Sept. 12, 1967 E. Q. SYLVESTER 3,340,926

CASTING APPARATUS

Filed July 14, 1964 9 Sheets-Sheet 1

Fig. 1.

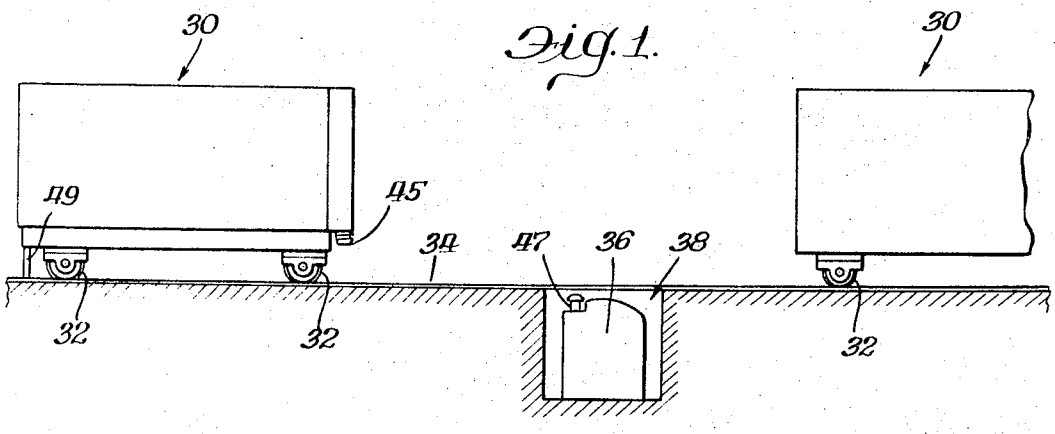


Fig. 2.

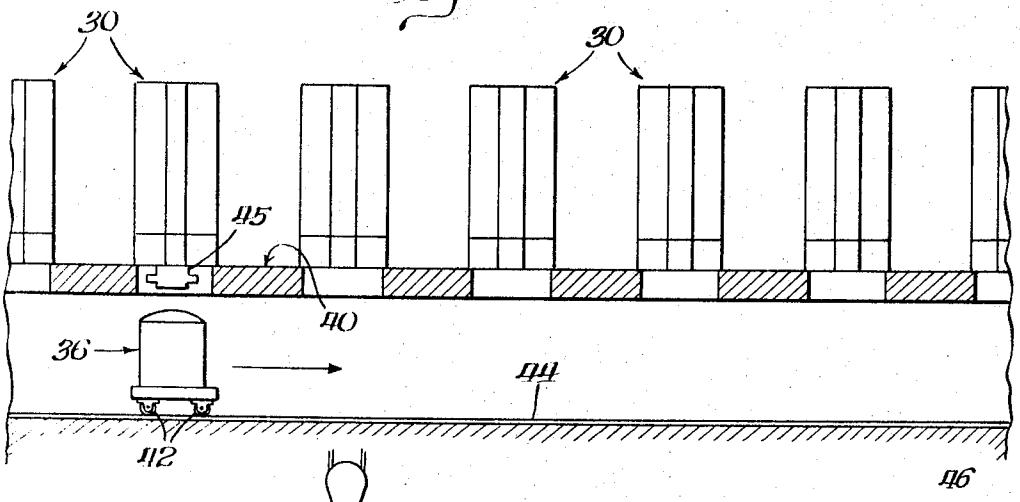
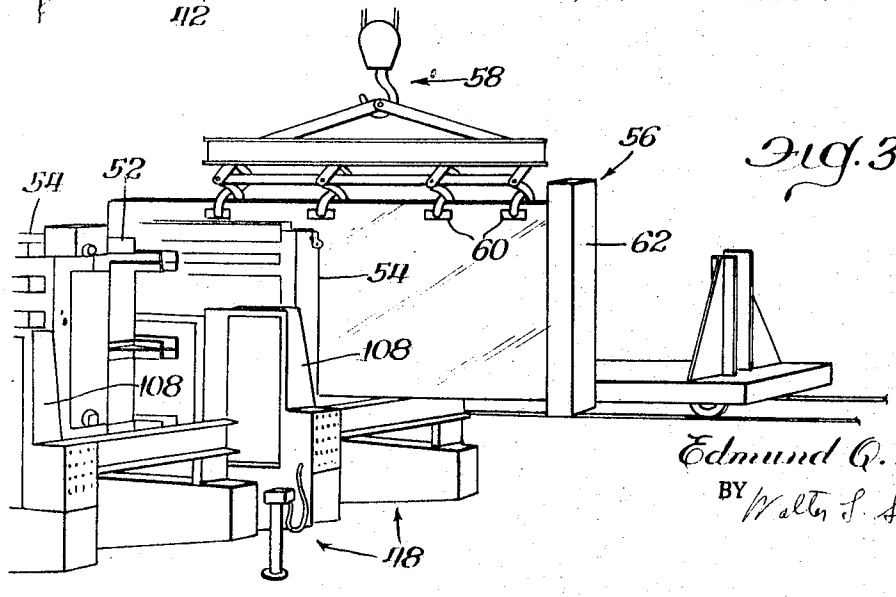


Fig. 3.



INVENTOR.
Edmund Q. Sylvester
BY Walter J. Sellegel, Jr
Atty.

