March 3, 1959 C. A. HAMILTON ET AL 2,875,482

PROCESS AND APPARATUS FOR THE PRODUCTION OF SAND MOLDS

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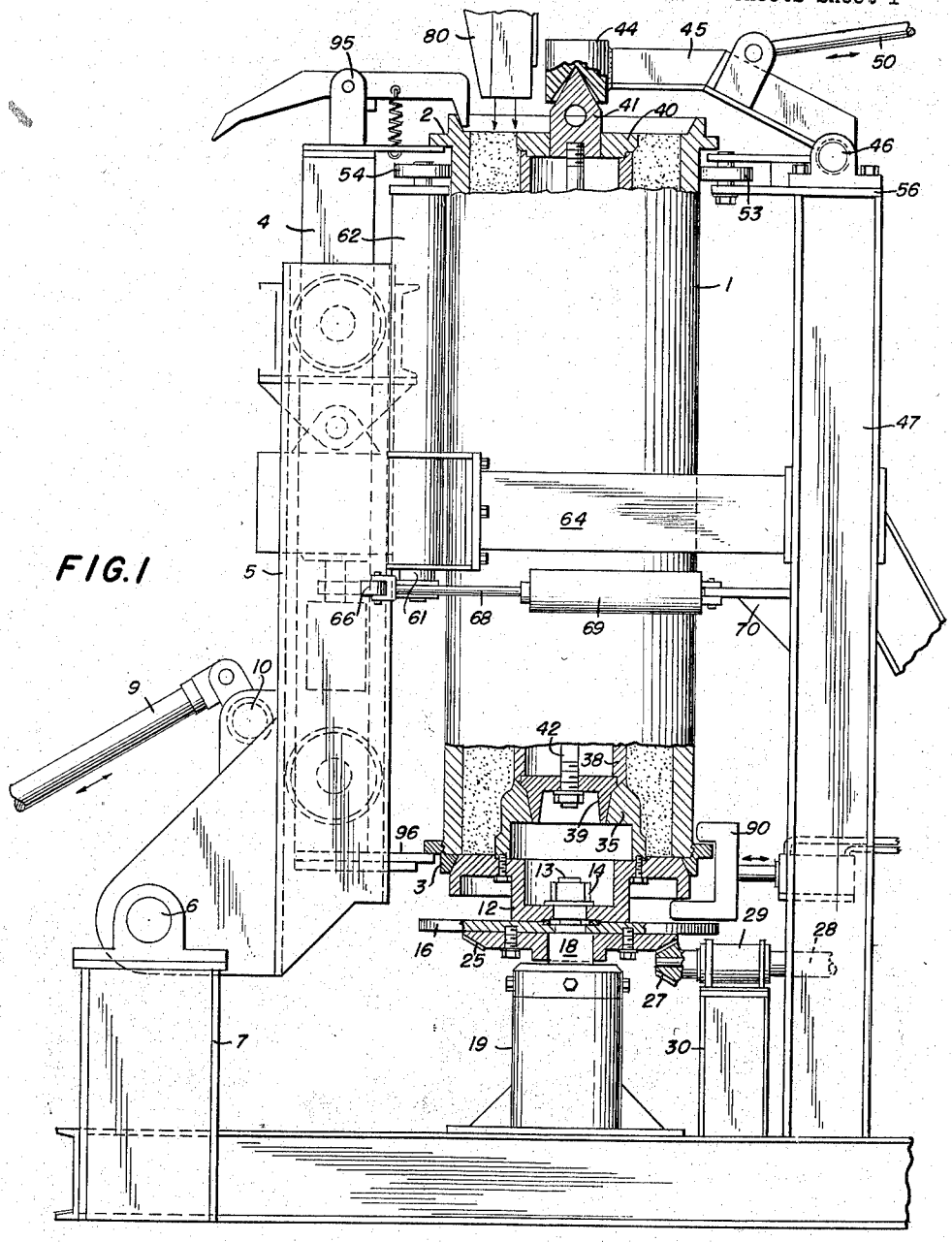


