 inches, and the size of the smaller pipe may be from 1 inch to 1½ inches. The length of the two pipes is preferably 30 inches; though it may be more or less.

Another way of making this fagot is shown in Figure 2. It is not always desirable to use a piece of commercial wrought iron pipe for the envelope of the fagot. I can use flat metal or bars by rolling pieces of suitable length and width to a semi-circular section, as shown at D in Figure 2. In this case the two semi-circular sections D are set up, and bound around with wire E. The wrought iron rods or bars are then packed into the space between the semi-circular plates D and hollow iron core B.

In Figure 3 I show another method of forming the fagot. In this case I set up in a form flat bars F of suitable width to form in section an octagon or a hexagon, or other polygonal figure, of the desired size. I set the hollow wrought iron core B in the center; then I pack the space between it and the surrounding plates with the wrought iron rods or bars C; and then I wrap the enveloping plates around with wire to secure them in place, before the whole is removed from the form.

The fagot may be built-up in other ways; for instance, by suitably arranging the rods or bars around the hollow metal core, and then wrapping the bundle tightly with wire, as in Figure 4.

The fagot built up, I fill the core with refractory material, G, as explained hereinafter; and I then thrust the fagot into a heating furnace, and raise to a welding and rolling temperature. I then remove the fagot, and send it immediately through the first and succeeding passes of the rolls.

It has been found that if a hollow billet or fagot is rolled through succeeding circular passes, it will turn and twist, so much so that the hole through the center of the bar will become very much distorted, and may even at places become closed. I have found that I can prevent the turning of the bar, as it is reduced by the rolls, by using rolls having passes octagonal or hexagonal in shape; in other words polygonal, rather than one sided, such as the circular pass. In the drawings I have shown rolls having octagonal passes H. It should be noted that in feeding the bar J into a pass I do not turn the bar so that its angles come in contact with the flats of the pass; but I feed it in with its flats in approximately the same planes as the flats of the pass. By this manner of feeding, the bar is less liable to distortion; and it is more readily reduced to accurate size.

I have also found that there is the least distortion of any kind when the number of passes is the greatest, so that the reduction in size at each pass is small. I therefore prefer to use from sixteen to twenty passes for the finishing of my bar. Of this number of passes the last one, or finishing pass K, is circular in form, to bring the iron finally to the desired shape. This is an important point in connection with bars for stay-bolt iron.

During the process of heating and rolling, the center hollow core, and the rods, and the outer envelope become welded together; and there is produced a long bar of accurate size, perforated from end to end with a small hole. In the case of bar rolled for stay-bolts this hole is usually $\frac{1}{16}$ to $\frac{1}{32}$ of an inch in diameter.

In order to prevent the collapse of the inner metal core during the heating or rolling, I pack the said core with a refractory material, G, preferably without any binding material, except that with some refractories I may use a small quantity at each end to hold the refractory material in place during the heating and the first part of the rolling of the fagot. My usual practice is to plug the ends of the metal core after filling it with the refractory materials. For the refractory material I may use any substance which will not fuse at a rolling temperature for example, silica sand, soapstone, graphite, carborundum sand, zircon sand, electrically sintered alumina, or magnesia, or any other granular or powdered refractory material the fusing point of which is higher than the temperature of the metal when heated for rolling.

The removal of the refractory material from the finished bar has heretofore been a difficult operation, and a costly one. I have found a simple and inexpensive method of removing the refractory core. I mount the

bar in a lathe or other machine by which it may be revolved on its axis; and I connect a metal tube, approximately as long as the bar, and of a size small enough to enter the core-hole easily, to a source of supply of compressed air. I start the bar (see M in Figure 7) revolving more or less rapidly, and I then introduce the free end of the metal tube, N, into the end of the core-hole; and turn on the compressed air. The object of rotating the bar is to produce a relative rotary motion between the core and the jet of compressed air. The jet of air then acts upon the core in somewhat the same way as a drill or boring tool. The speed of rotation is a marked factor in the speed at which the bore will be cleaned; and I have found that a speed of about 500 revolutions per minute is good, and enables me to clean a large number of bars in a short time. I find it best to rotate the bar containing the core; and to advance the air tube, which is about $\frac{1}{8}$ " outside diameter, into the bore of the bar without rotation. I rotate the bar by chucking it in a lathe, and carrying it in suitable rests. The pressure of air I prefer to use is approximately 100 lbs. per square inch; though other pressures may be used. This pressure is effective for the removal of the core; and it is also a pressure commonly available in industrial plants. As the hollow tube is inserted into the end of the core-hole the refractory is loosened by the rapidly flowing air, but not necessarily by contact with the end of the tube; and the loosened refractory is expelled rapidly from the core backward around the tube. By this method I am able to remove the core cleanly and rapidly, and at a very small cost.

