No. 817,714. PATENTED APR. 10, 1906.

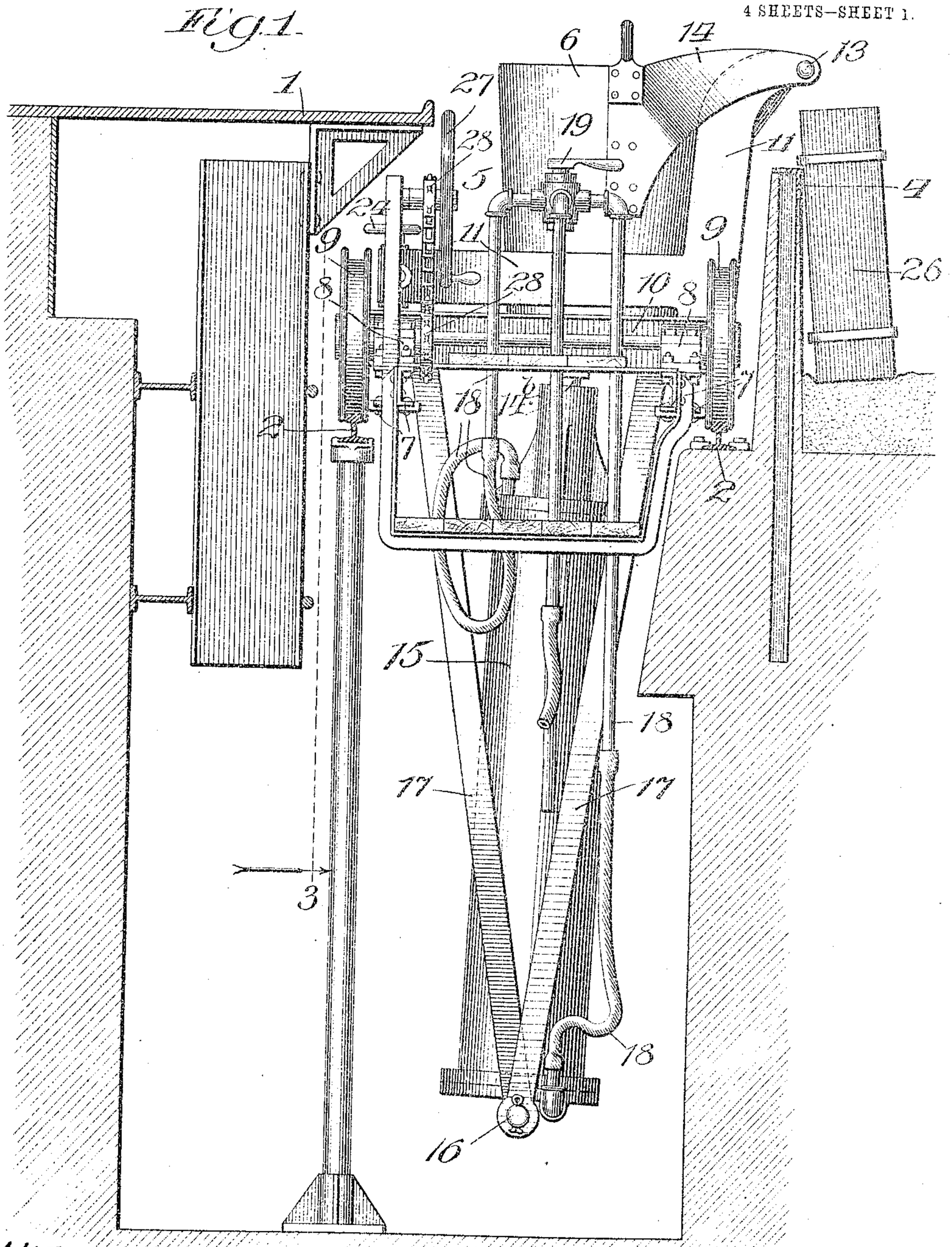
L. E. HOWARD.

APPARATUS FOR CASTING CRUCIBLE STEEL.

APPLICATION FILED DEC. 3, 1904.

4 SHEETS—SHEET 1.

Fig. 1.