Sept. 12, 1967 E. Q. SYLVESTER 3,340,926

CASTING APPARATUS

Filed July 14, 1964 9 Sheets-Sheet 2

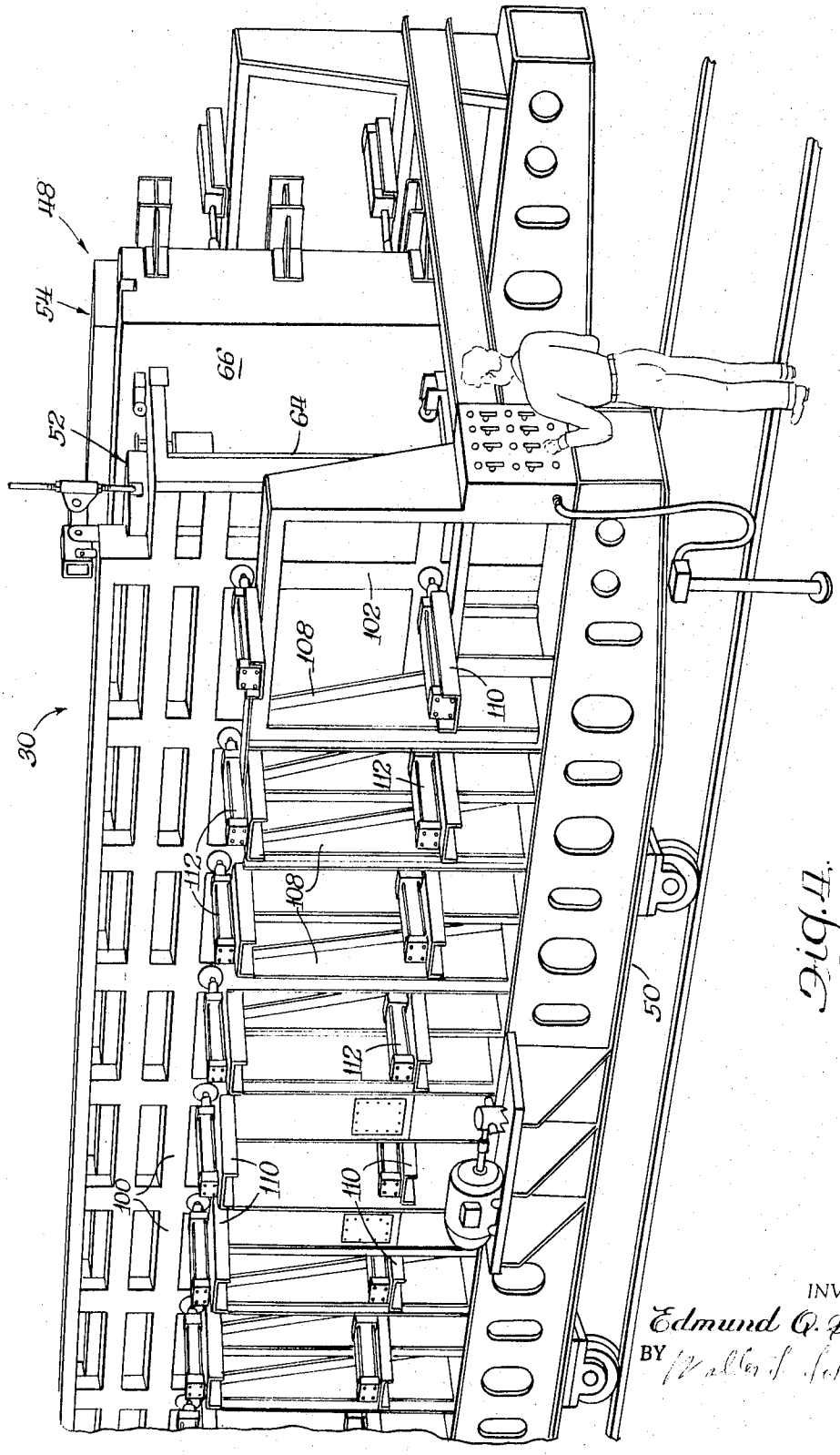


Fig. 2

INVENTOR.
Edmund Q. Sylvester
BY Walter J. Schlegel, Jr.
Atty.

