(No Model.) 2 Sheets—Sheet 1.

J. B. D'A. BOULTON.

APPARATUS FOR CASTING TUBULAR INGOTS.

No. 442,305. Patented Dec. 9, 1890.

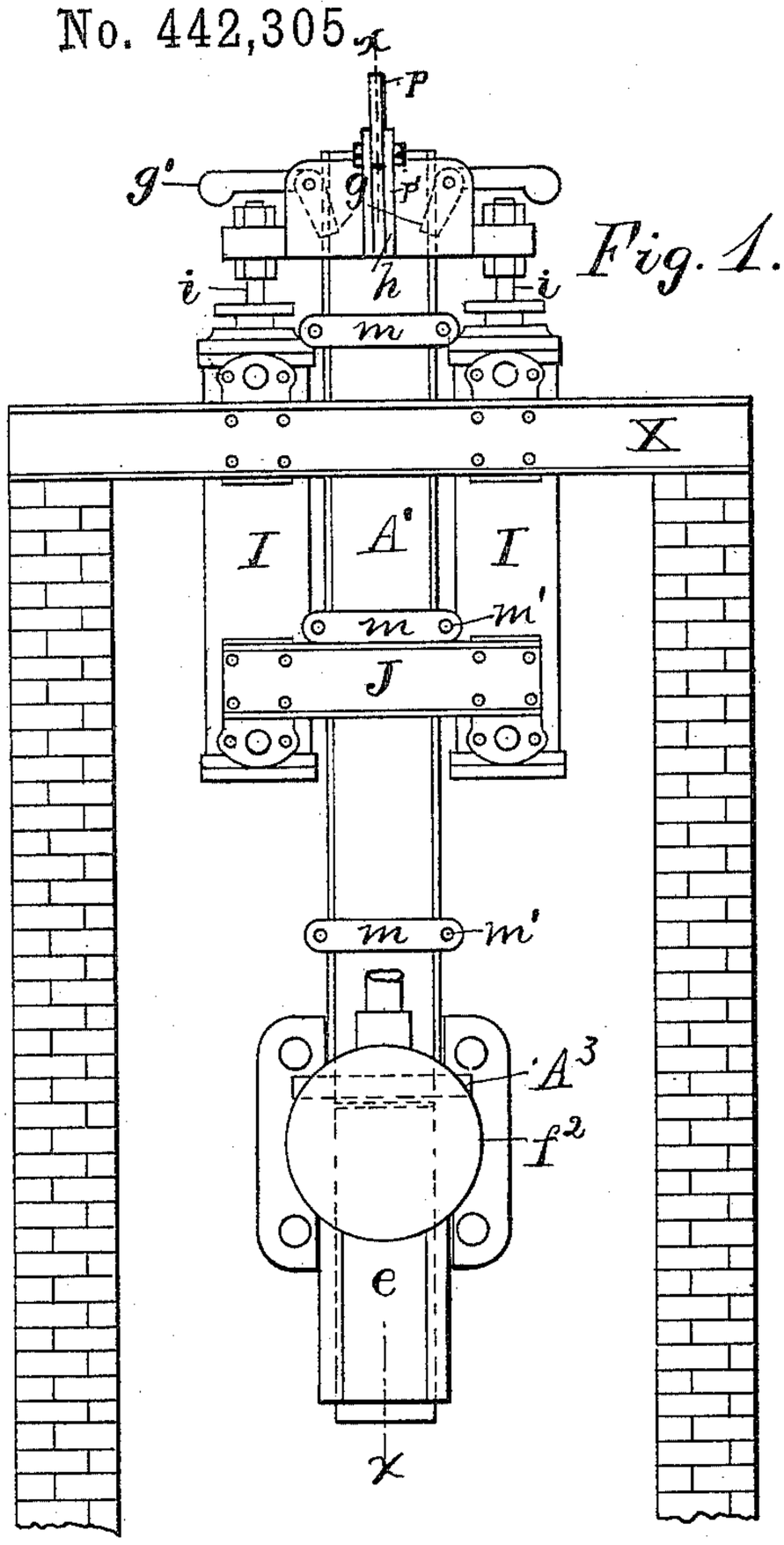


Fig. 1.