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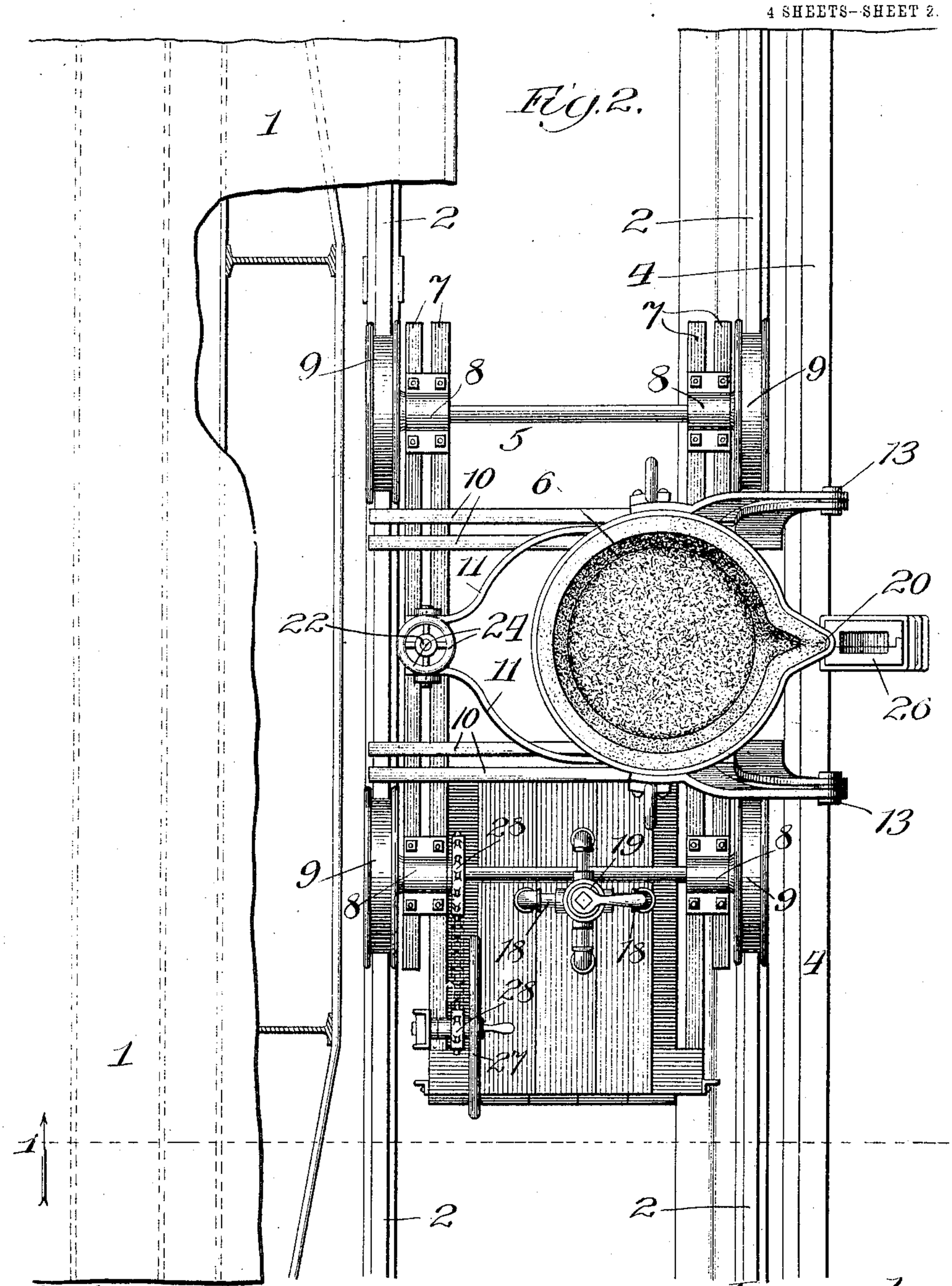
4 SHEETS—SHEET 2.

Fig. 2.