FIG. 1

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FIG. 2

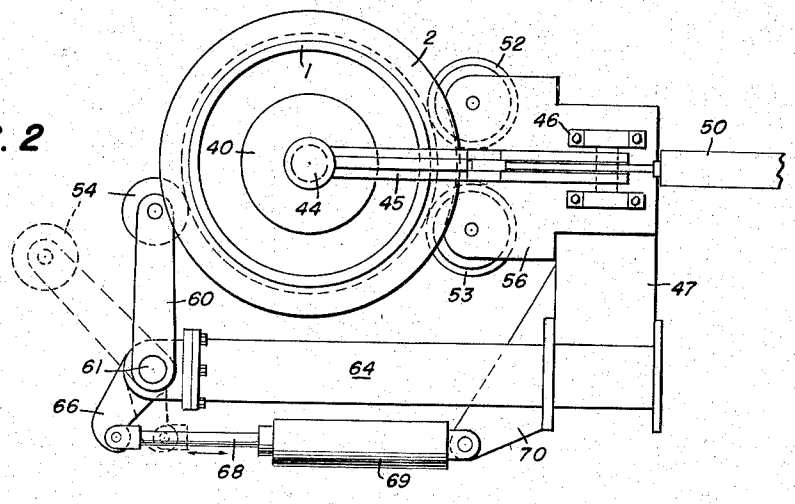
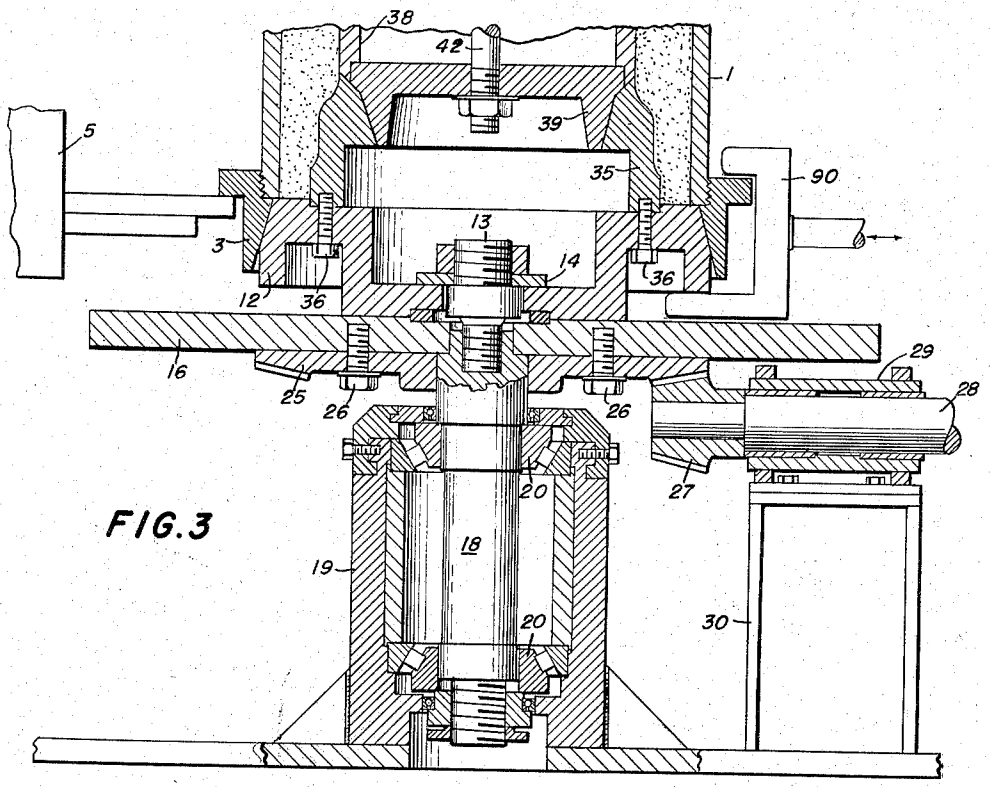


FIG. 3



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PROCESS AND APPARATUS FOR THE PRODUCTION OF SAND MOLDS

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Application April 9, 1957, Serial No. 651,609

2 Claims. (Cl. 22—16)

The present invention relates to the centrifugal casting of molten metals and more particularly to the preparation of sand molds which are employed in such centrifugal casting. This application constitutes a continuation-in-part of our application, Serial No. 651,608 filed on April 9, 1957.