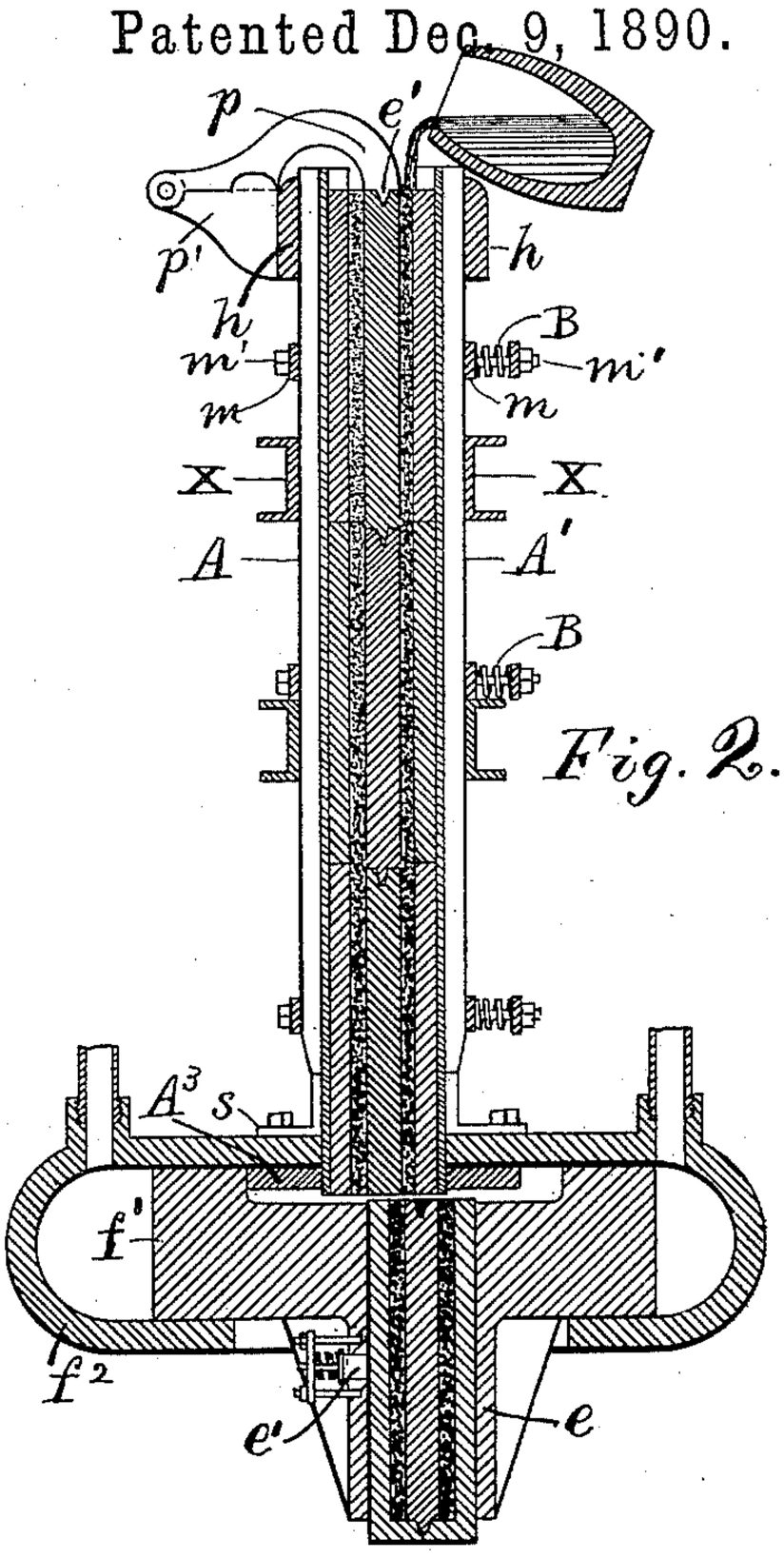
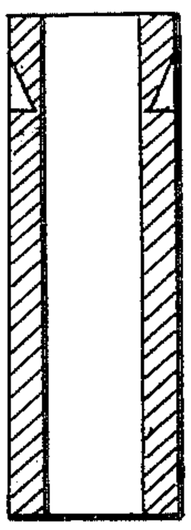


Fig. 2.

FIG. 9.