Sept. 12, 1967 E. Q. SYLVESTER 3,340,926

CASTING APPARATUS

Filed July 14, 1964 9 Sheets-Sheet 3

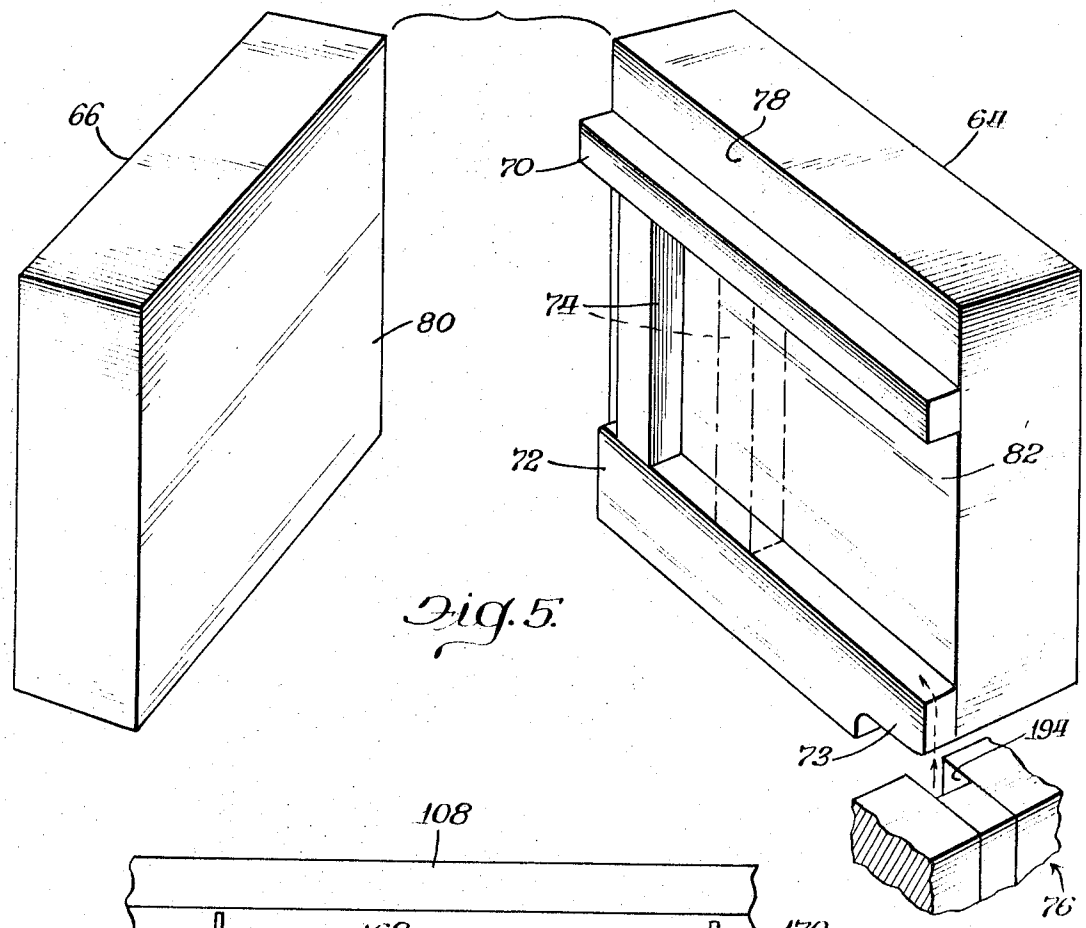


Fig. 5.

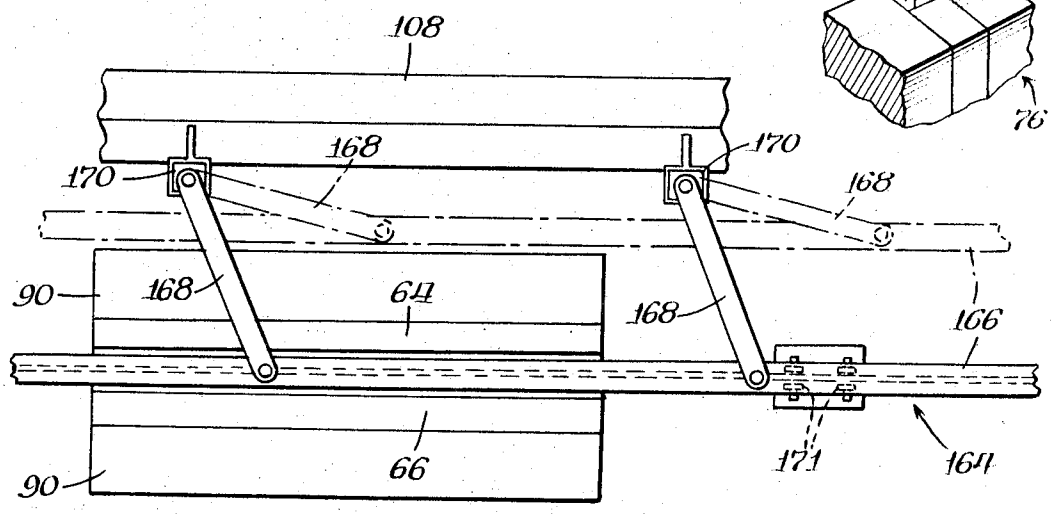


Fig. 6.

INVENTOR.
Edmund Q. Sylvester
BY Walter J. Schlegel, Jr.
Atty.

Sept. 12, 1967 E. Q. SYLVESTER 3,340,926

CASTING APPARATUS

Filed July 14, 1964 9 Sheets-Sheet 4

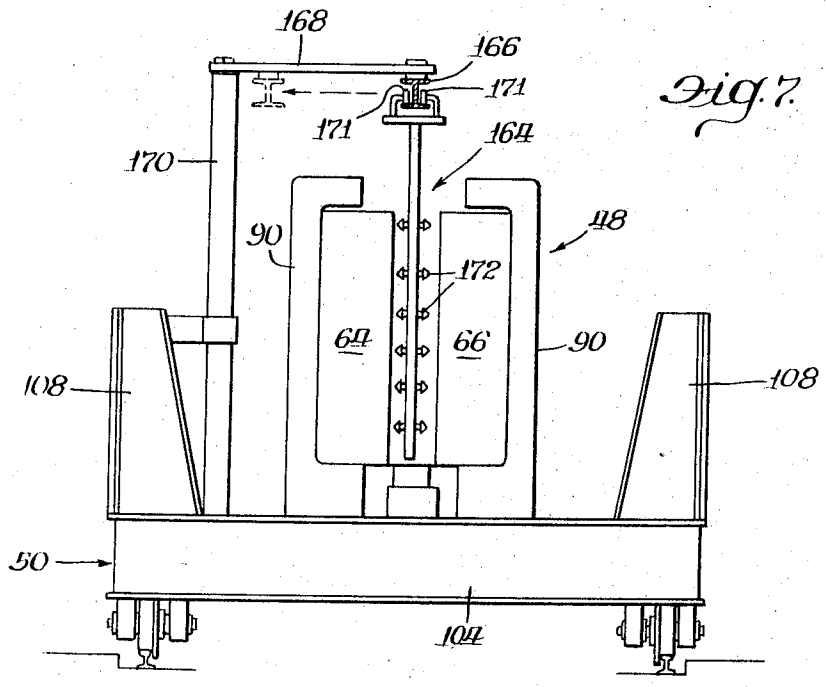


Fig. 7.