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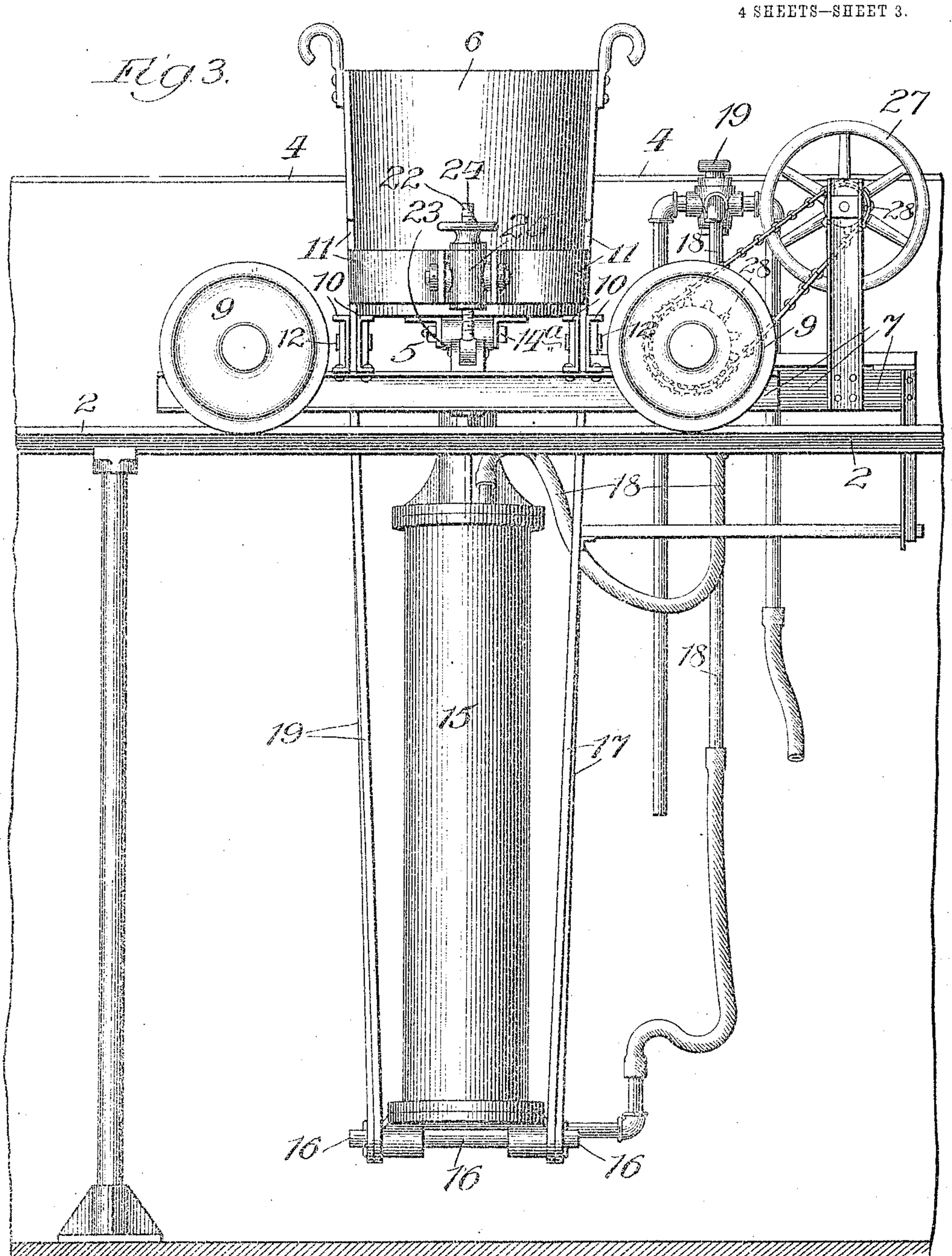
4 SHEETS—SHEET 3.

Fig 3.



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4 SHEETS—SHEET 4

Fig 4.