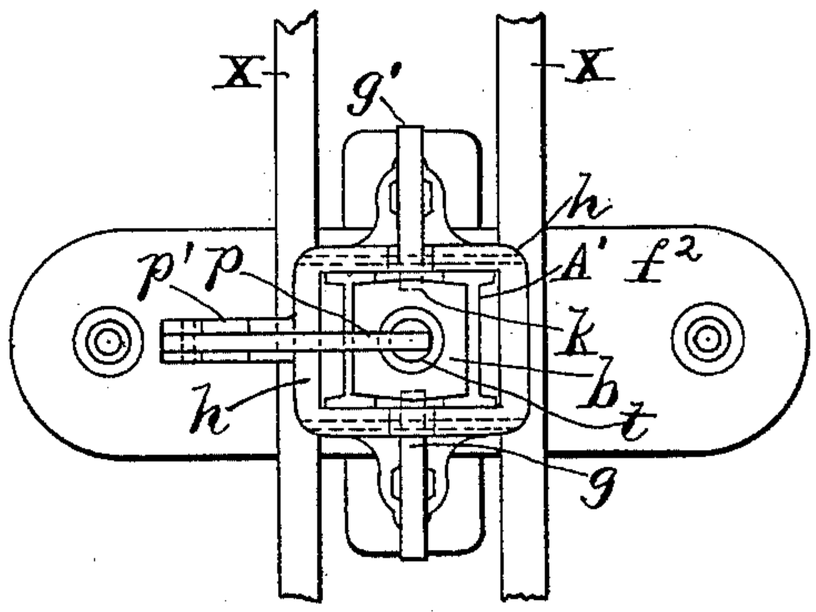


Fig. 3.

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(No Model.) 2 Sheets—Sheet 2.

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Fig. 5.

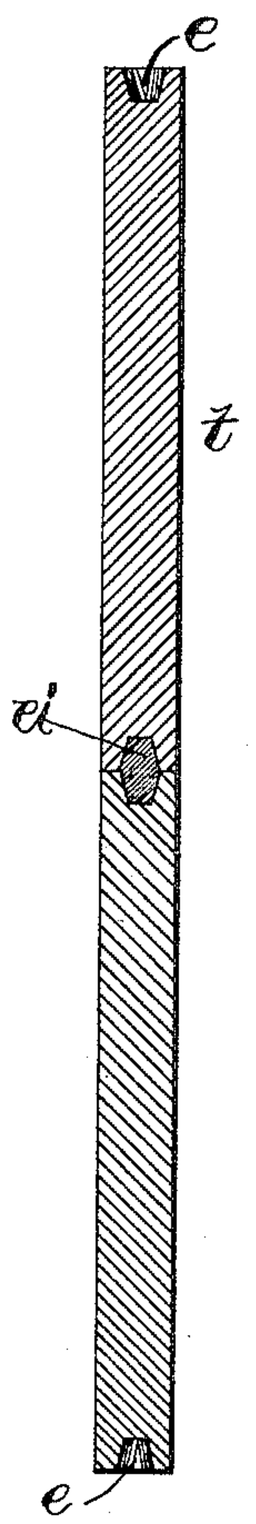


Fig. 7.