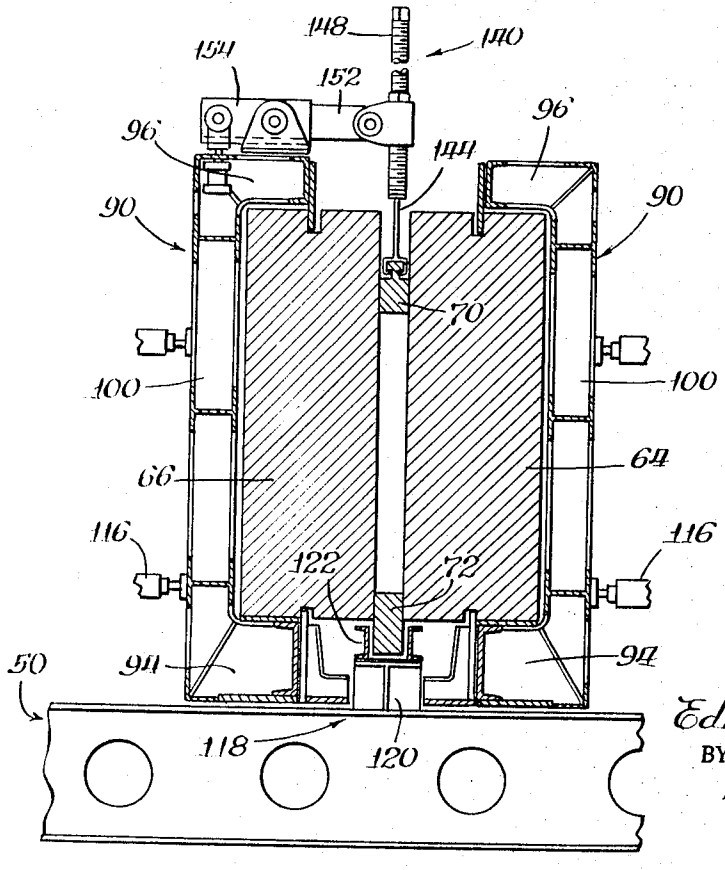


Fig. 8.

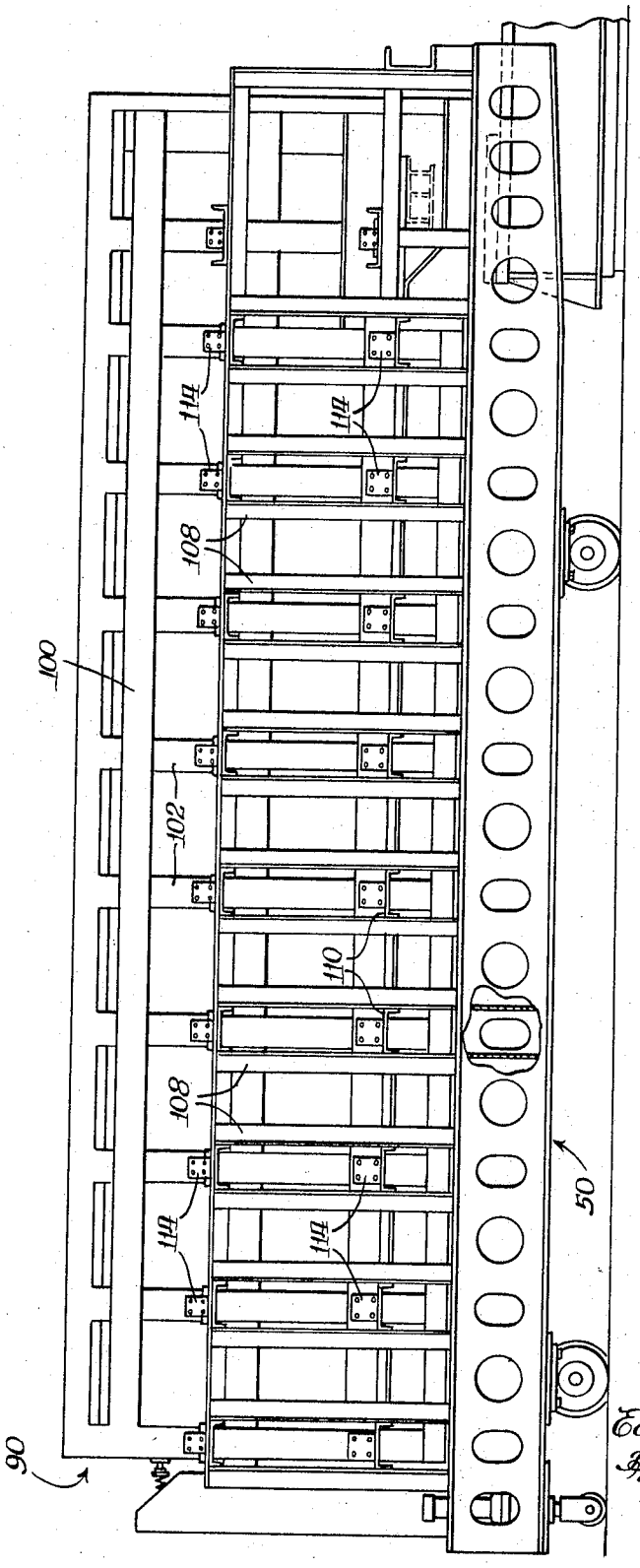
INVENTOR.
Edmund Q. Sylvester
BY
Walter J. Schlegel, Jr.
Atty.

Sept. 12, 1967 E. Q. SYLVESTER 3,340,926

CASTING APPARATUS

Filed July 14, 1964 9 Sheets-Sheet 5

Fig. 9.



INVENTOR.
Edmund Q. Sylvester
By: Walter L. Schlegel Jr
Atty.