The formation of sand molds of uniform configuration and consistency, essential to the mass production of metal castings by known centrifugal processes, has occasioned considerable difficulties in the past. It has not been possible to ram the sand core into the cavity between the flask walls and the inner pattern to provide a homogeneous filling, the resultant areas of lessened density creating rough spots upon the surface of the ultimate casting formed in the mold. Additionally, the so-called "weak"spots in the sand molds frequently cause a collapse of the mold upon removal of the pattern from the mold and it is necessary to reprocess the mold before it can be used in the casting operation.

It is a principal object of the present invention to provide an improved method of preparing sand molds to be employed in the centrifugal casting of metal shapes, whereby uniformity of mold bodies is increased.

Another object of our invention is to provide a method of preparing sand molds to be employed in the centrifugal casting of hollow metal shapes, wherein sand is forceably injected into a predetermined cavity established within a casting flask maintained in vertical position and undergoing rotation about its longitudinal axis to establish a core mold of uniform body density.

A further object of our invention is to provide a means of spin forming sand molds which are particularly adapted to the centrifugal casting of metal pipes.

Other objects and advantages of our invention will be readily apparent from the following detailed description of a preferred embodiment thereof when taken in conjunction with the accompanying drawings, wherein:

Figure 1 is a side elevation, partly in section, of apparatus adapted to the vertical spin forming of sand molds as contemplated by our invention;

Figure 2 is a top plan view thereof, portions being removed for clarity; and

Figure 3 is a fragmentary vertical sectional view on an enlarged scale of the support and drive means of the apparatus.

Referring to the drawings, a tubular shell flask 1 of steel or other suitable material equipped with rim guides 2 and 3 at its ends is transported by a lift frame mechanism 4 vertically reciprocable in a supporting carriage 5 pivoted at 6 upon suitable framing elements and actuated by a control arm 9 pivotally connected therewith as at 10 from a horizontal trackway (not shown) intersected by the carriage 5 into vertical position for charging. The lift mechanism 4 is adapted to lower the shell flask 1 onto a base mount 12 centrally secured by bushing 13 and spaced collars 14 to a horizontally disposed spinning table 16 welded to a vertical shaft 18 supported within a housing 19 upon spaced tapered

roller bearings 20, so designed as to take both upward and downward loads on the table 16. A bevel ring gear 25 secured by any suitable means, as for example stud bolts 26, to the underside of the spinning table 16 is engaged by a spur gear 27 keyed to the end of a shaft 28 in a suitable pillow block 29 carried upon a supporting frame element 30, the shaft 28 being driven from any convenient source of power to obtain any desired speed of rotation of the table 16.

A pattern base 35 is secured to the top face of the base mount 12 by means of stud bolts 36. The pattern base 35 has one contoured surface of any desired configuration, as for example, that of the lower hub or bell of a soil pipe. A core pattern 38 carrying a machined centering ring 39 adapted to engage the inner taper on the lower hub pattern, as shown in Figure 3, is also provided at its top with a centering plate 40 from which projects upwardly a pivot point 41, the two centering elements being united by a tie rod 42, all disposed within the shell flask 1 to define the cavity in which the ultimate sand mold is to be formed. The top element 40 and the inner core pattern 38 are centered by adjustment of a live center guide 44 coacting with the point 41, the guide 44 being carried on an extension arm 45 suitably pivoted as at 46 on an element 47 of the supporting frame and movable by means of an actuating mechanism 50.

The shell flask 1 is centered at the bottom by its engagement through the rim guide 3 with the tapered annular edge of the base mount 12. At the top, the flask 1 is centered by cooperation of three rollers, 52, 53 and 54, two of which are maintained in definitely spaced relation and are mounted between brackets 56 projecting inwardly from the frame element 47. The third roller 54 is carried upon an arm 60 secured to and projecting outwardly from a shaft 61 disposed centrally of a vertically maintained bearing 62 mounted upon a bracket 64 extending inwardly from the frame element 47 in spaced relation to the bracket 56. The lower end of the shaft 61 has attached thereto a bell crank 66 to which is linked a rod 68 movable by means of a hydraulic cylinder 60 mounted upon a platform 70 extending from the frame element 47 and actuated by conventional controls. The fixed rollers 52 and 53 and the movable roller 54 combine to secure proper alignment of the shell flask 1.