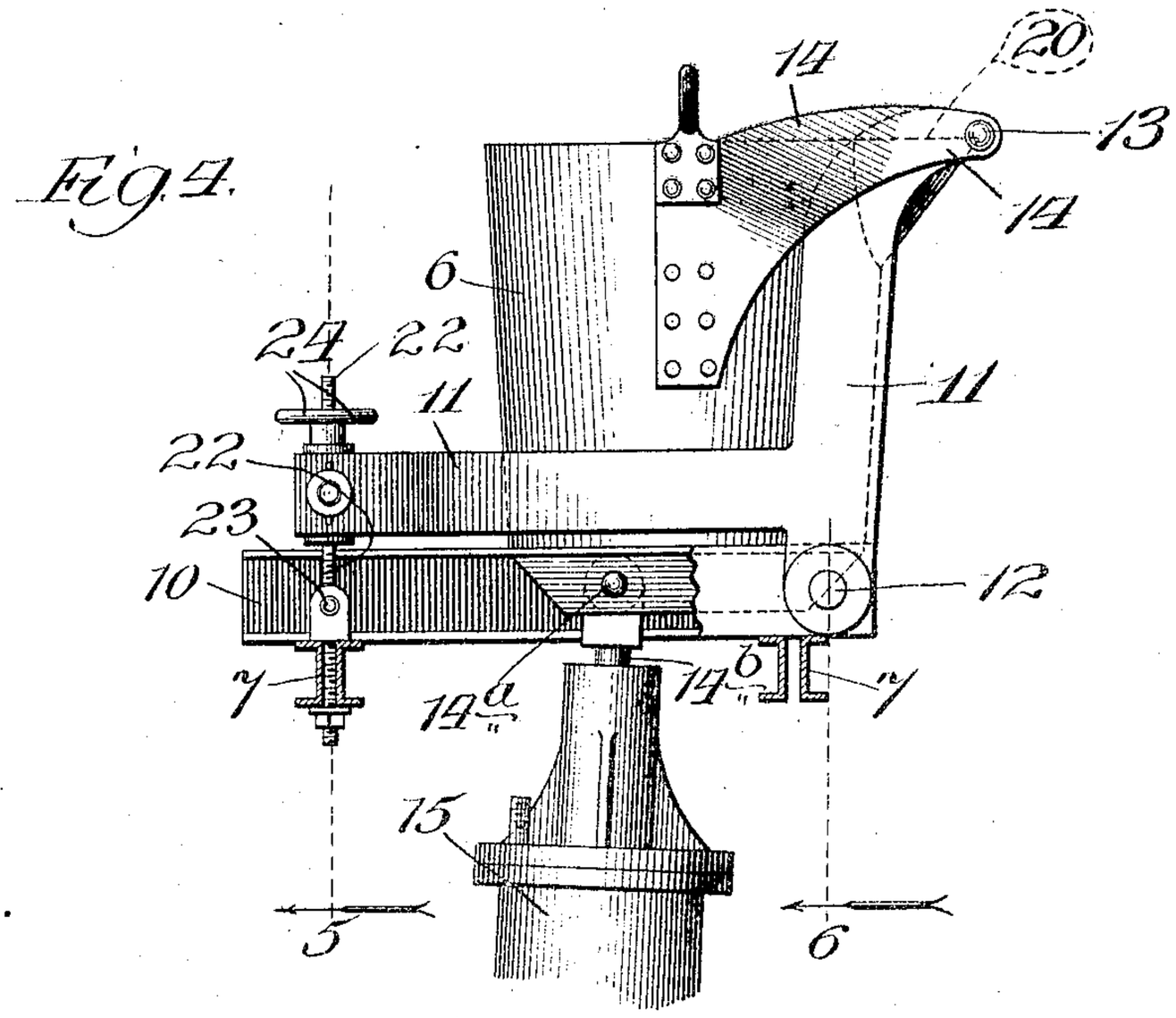


Fig.5.