Sept. 12, 1967 E. Q. SYLVESTER 3,340,926

CASTING APPARATUS

Filed July 14, 1964 9 Sheets-Sheet 6

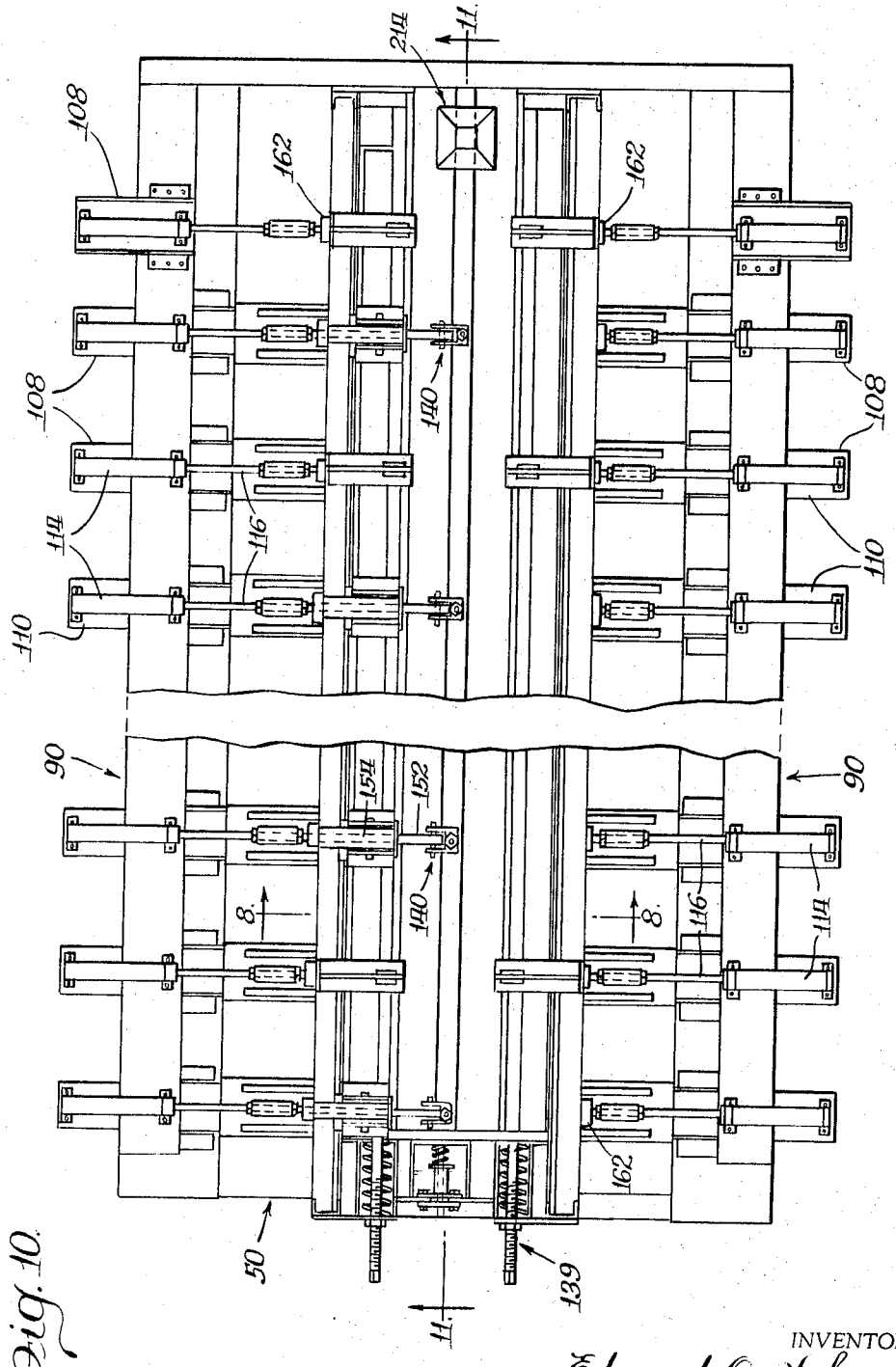


Fig. 10.

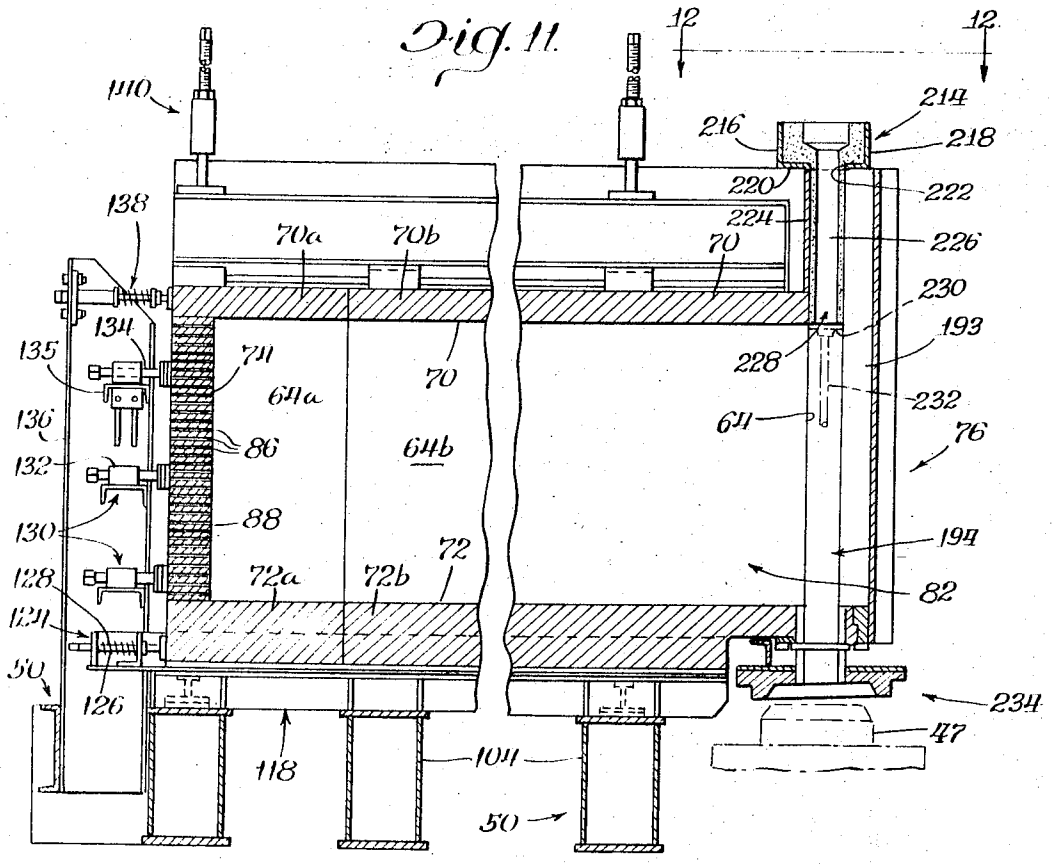
INVENTOR.
Edmund Q. Sylvester
BY Walter J. Schlegel, Jr
Atty.