I claim:

1. The method of making hollow metal bars, which comprises bundling weldable metal around a hollow core also of weldable metal to form a fagot; packing the hollow core with refractory material; heating the fagot to a welding and rolling temperature; rolling the fagot through a series of polygonal passes to the desired dimensions; and removing the refractory core by advancing compressed air into the hollow bar through a tube at the same time changing the relative positions of the bar and tube about their axes.

2. The method of making hollow metal bars, which comprises bundling weldable rods around a hollow core also of weldable metal to form a fagot; packing the hollow core with refractory material; heating the fagot to a welding and rolling temperature; rolling the fagot to the desired dimensions; and removing the refractory core by advancing compressed air into the hollow bar through a tube at the same time changing the relative positions of the bar and tube about their axes.

3. The method of making hollow metal bars, which comprises bundling weldable metal around a hollow core also of weldable metal to form a fagot; packing the hollow core with granulated refractory material; heating the fagot to a welding temperature; rolling the fagot to the desired dimensions; and removing the refractory core by advancing compressed air into the hollow bar through a tube, at the same time revolving the bar.

4. The method of making hollow metal bars, which comprises bundling weldable metal around a hollow core also of weldable metal to form a fagot; packing the hollow core with refractory material having a fusing point higher than the welding temperature of the core; heating the fagot to a welding and rolling temperature; rolling the fagot through a series of polygonal passes to the desired dimensions; and removing the refractory core by advancing compressed air into the hollow bar through a tube at the same time changing the relative positions of the bar and tube about their axes.

5. The method of making hollow metal bars, which comprises bundling weldable metal around a hollow core also of weldable metal to form a fagot; packing the hollow core with refractory material having a fusing point higher than the welding temperature of the core; heating the fagot to a welding and rolling temperature; rolling the fagot through a series of polygonal passes to the desired dimensions; and removing the refractory core by advancing compressed air into the hollow bar through a tube, at the same time revolving the bar.

6. The method of making hollow metal bars, which comprises bundling weldable metal around a hollow core also of weldable metal to form a fagot; packing the hollow core with refractory material having a fusing point higher than the welding temperature of the core; heating the fagot to a welding and rolling temperature; rolling the fagot through a series of polygonal passes to prevent distortion and through a circular pass to the final desired dimensions; and removing the refractory core.

7. The method of making hollow metal bars, which comprises bundling weldable metal around a hollow core also of weldable metal to form a fagot; packing the hollow core with refractory material having a fusing point higher than the welding temperature of the core; heating the fagot to a welding and rolling temperature; rolling the fagot through a series of polygonal passes to prevent distortion and through a pass bound-

ed by one line to the final desired dimensions; and removing the refractory core.

8. The method of making hollow metal bars, which comprises bundling weldable metal around a hollow core also of weldable metal to form a fagot; packing the hollow core with refractory material having a fusing point higher than the welding temperature of the core; heating the fagot to a welding and rolling temperature; rolling the fagot through a series of polygonal passes to prevent distortion, the sides of the bar being presented parallel to the sides of the passes; and removing the refractory core by advancing compressed air into the hollow bar through a tube, at the same time revolving the bar.

9. The method of making hollow metal bars, which comprises bundling weldable metal around a hollow core also of weldable metal to form a fagot; packing the hollow core with refractory material having a fusing point higher than the welding temperature of the core; heating the fagot to a welding and rolling temperature; rolling the fagot to the desired dimensions; and removing the refractory core by advancing compressed air into the hollow bar through a tube at the same time changing the relative positions of the bar and tube about their axis.

10. The method of making hollow metal bars, which comprises bundling weldable metal around a hollow core also of weldable metal to form a fagot; packing the hollow core with refractory material having a fusing point higher than the welding temperature of the core; heating the fagot to a welding and rolling temperature; rolling the fagot to the desired dimensions; and removing the refractory core by advancing compressed air into the hollow bar through a tube, at the same time revolving the bar.

11. The method of making hollow metal rods around a hollow core also of weldable metal to form a fagot; packing the hollow core with refractory material having a fusing point higher than the welding temperature of the core; heating the fagot to a welding and rolling temperature; rolling the fagot through a series of polygonal passes and a circular pass to the desired dimensions; and removing the refractory core by advancing compressed air into the hollow bar through a tube, at the same time revolving the bar.

In testimony whereof I have hereunto affixed my signature.

THOMAS S. WHEELWRIGHT.