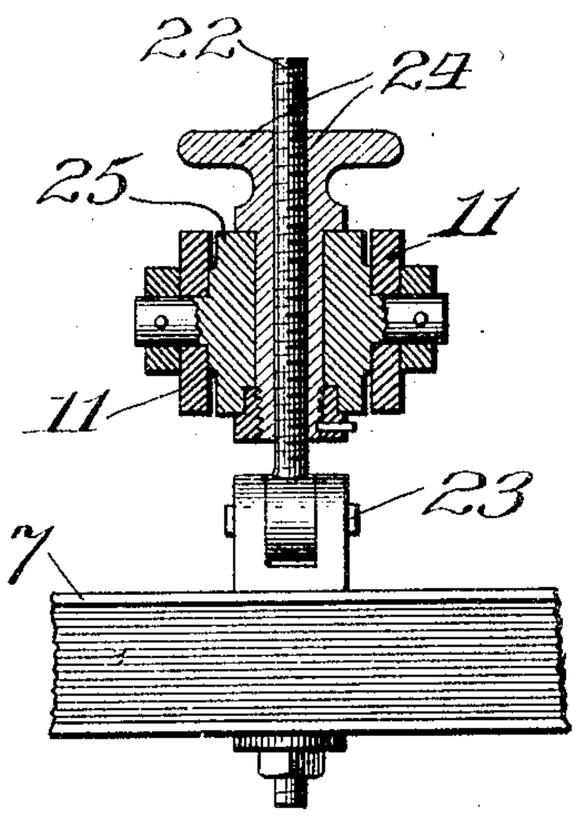
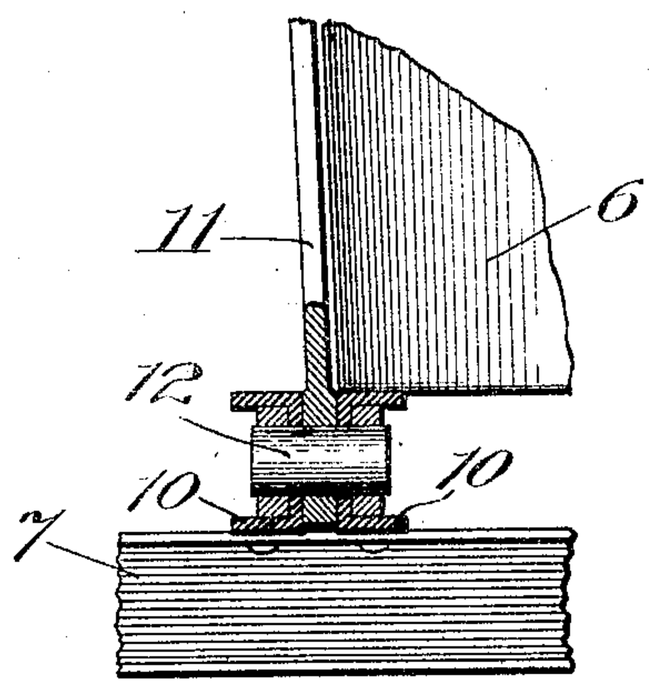


Fig.6.



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UNITED STATES PATENT OFFICE.

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APPARATUS FOR CASTING CRUCIBLE STEEL.

No. 817,714. Specification of Letters Patent. Patented April 10, 1906.

Application filed December 3, 1904. Serial No. 235,282.

To all whom it may concern:

Be it known that I, LESLIE E. HOWARD, a citizen of the United States, and a resident of La Grange, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Apparatus for Casting Crucible Steel, of which the following is a specification.

In the manufacture of crucible steel by processes usually employed it is customary to melt the iron and necessary steel-forming ingredients in a number of separate melting-pots or crucibles each containing but a relatively small quantity, usually less than one hundred pounds. Each crucible, with its contents of molten steel, is then at the proper time drawn from the furnace and poured or teemed by hand into a mold, where it forms the ingot, which is subsequently heated, rolled, hammered or otherwise worked into the desired product. By this method, however, each ingot is formed by the contents of but a single crucible or, at least, of only a few crucibles, so that in producing any considerable quantity of ingots there is certain to be a considerable variation in the resulting product, notably in its carbon content, owing to the fact that the melter is unable to exactly control the process, so as to repeatedly produce just the same quality of steel in the several pots or crucibles with which he is working. No matter how carefully the melting-pots or crucibles may be selected and charged the quality of the steel made in different pots is bound to vary and does inevitably vary to a noticeable extent. In fact, the variation is so great that in practice it is necessary to inspect or analyze each individual ingot in order to insure a uniform product, and more or less of the ingots must inevitably be discarded. This lack of uniformity, with its attendant difficulties, may be entirely overcome by first pouring the contents of the several crucibles or of a considerable proportion of the several crucibles constituting a heat into a container or ladle in which the molten steel becomes uniform by diffusion, particularly the diffusion resulting from the high diffusive power of carbon, and from which container the several ingots are then poured in succession until the ladle is emptied. As a result of this change in the process and of the employment of the intermediate container in which the contents of the several crucibles are diffused into a uniform molten mass the cast of ingots is rendered uniform throughout, each ingot being substantially identical in composition, and particularly in carbon, with every other ingot, so that it is necessary to inspect and analyze but a single sample in order to determine the character of the product and so that the product resulting from each heat will be absolutely uniform in character.

It is the object of the present invention to provide an improved apparatus for carrying out the above-described process; and to the accomplishment of this object and such others as may hereinafter appear the invention consists of the parts and combination of parts hereinafter fully described, and particularly pointed out in the appended claims, reference being had to the accompanying drawings, forming a part of this specification, in which the same reference characters designate like parts throughout the several views.