Sept. 12, 1967 E. Q. SYLVESTER 3,340,926

CASTING APPARATUS

Filed July 14, 1964 9 Sheets-Sheet 7

Fig. 11.



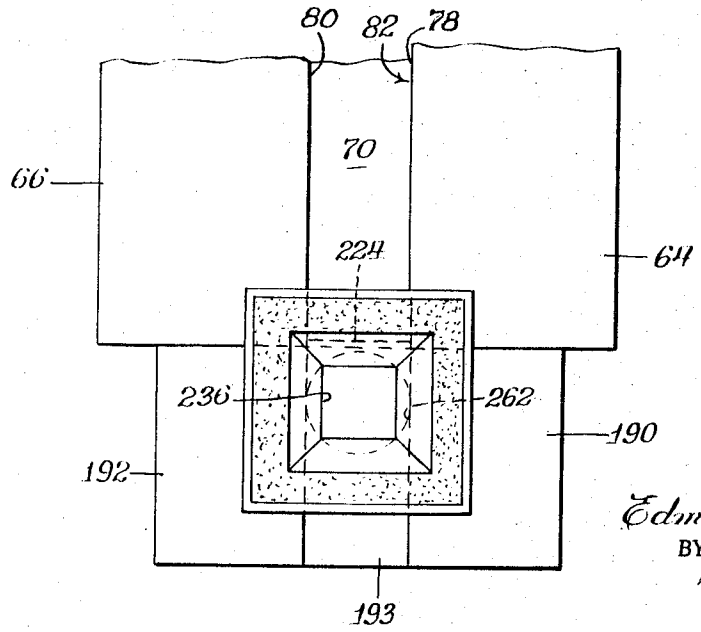


Fig. 12.

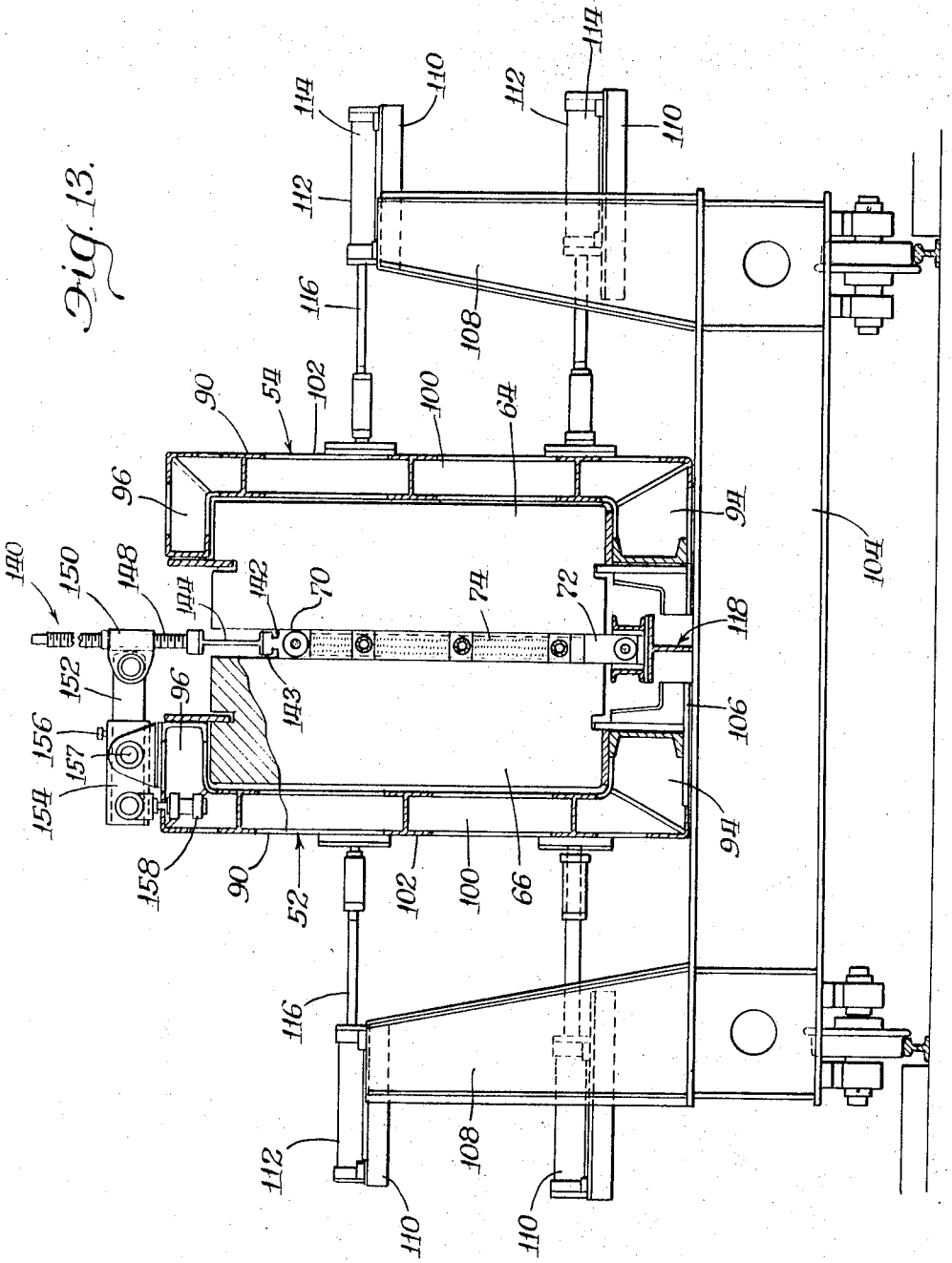
INVENTOR.
Edmund Q. Sylvester
BY
Walter J. Schlegel, Jr.
Atty.