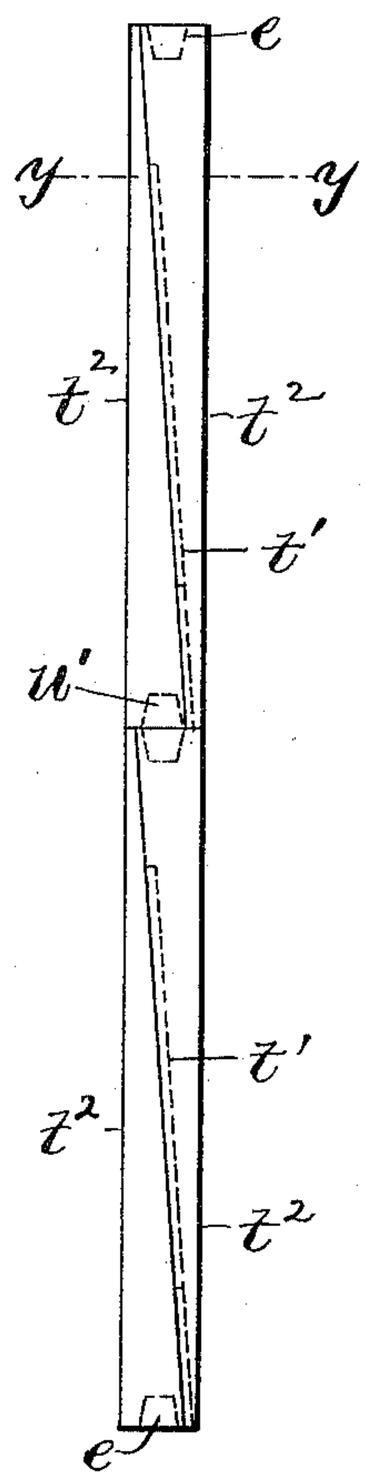
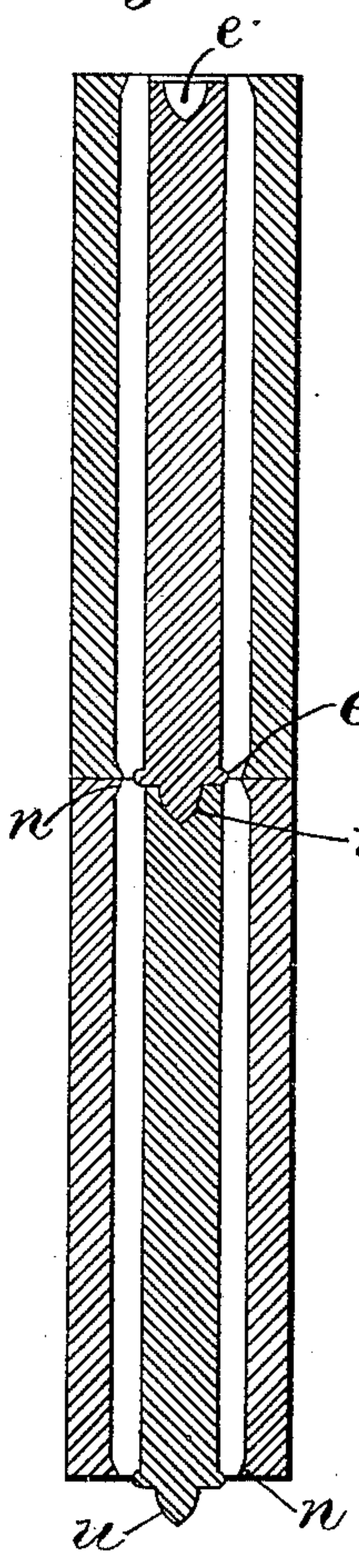


Fig. 4.



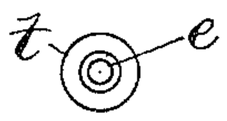


Fig. 6

Fig. 8.

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UNITED STATES PATENT OFFICE.

JAMES B. D'ARCY BOULTON, OF JERSEY CITY, NEW JERSEY, ASSIGNOR TO THE SOLID INGOT COMPANY, OF NEW JERSEY.

APPARATUS FOR CASTING TUBULAR INGOTS.

SPECIFICATION forming part of Letters Patent No. 442,305, dated December 9, 1890.

Application filed April 10, 1889. Serial No. 306,708. (No model.)

To all whom it may concern:

Be it known that I, JAMES B. D'ARCY BOULTON, a subject of the Queen of Great Britain, residing at Jersey City, Hudson county, New Jersey, have invented certain new and useful Improvements in Apparatus for Casting Tubular Ingots, fully described and represented in the following specification and the accompanying drawings, forming a part of the same.

The object of this invention is to provide an apparatus for forming tubular sectional ingots; and the invention consists in the combination, with a series of bottomless mold-sections and a holder adapted to sustain the same in line with one another during the casting operation, of a series of core-sections sustained within the mold-sections and provided at their ends with studs for centering them upon one another.

It also consists in various details of such constructions.

In the annexed drawings, Figure 1 is a side elevation of a casting-machine, the same as that shown in my patent No. 365,902. Fig. 2 is a vertical section of the same on line $x\ x$ in Fig. 1, with a crucible discharging its contents into the upper mold-section. Fig. 3 is a plan of the same with part of the supporting-beams. Fig. 4 is a longitudinal section of two mold-sections with the core-sections therein. Fig. 5 is a longitudinal section of two core-sections of alternative construction. Fig. 6 is a plan of the same. Fig. 7 is a side view of two metallic core-sections with a diagonal joint. Fig. 8 is a transverse section of the same on line $y\ y$ in Fig. 7, and Fig. 9 a sectional view of one mold.

