Nov. 18, 1924. 1,516,153

J. P. GORMAN ET AL

PROCESS AND APPARATUS FOR PRODUCING HOLLOW STEEL BARS

Filed Jan. 9. 1920 2 Sheets-Sheet 1

Fig. 1a

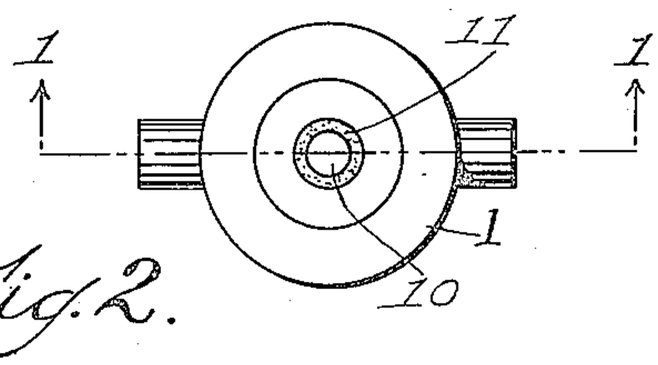


Fig. 2.

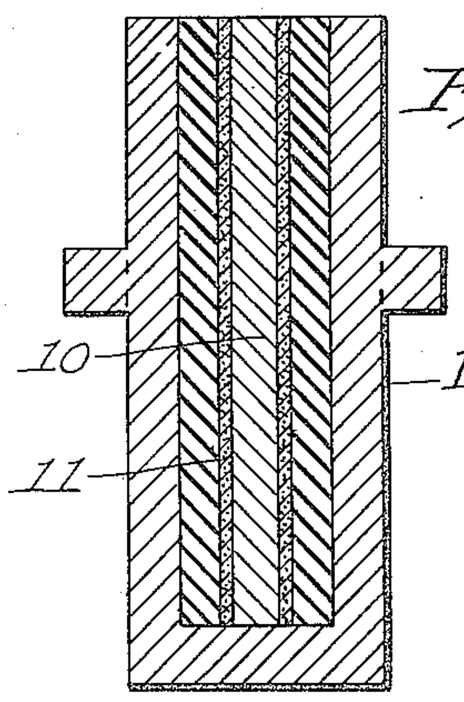


Fig. 1

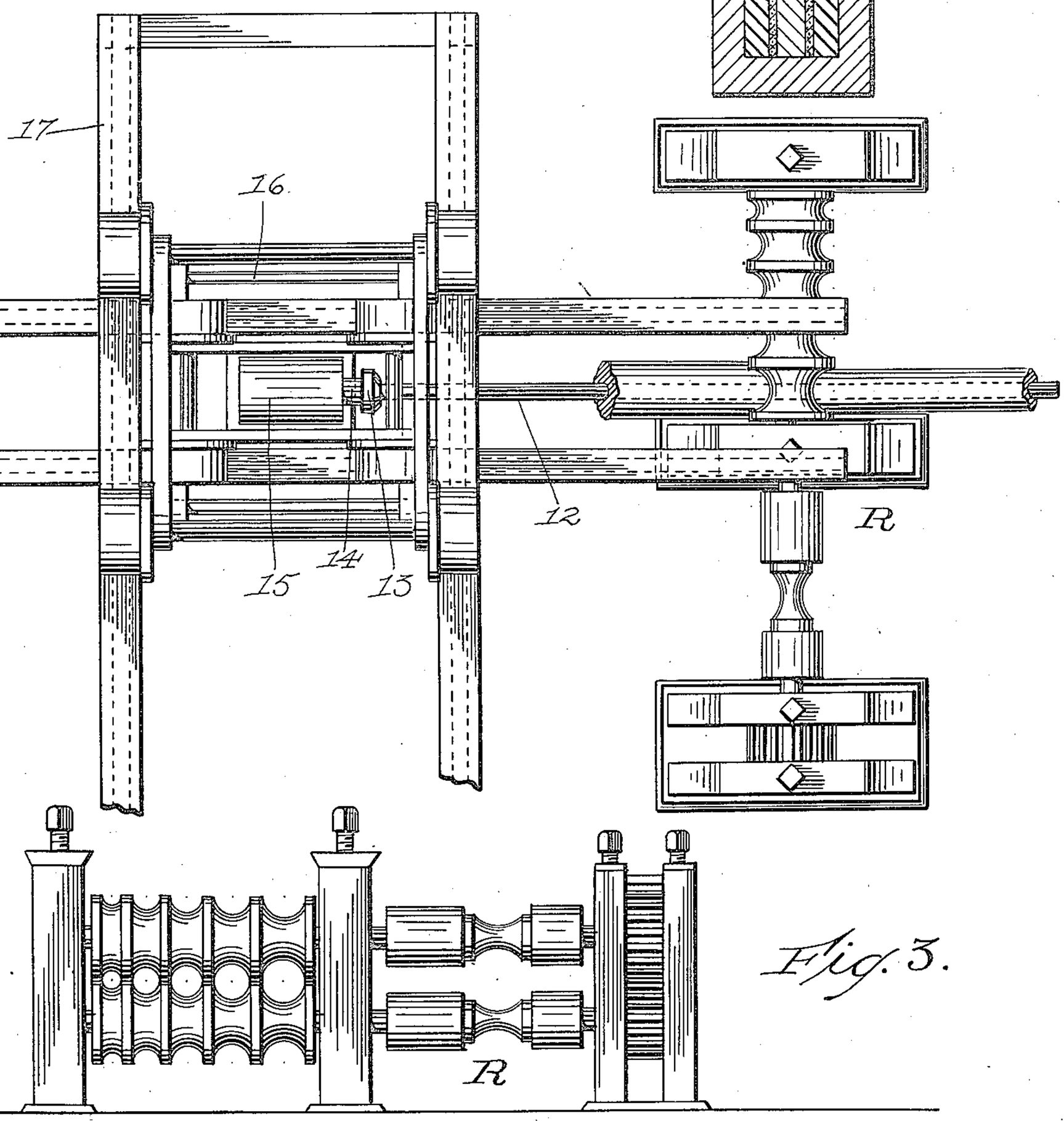


Fig. 3.

INVENTOR
James Paul Gorman
Henry Frank Weglarz
BY
W. N. Barker
ATTORNEY

Nov. 18, 1924. 1,516,153

J. P. GORMAN ET AL

PROCESS AND APPARATUS FOR PRODUCING HOLLOW STEEL BARS

Filed Jan. 9, 1920 2 Sheets-Sheet 2

Fig. 4.