Sept. 12, 1967 E. Q. SYLVESTER 3,340,926

CASTING APPARATUS

Filed July 14, 1964 9 Sheets-Sheet 8

Fig. 13.



INVENTOR.
Edmund Q. Sylvester
BY Walter J. McCarthy, Jr.
Atty.

Sept. 12, 1967 E. Q. SYLVESTER 3,340,926

CASTING APPARATUS

Filed July 14, 1964 9 Sheets-Sheet 9

Fig. 15.

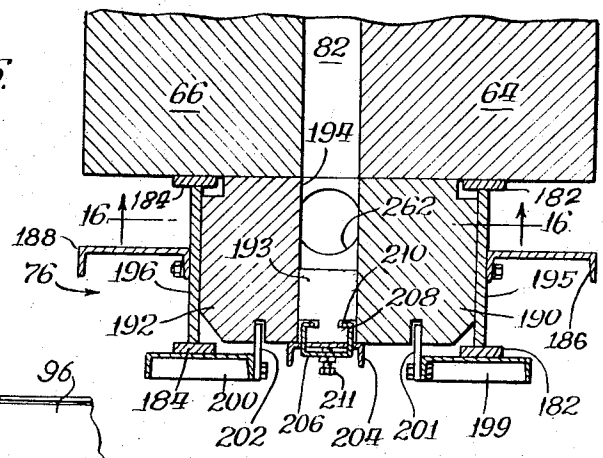


Fig. 14.

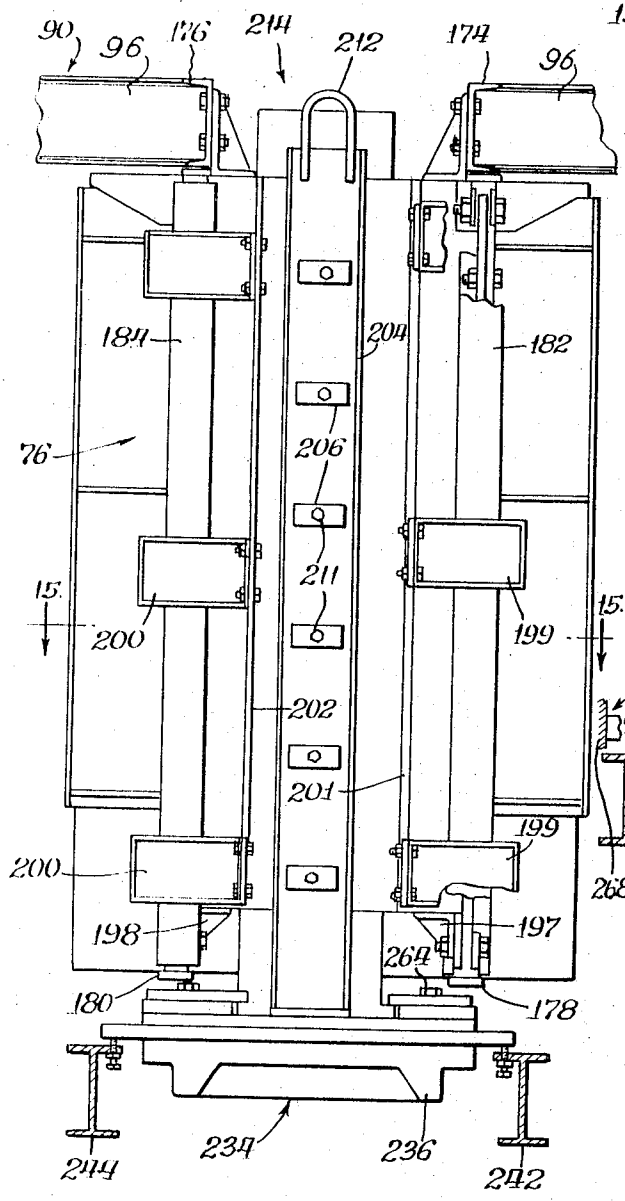
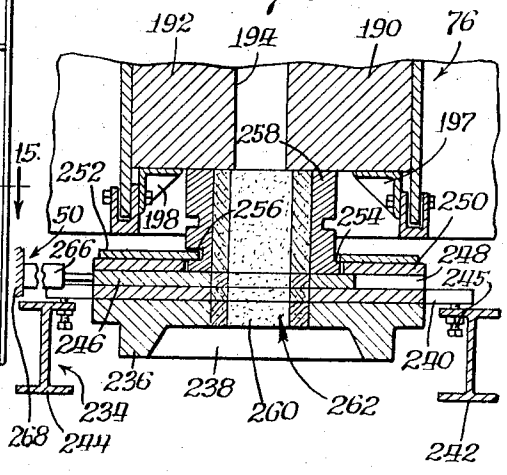


Fig. 16.