The flask and pattern 38 having been properly positioned and centered, the table 16 is rotated and the sand mold is formed by deposition in the cavity between the flask 1 and pattern 38 of sand ejected in the form of wads or slugs from a conventional stationary sand slinger 80 mounted above the rotating shell flask 1. Some excess sand can be introduced and a fixed cutter blade used to strike off the sand flush with the top of the pattern.

After the sand mold has been formed, an electric hoist or the like is brought into engagement with the top center 41, the guide element 44 having been removed, and the pattern 38 is withdrawn from the flask 1. In order to avoid possible displacement of the flask 1 during this operation, a clamp 90 is moved into position over the rim guide 3 of the flask and the edge of the mold plate 12 to lock the two elements together. The clamp 90 is removed following withdrawal of the pattern 38 and the frame 4 is elevated in its supporting carriage 5 so as to raise the flask 1 and its contained sand core above the pattern base to provide clearance for return of the flask 1 to its horizontal position upon the adjoining track for transportation to the charging station. A spring biased clip 95 coacts with the flask 1 and lift element 4 to prevent lateral displacement of the flask 1 during its translatory movements while the projecting plates 96 engaging rim guides 2 and 3 support the flask

1 as it is being raised from or lowered onto the spinning table 16.

The material injected into the flask 1 to form the core can be a regular molding sand, either synthetically or naturally bonded. A preferred sand is a synthetic bonded silica sand containing about 10% by weight of bentonite clay for additional bonding strength and about 3½% by weight of carbon to aid in parting the sand from the ultimate casting produced in the mold. To assist in the formation of charging pellets or slugs within the sand slinger, the sand should contain slightly in excess of 3% by weight of water. The described composition should have a green strength of from 12 to 14 and a permeability of from 95 to 110.

The speed of rotation of the shell flask will determine the density of the sand core formed therein. For most molds, it is preferred that the flask turn one-half lap for each pellet or wad of sand injected therein from the sand slinger. A sand slinger can deliver 1800 wads per minute and each wad is approximately 4 inches long. One-half lap would be the equivalent of two inches of travel per wad or 3600 inches per minute. It follows, therefore, that the inside diameter of the mold will be travelling at the rate of 300 feet per minute. If the mold is too soft, a slight increase in speed of rotation of the flask will cause the sand to pack and harden the mold. Conversely a softer mold will follow a slowing up of the rotation speed. Manifestly, the depth of the mold to be formed as well as its thickness will materially affect the rate of formation, but a standard length pipe mold can be formed in at least 45 seconds.

A mold produced within a vertically rotating shell flask exhibits an improved resistance to mechanical failures while being transported from the forming station to the casting area. The core molds of our invention are more rapidly formed through the use of the vertically rotating shell flask and the material efficiencies of the contemplated method are manifest.

It will be obvious that various modifications in the structural elements incorporated in our apparatus and their arrangement as well as in the procedural details are possible without departing from the spirit of the invention or the scope of the appended claims.

What we claim is:

1. Apparatus for the production of lined molds for use in centrifugally casting hollow cylindrical metal objects, comprising a rotatable, horizontally disposed table, a portable cylindrical shell flask, flask supporting frame elements associated with said table, one of said elements being pivoted adjacent its lower end for swinging movement from horizontal to vertical positioin, means for swinging said pivoted element on its pivot, means on said pivoted element for releasably retaining said flask to position the same vertically on said table and remove it therefrom, means for centering said flask in vertical position on said table for rotation therewith, means for securing a cylindrical core pattern in said vertically positioned flask in concentrically spaced relation thereto, a sand slinger mounted above said shell flask in fixed relation thereto and to the pattern therein, for injecting a lining material into the space between the core pattern and the flask, and means for rotating the table and cored flask during the feed of lining material thereto.

2. Apparatus as claimed in claim 1 including a removable core pattern and means to facilitate removal of said core pattern from said shell flask and said shell flask from said table.

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