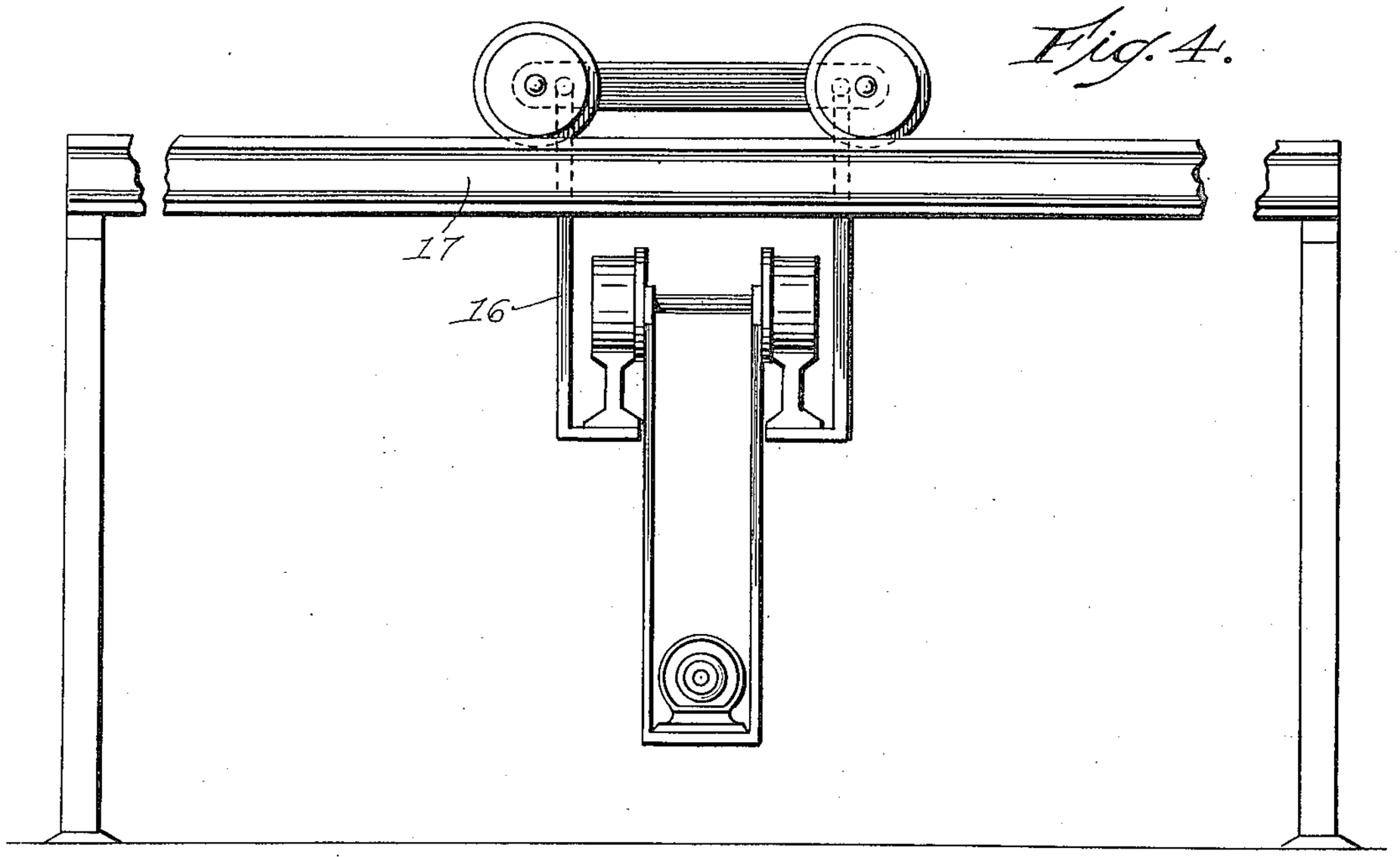