The apparatus shown herein, like that in my patent, No. 365,902, is provided with a spring-holder to sustain the mold-sections in line with one another during the casting operation and by friction upon the sides of the mold to support their weight until moved downward by reciprocating mechanism. My present invention, however, is independent of any particular form of holder, and the molds may therefore be sustained by any suitable means within the holder and be moved downward by gravity or by other means than that shown herein. The holder is formed of two I-beams A A′, pressed toward one another by gibs m, held together by tie-bolts m', and provided with springs B. The bottom of the holder is attached by brackets s to a hydraulic cylinder f^2, containing a reciprocating plunger f', carrying a pocket e, having a spring-presser e' at one side. The holder is shown suspended from two beams X and a hydraulic cylinder I is sustained at each side of the holder by such beams and by bars J to actuate a head h, which is fitted to embrace the upper end of the holder and reciprocated by piston-rods i, moved by the pistons within the cylinders. The mold-sections b are shown with notches k in their opposite sides near the upper end, and pawls g are pivoted in the head and pressed by weights g' toward the sides of the mold when inserted within the holder to engage the notches k. Keys A^3 are inserted through the cylinder f^2 at the bottom of the holder to form an abutment at the joint of the molds.

In operating such machine the mold-sections are inserted in succession at the upper end of the holder and forced downward therein by elevating the head h until the pawls g engage the notches k in the sides of the mold, and then moving the head downward. The holder A A′ is provided with slots at its upper end, into which the pawls may enter when the head is moved downward, as shown in Fig. 1, and the reversal of the upward movement of the head therefore operates to move the mold downward into the position shown in Fig. 2, with its upper end a little below the top of the holder. The first mold inserted would be provided with a bottom and with provision for centering the first core-section, but the molds subsequently used would be bottomless, and would be applied in succession upon one another and moved downward within the holder after they were filled. While the filling of one mold is proceeding at the top of the holder, the mold which has reached the pocket e would be shifted transversely, as shown in Fig. 2, by actuating the hydraulic cylinder f, thus rupturing the ingot in such lowest mold from that in the mold above it. The plunger f' would then be re-

versed to bring such lowest mold-section again in line with the holder, and the subsequent descent of the mold above it would force out from the pocket the mold containing the ruptured ingot.

To form the bore of the ingot, I provide a core of suitable material in separate sections sustained within the mold by any convenient means, each core-section being set within the mold-section as the mold-sections are applied in succession to the holder, and the fluid metal being poured around such core within the mold. To sustain the cores in the desired relation to the mold, which, in casting ingots for making cylindrical tubes, would be in the center thereof, I provide one or both ends of each core-section with a recess and with a stud fitted to such recess, and at the upper end of the mold, where the fluid metal is applied, I provide a movable stud, which may be held over the center of the mold during the pouring operation, with the stud inserted in the recess at the top of the core-section, as shown in Fig. 2, to center the same. Where a reciprocating head is arranged to embrace the top of the holder, such movable stud would be formed upon a pivoted brace fixed to such head. Such brace *p* is shown in Figs. 2 and 3 pivoted upon ears *p'* attached to the head *h*, and has its free end extended over the center of the holder and provided with a stud *e'*. A recess *e* is formed in at least one end of each core-section *t*, and the sections are centered upon one another by forming a dowel *u* directly upon the opposite end of each section, as in Figs. 2 and 4, or by providing both ends of each core-section with a recess and forming a dowel *u'* separate and inserting it in the two recesses at the junction of the sections, as shown in Figs. 5 and 7.

Where the ingots are separated by a transverse shearing operation, as indicated in Fig. 2, the construction shown in Fig. 4 is only applicable where the core is formed of sand or other friable material, as the dowel or core must be adapted to shear off at the junction of the mold-sections.

Figs. 5 and 7 show suitable constructions for a metallic core adapted to chill the interior of the ingot, or to form them with a smoother or more accurate inner surface than can be produced by means of a sand core. Such metallic cores could not be sheared off by the apparatus shown in Fig. 2, and the core-sections must therefore be centered by a friable dowel formed of sand or other friable material, as indicated in Figs. 5 and 7.

The metallic core may be extracted from the ingot when cold by rolling the ingot between parabolic rolls set at an angle with one another, and thus extending the tube diametrically upon the core; or the core may be divided into longitudinal parts t^2 diagonally, as shown in Figs. 7 and 8, by which the separate parts are of wedge shape, and thus adapted to withdraw from the ingot separately. The separate parts are shown united by a dovetail t', which is not extended to the ends of the core, by which construction the larger end of each part is adapted to receive a large recess *e* to fit a friable dowel of suitable size and strength to perform its functions.

To aid in rupturing the ingots from one another when cast in a continuous bar, the core may be formed with an annular projection or bead e^2 at one or both ends, as shown in Fig. 4, which forms an annular groove around the interior of the ingot opposite the joint of the mold-sections, and thus facilitates the rupture of the tubular ingot-bar at such point.