In the accompanying drawings, Figure 1 is a sectional elevation of my improved apparatus, taken on line 1 of Fig. 2. Figure 2 is a top plan view thereof. Fig. 3 is a rear elevation thereof viewed from line 3 of Fig. 1. Fig. 4 is a detail of the ladle and its supporting-cradle. Fig. 5 is a sectional detail taken on line 5 of Fig. 4. Fig. 6 is a similar detail taken on line 6 of Fig. 4.

In said drawings, 1 designates the platform of any suitable crucible-steel furnace, (not otherwise herein illustrated,) and 2 the rails of a track which runs along the front of the platform and extends to any desirable length between the platform and an ingot-rack 4. This track serves to support a rolling carriage 5, within which a container or ladle 6 is suitably cradled.

As herein shown, the carriage 5 is composed of longitudinal channels 7, upon which the journal-bearings 8 for the supporting-wheels 9 of the carriage are provided, and of transverse channels 10, which rest upon the longitudinal channels 7 and upon which the cradle for the ladle is mounted. This cradle is shown in detail in Fig. 4 and comprises a pair of L-shaped side bars 11, which are pivoted at their angles to the transverse chan-

nels 10 and 12, and between the upper ends of which the ladle 6 is pivotally hung at 13 by means of brackets 14, that are rigidly secured to the ladle and extend thence upwardly and forwardly to the pivots 13.

The tilting of the ladle and its necessary further support are accomplished by pivotally securing its bottom to the upper end 14^a of a plunger-rod 14^b, that works in and out of a double-acting cylinder 15. This cylinder is itself pivotally mounted at its lower end upon a trunnion bar or rod 16, that extends between two pairs of downwardly-converging frame-bars 17, the upper ends of which are secured to the transverse channels 10 of the carriage. Water or other fluid under pressure is admitted to and expausted from the cylinder 15 through suitable pipes 18, controlled by an ordinary four-way valve 19, to force out or retract the piston and to consequently tilt the ladle, as desired.

As an important feature of construction, furthermore, the ladle is so shaped that its pouring-lip 20 coincides substantially in location with the axis of the pivots 13, upon which the ladle swings in its cradle, and consequently this lip always discharges the contents of the ladle from the same point regardless of the amount of such contents or the extent to which the ladle may be tilted. The position of the pivots 13 and of the pouring-lip 20 is, however, made adjustable relatively to the carriage, so that the point of discharge of the ladle may be regulated as desired with reference to the ingot-rack 4, and for this purpose the converging rear ends of the L-shaped cradle-bars 11 are adjustably connected with the carriage-framework in such manner as to enable them to be raised and lowered to swing the cradle on its pivots 12. As herein shown, such adjustable connection between the rear converging ends of the bars 11 and carriage-frame is formed by a screw-bolt 22, which is pivotally secured at its lower end 23 to one of the channels 7 and which carries a screw-threaded hand-wheel 24, that indirectly engages said end portions of the side bars 11 through an oscillating coupling 25. By turning the hand-wheel 24 up or down on the screw 22 the tilting of the cradle may obviously be accomplished to the end above mentioned.

The operation of the apparatus thus described will be readily understood. The numerous crucibles, each of which can only be large enough to contain a small quantity of steel, for the reason that the crucibles must necessarily be handled manually, as has been demonstrated by years of experience, are charged with the iron and other steel-making ingredients and stowed away in the furnace, where they are allowed to remain some hours and until the melting of the metal is completed. The crucibles are then drawn out upon the platform 1 of the furnace and poured one by one into the ladle 6. The ingot-molds 26, arranged along the ingot-rack 4, are then filled in succession from the ladle, the tilting of which to pour the metal into the mold is controlled by the four-way valve 19, that admits the pressure to the cylinder 15, the carriage being advanced along the track after each mold is filled to bring the spout of the ladle opposite the next succeeding mold. The filling of the ladle with the contents of many crucibles causes its contents, particularly carbon, to diffuse themselves throughout the ladle in a mass of molten steel of uniform composition, and since all of the ingots are poured from this uniform composition their composition in turn is uniform, as is also the product which results when these ingots are worked into final form. A single analysis or other examination of any one of the ingots may now be relied upon as correctly indicative of the composition of all of other ingots resulting from the same heat, and if the charging of the crucibles has been generally correct none of the ingots will require to be discarded, since each will represent the proper average of the several charges, notwithstanding that the contents of the crucibles themselves may have varied considerably owing to differences in charging or to the different extent to which the metal may have been affected in the several pots by the composition of the pots themselves or to other uncontrollable factors inherent in the process. Owing to the relatively stationary position of the pouring-lip of the ladle no difficulty can be experienced in directing the flow of metal properly from the ladle into each of the ingot-molds, the position of which with respect to the ladle and carriage will be determined and kept uniform by the rack 4, and the original adjustment of the lip of the ladle with respect to all of the ingot-molds can be readily accomplished by a manipulation of the hand-wheel 24. Any suitable arrangement of flexible tubing or the like can be utilized to supply fluid-pressure to the cylinder 15 of the movable carriage, and the pipes 18 are herein shown as also composed in part of flexible tubing to permit of the necessary swinging movement of the cylinder within the carriage. The moving of the carriage itself along on its tracks can be accomplished by a suitable motor or by hand, and in this instance I have shown for the purpose a hand propelling device, consisting of a hand-wheel 27, connected by sprocket-chain and wheels 28 with one set of the supporting-wheels 9 of the carriage, which thus also becomes a driving-wheel.