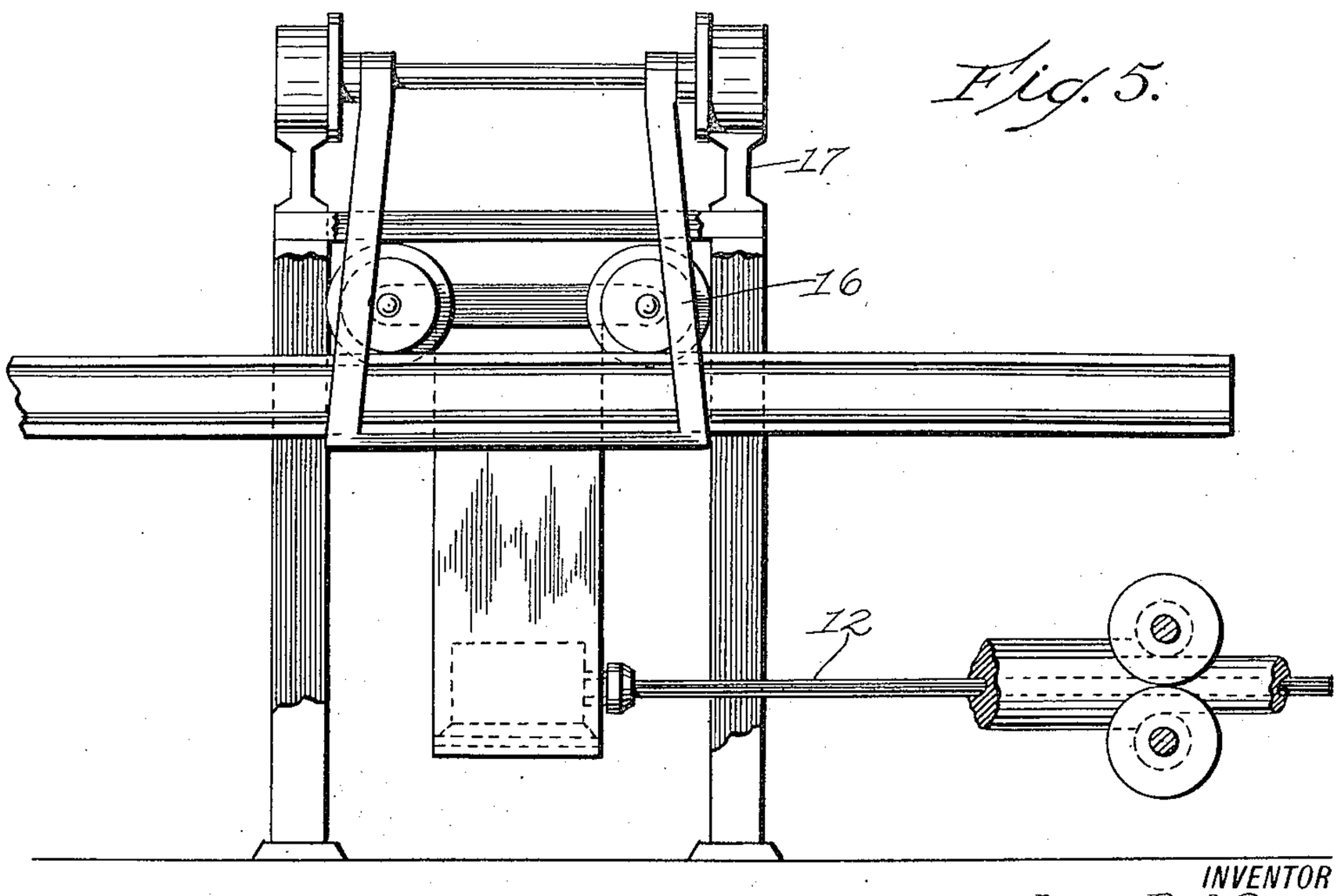