In Fig. 4 the ends of the molds are shown formed with an inward projection *n* around the bore at each end, adapted to indent the exterior of the tubular ingot for the same purpose as the indentation caused by the bead e^2. One or both of such means may be used to weaken the tubular ingot-bar at the junction of the sections.

A layer of asbestus packing may be placed in the joint of the wedge-shaped parts t^2, which form the removable metallic core, to facilitate the removal of the core when the casting is cooled. The yielding character of the asbestus enables the casting to shrink without binding tightly upon the core, and thus enables the parts t^2 to be readily removed.

Having thus set forth my invention, it will be seen that it is not only adapted to form a continuous tubular ingot-bar having an aperture extended throughout the same, but that the form or dimensions of the aperture and its precise relation to the exterior of the ingot are wholly immaterial.

The invention affords means not only of forming an aperture in the ingot by a core of any suitable material, and for sustaining such cores within the mold in any desired relation thereto, but it furnishes means of making compound ingots by applying cores of heated metal adapted to unite with the fluid metal poured around the same. Such compound ingots have been heretofore made in preparing steel for the manufacture of skates and other articles; and it is obvious that by my invention metallic cores of harder or softer metal than the envelope may be readily united with the fluid metal by operating in the manner already well known in the art.

It is immaterial how the brace *p* be held adjacent to the top of the holder; but it is evident that such brace is preferably made movable to facilitate the application of the core-section within each mold-section. It will be noticed that the lower end of each core-section is centered or set in a suitable position within the mold by a stud or dowel connecting it with the preceding core-section, it being assumed that each core-section after the first is held in a suitable position (to guide the subsequent core-section) by the chilling of the fluid metal between the core and the mold. As the object of the brace at the upper end of the holder is merely to cen-

ter or steady the upper end of the core-section until the fluid-metal is poured around it, it is obviously immaterial whether the brace be constructed with a stud to fit a recess in the end of the core-section, or a recess to fit a stud upon the core-section, or with any other suitable construction for bracing the upper end of the core.

Having thus set forth my invention, what I claim herein is—

1. The combination, with a series of bottomless mold-sections and a holder adapted to sustain the same in line with one another during the casting operation, of a series of core-sections sustained within the mold-sections, and provided at their ends with studs for centering the core-sections upon one another, substantially as herein set forth.

2. The combination, with a series of bottomless mold-sections and a holder adapted to sustain the same in line with one another during the casting operation, of a series of core-sections of the same length as the mold-sections, recesses in the ends of the core-sections, and friable dowels inserted in such recesses to center the core-sections, as and for the purpose set forth.

3. The combination, with a series of bottomless mold-sections and a holder adapted to sustain the same in line with one another during the casting operation, of a series of core-sections having each a recess at its upper end, a dowel fitted to such recess between the adjacent core-sections, and a movable brace provided with a stud to engage the recess in the upper end of each core-section in turn, as and for the purpose set forth.

4. The combination, with a series of bottomless mold-sections and a holder adapted to sustain the same in line with one another during the casting operation, of a series of core-sections having each a recess at its upper end, a dowel fitted to such recess between the adjacent core-sections, and a brace pivoted adjacent to the top of the holder and provided with a stud to engage the recess in the upper end of each core-section in turn, as and for the purpose set forth.

5. The combination, with a series of separate bottomless mold-sections superposed upon one another, as set forth, of a series of core-sections of the same length as the mold-sections centered within the same and provided with a projection to weaken the interior of the tubular ingot at the joint of the mold-sections, substantially as herein set forth.

6. The combination, with a series of separate bottomless mold-sections having an inward projection around the bore of the mold at the end to indent the tubular ingot, of a series of core-sections of the same length as the mold-sections centered within the same and provided with a projection to weaken the interior of the tubular ingot at the joint of the mold-sections, substantially as herein set forth.

7. The combination, with a series of separate bottomless mold-sections superposed upon one another, as set forth, of a series of metallic core-sections divided longitudinally at an inclination to their axes, as and for the purpose set forth.

8. The combination, with a series of separate bottomless mold-sections superposed upon one another, as set forth, of a series of metallic core-sections having an inclined longitudinal dovetailed joint and the portions upon the opposite sides of such joint being provided each upon its larger end with a recess to receive a dowel, as and for the purpose set forth.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

JAMES B. D'ARCY BOULTON.

Witnesses:

FREDERICK C. FISCHER,

HENRY J. MILLER.