Obviously many changes may be made in the details of the construction shown without departure from the broad spirit of the invention claimed, and it will also be obvious that the several features of improved construction in the mechanism described may be advan-

ageously employed separately or in connection with, but a part of, the other features set forth, and for the carrying out of other processes than that to which this application more particularly relates, if so desired.

I claim as my invention—

1. The combination with a platform and a ladle-supporting frame thereon, of a ladle pivotally mounted in said frame and having its pouring-lip coincident with its axis of pivotal movement, and means for bodily and simultaneously shifting the pivots of the ladle with respect to the platform and without affecting their alinement with the pouring-lip, substantially as set forth.

2. The combination with a platform and a ladle-supporting frame, of a ladle pivotally mounted in said frame and having its pouring-lip substantially coincident with its axis of pivotal support, means connected to said frame for bodily and simultaneously shifting the pivots of the ladle with respect to the platform and without affecting their alinement with the pouring-lip, a cylinder pivotally mounted in proximity to the ladle and having its plunger-rod pivotally connected therewith, and means for supplying fluid-pressure to and exhausting it from the cylinder, for the purpose set forth.

3. The combination with a pivotally-mounted cradle, of a ladle pivotally supported in the cradle and formed with its pouring-lip substantially coincident with its axis of pivotal support, means for tilting the ladle, and means for adjustably tilting the cradle to vary the position of the pouring-lip of the ladle, substantially as described.

4. The combination with a carriage, of a cradle pivotally mounted on the carriage and consisting of a pair of L-shaped side frames pivotally connected at their angles to the carriage, an adjustable connection between the lower rear ends of the cradle-bars and the carriage to enable the cradle to be tilted on its pivots, and a ladle pivotally mounted between the upper ends of the L-shaped cradle-bars, substantially as described.

5. The combination with a rolling carriage, of a cradle pivotally mounted on the carriage, a ladle pivotally supported in the cradle and formed with a pouring-lip substantially coincident with its axis of pivotal support, means for adjustably tilting the cradle to vary the position of the supporting-lip on the carriage, and a cylinder trunnioned in the carriage beneath the ladle, with its plunger-rod engaging the ladle to tilt the latter, substantially as described.

6. In an apparatus of the class described, the combination of a track, a carriage mounted to run on said track and carrying a ladle-platform, an upright frame pivotally supported at one side of this platform, means for tilting this frame for the purpose set forth, a ladle pivotally connected to the upper end of said frame, the pouring-lip of this ladle being in line with its axis of pivotal movement, and means supported on the carriage for tilting the ladle.

7. In combination with a track, of a carriage mounted on said track, a ladle-supporting frame mounted on said carriage, a ladle pivotally mounted on said frame and adapted to tilt toward one side of the track, a frame depending from the carriage and carrying a pivotally-supported upright cylinder, a piston-rod working in this cylinder and pivotally connected to the bottom of the ladle, a valve and fluid-conducting pipes mounted on the carriage, and flexible connections between these pipes and the cylinder.

In testimony that I claim the foregoing as my invention I affix my signature, in presence of two subscribing witnesses, this 30th day of November, A. D. 1904.

LESLIE E. HOWARD.

Witnesses:
HENRY SAEHTLEBEN,
ROBERT N. HEYDEN.