Fig. 5.



INVENTOR
James Paul Gorman
Henry Franck Weglarz
BY
W. A. Barker
ATTORNEY

Patented Nov. 18, 1924. 1,516,153

UNITED STATES PATENT OFFICE.

JAMES PAUL GORMAN, OF WATERVLIET, AND HENRY FRANK WEGLARZ, OF COHOES, NEW YORK.

PROCESS AND APPARATUS FOR PRODUCING HOLLOW STEEL BARS.

Application filed January 9, 1920. Serial No. 350,440.

To all whom it may concern:

Be it known that we, JAMES PAUL GORMAN and HENRY FRANK WEGLARZ, citizens of the United States, and residents, respectively, of Watervliet and Cohoes, in the county of Albany and State of New York, have invented certain new and useful Process and Apparatus for Producing Hollow Steel Bars, of which the following is a full, clear, and exact description whereby anyone skilled in the art may make and use the same.

The invention, as indicated by its title, relates to the production of hollow steel bars as distinguished from drawn tubes and is directed particularly to producing bars of steel or other metal with a central opening therethrough, at the same time subjecting the metal to the breaking down and reducing action of the hammer or rolls.

In ordinary practice, steel is first run into ingots or blooms and is then subjected to a reducing process by annealing and forging or rolling to break up the segregated form of structure produced in casting the molten metal and reducing the crystalline structure of the metal to a proper form with the carbides in solution.

In forming seamless tubes, the operation is even more complicated, as the blooms of metal must first be perforated and drawn down, until they can be gripped by dies and worked through drawing dies and over mandrels on the draw-bench. There are, of course, the requisite annealing operations to keep the metal in condition for drawing.

So far as is known to applicants it has not been a practice to produce hollow steel bars with walls of any desired thickness, purely by a rolling and reduction process, with the usual annealing of the metal, in contradistinction to drawing the metal through a die.

It is the object of the present invention to produce hollow steel bars having the same structural form for any given formulæ of analysis, as is found in bar steel reduced in the usual manner of annealing forging and rolling.

It is a further object of the invention, as a step in the process of producing hollow steel bars, to cast hollow ingots, which may be subsequently subjected to the necessary forging and rolling operations, to bring up the requisite structural form of the steel.

Obviously hollow steel bars have almost an indefinite field of usage permitting the manufacture of hollow shafting, hollow bolts and hollow bars for tools and fixtures of various sorts where lightness and the strength of steel is required.

The process hereinafter defined makes it possible to produce hollow steel even for gun barrels, with the bore approximately to size, or at any rate requiring only the finishing cut and the "rifling". This obviates the expensive and arduous operation of boring through the solid bar. The structural form, of the steel, that is, its microstructure will be the same as though a solid bar had been rolled and bored. The advantages are apparent from the above brief reference.

Referring to the drawings:

Fig. 1 is a view of a mould illustrating the manner of casting the hollow ingot. Fig. 1ª is a plan view.

Fig. 2 illustrates an ordinary rolling mill and a means of handling the ingots and core during the rolling operation, for the different passes.

Figs. 3, 4 and 5 illustrate more in detail the apparatus shown in plan in Figure 2.

In carrying out the process we employ an ingot mould 1, of the usual type or we may employ a sand mould. In fact, the type of mould for the ingot is not material. In pouring the molten steel into the mould we provide a core 10, of metal which is surrounded by a tubular core piece or tube 11, of a refractory material such as a brick-dust tube.

The use of the metallic core-bar, with the covering of refractory material prevents the steel from welding to the core-bar and makes it possible to readily remove the core-bar when the ingot has chilled.

It will be observed that the core is merely a composite structure having an iron or steel inner core, with the brick tube or similar refractory covering against which the metal may shrink.

The ingots so cast, if examined microscopically would show the usual cast structure common to molten metals cooled down after being poured.

The ingots thus formed are now annealed to a forging heat and are swedged out under the hammer in the usual manner except that a core of steel or iron is inserted in the cored opening of the ingot.

The core indicated at 12, is rotated by any suitable means such as the chuck 13, attached to the motor shaft 14, of the motor 15, and is constantly rotated, throughout the swedging and hammering operations upon the ingot.

After being suitably reduced, the bars are now heated to a rolling temperature and the hollow bars are given several passes through the rolls of the rolling mill R, until the desired size of bar has been attained.

During each rolling operation a cold mandrel is employed and is rotated during the reduction processing of the bar.

The size of the core-bar determines, of course, the size of opening, through the steel bar and it is apparent that the core-bar must be of sufficient length to permit of the elongation of the bar due to the rolling operation.

As illustrated in the drawing the motor 15, may be under-slung from a carrier 16, running upon a track 17, parallel with the axes of the rolls of the rolling mill R, so that the bars may be shifted from one roll to another during the different passes.

The carrier for the motor also has a movement axially in line, with the movement of the bars through the rolls. This provides for feeding the core with the bar as the latter passes through the rolls. The motor or other desired devices constantly rotates the core bar during the rolling of the hollow bar.

Of course, the bars, during the rolling operation, are from time to time annealed so that they will take the necessary reduction without cracking or scaling.

It will be quite apparent that the cross-sectional form of the steel bars will depend upon the form of groove employed in the rolls and the invention applies as well to round, square, hexagonal, octagonal or any other form required.

If desired a comparatively large core-bar may be employed in the initial steps of reduction and core-bars of lesser diameter may be used after each reduction.

In some instances, this has been found advantageous particularly where a comparatively small tubular opening is required, with unusually thick surrounding walls of metal.

The use of mandrels of different sizes will bring the entire body of the metal into an intimate reduction field so that the entire metal structure will be homogenous and will have a uniform character of micro structure.

After the bars are finally reduced to the desired size they are annealed to the required working temper and are ready for machining, or use such as a corresponding solid bar might require.

The steel, formed into hollow bars as defined, is not different in character, from the steel of solid bars having the same formula of composition and treated in the ordinary annealing hammering and rolling process from the cast ingot to the finished solid bar.

Of course, the process may be applied to cold rolling as well as hot rolling. It will be apparent that, with the core bar maintaining a definite interior diameter and with the rolls working upon the exterior of the bar, there is actually a double reduction force applied in any given pass of the metal through the rolls. The core forms a solid backing against which the steel of the ingot or bar is swedged by the rolls so that the entire body of the metal comes within the influence of the swedging or reducing action.

Obviously the mechanism for holding the mandrels and feeding them may be modified to suit the exigencies of any particular requirement without departing from the spirit or intent of the invention, which broadly stated contemplates producing a hollow ingot and maintaining an opening of definite size therethrough, during the swedging and rolling operations to secure the proper character of reduction of the metal.

When it is desired to produce a hollow bar having a non-cylindrical opening therethrough, it is possible to use a core bar of any desired cross-section.

This is made possible by using a hollow core bar and injecting a cooling medium therethrough.

The cooling medium may, of course, be either a liquid or fluid, such as chilled air or gas, so long as it will maintain a reduced temperature in the core bar.

Very low temperature air will absorb the excessive heat conducted through the core bar and obviates the objections of using a liquid.

Where a core bar of angular cross-section or non-cylindrical section is employed, the bar is simply fed in an axial direction as the steel bar is passed through the rolls. Obviously it would be quite impossible to rotate the core bar within the steel under reduction.

From the above it is apparent that the invention has an extremely wide application either, to the production, of hollow steel bars, having a cylindrical inner and outer surface or to hollow steel bars having a cylindrical bore and an irregular exterior surface or to bars having both the bore and exterior surface of irregular cross-section.

What we claim as our invention and desire to secure by Letters Patent is:—

1. The method of producing hollow steel bars which consists in casting a hollow steel ingot, annealing the same and forging over a metallic core-bar, and further reducing the structure of the steel by rolling the hollow bars upon metallic core-bars.

2. An apparatus for producing hollow steel bars which consists of rolling means for reducing the bars by successive passes, means for supporting and rotating a core-bar within the steel bar during each rolling operation, means permitting shifting of the core-bar into axial line corresponding to each pass through the rolls, and means permitting advancing the core-bar axially during each rolling operation.

JAMES PAUL GORMAN.
HENRY FRANK WEGLARZ.

Witnesses:
ALFRED S. ROWLES,
JOHN H. MACKLE.