INVENTOR.
Edmund Q. Sylvester
BY Walter J. Schlegel, Jr
Atty.

United States Patent Office 3,340,926
Patented Sept. 12, 1967

3,340,926

CASTING APPARATUS

Edmund Q. Sylvester, Shaker Heights, Ohio (% Sylvester Enterprises, 850 Hanna Bldg., Cleveland, Ohio 44115)

Filed July 14, 1964, Ser. No. 382,533
21 Claims. (Cl. 164—323)

This invention relates generally to the art of casting and more specifically to an apparatus for the pressure casting of molten metal.

Present practice of the metal founding industry and more specifically the steel industry, requires the casting of ingots which are subsequently processed through various necessary preliminary conditioning operations such as cropping, grinding and/or scarfing in order to prepare such ingots for subsequent rolling operations whereby the ingots are formed into various sizes of slabs, blooms or billets. Such rolled products are then in turn used in forming finished mill products such as beams, plates, sheets or rails.

Methods have been proposed whereby the steps of casting ingots, conditioning the ingots for subsequent rolling, and the rolling of slabs, blooms or billets can be eliminated. Such methods involve a pressure casting operation and usually require the use of a chill mold, as one made of graphite, wherein a cavity having the shape of either a slab, billet, or bloom is formed. Even though experience indicates that such methods of forming billets, blooms or slabs are highly successful, one drawback does exist. That is, once the chill mold is formed and the shape of the cavity therein determined, such a mold assembly cannot be employed for casting any other shape or even a similar shape of different sizes. This, of course, results in the necessity of having many mold assemblies continuously in stock so as to be able to produce the particular cast shape desired.

Accordingly, an object of this invention is to provide a molding apparatus capable of producing either slabs, blooms or billets as desired.

Another object of this invention is to provide an adjustable molding apparatus capable of not only producing such articles as either slabs, blooms or billets but also producing such articles in various sizes.

Another object of this invention is to provide a mobile adjustable molding apparatus capable of functional engagement with a suitable stationary pressure pouring ladle assembly.

A further object of this invention is to provide a relatively stationary adjustable molding apparatus capable of functional engagement with a suitable mobile pressure pouring ladle assembly.

Another object of the invention is to provide mold apparatus of the foregoing general character wherein mold means is provided for power shifting the mold parts toward and from each other for closing and opening the mold respectively.

An additional object is to provide mold apparatus of the foregoing general character, having parts adjustable relative to each other, and slide shut-off means, wherein power means is provided for adjusting the mold parts and operating the slide shut-off means, and wherein all thrust of the power means and reaction thereof are self-contained within the structure of mold apparatus.

Still another object is to provide mold apparatus of the foregoing general character including novel means for spraying a coating on the surface of the cavity of the mold preparatory to a casting operation.

Another and more specific object of the invention is to provide mold apparatus of the foregoing general character wherein the mold is made up of a pair of opposed main blocks that are moved toward and from each other for closing and opening the mold and in which adjustable inner blocks are interposed between the main mold blocks for forming cavities of different sizes and proportions by relatively adjusting those inner blocks.

Still another object is to provide mold apparatus of the kind just mentioned in which a plurality of sets of inner blocks are provided whereby to selectively utilize the different sets thereof for providing castings of different thicknesses in the direction between the main mold parts.

A further object is to provide mold apparatus of the foregoing general character including novel ingate construction which in addition to providing the inlet to the mold also constitutes one end of the mold cavity.

Other objects and advantages of the invention will appear from the following detailed description taken in conjunction with the accompanying drawings in which:

FIGURE 1 is a semi-diagrammatic view of mold apparatus made according to the present invention, shown in mobile form and in conjunction with a stationary ladle construction;

FIGURE 2 is a semi-diagrammatic view of a plurality of stationary mold apparatuses in conjunction with a mobile ladle;

FIGURE 3 is a perspective view of a portion of the mold apparatus made according to the invention, with the main mold blocks separated and the ingate construction separated from the main mold, and showing a slab being withdrawn from the mold;

FIGURE 4 is a perspective view of the apparatus from the rear, with the blocks in separated position;

FIGURE 5 is a perspective view showing only the blocks making up the mold together with the ingate, this view showing the parts of the mold separated to expose the interior thereof and particularly the inner blocks between the main blocks;

FIGURE 6 is a semi-diagrammatic plan view of the mold apparatus;

FIGURE 7 is an end elevational view showing the spraying apparatus in operating position;

FIGURE 8 is a transverse vertical sectional view of the central portion of the mold apparatus, taken approximately on line **8—8** of FIGURE 10;

FIGURE 9 is a side elevational view of the mold apparatus;

FIGURE 10 is a plan view of the mold apparatus;

FIGURE 11 is a fore-and-aft longitudinal vertical sectional view of the mold;

FIGURE 12 is a plan view of the riser box and adjacent portions of the blocks of the mold and ingate construction, omitting the supporting frame elements;

FIGURE 13 is a rear elevational view of the mold apparatus;

FIGURE 14 is a front elevational view showing particularly the ingate construction and riser construction;

FIGURE 15 is a sectional view taken at line **15—15** of FIGURE 14;

FIGURE 16 is a sectional view taken at line **16—16** of FIGURE 15.

Referring now in detail to the drawings, attention is directed first to FIGURES 1 and 2 showing in semi-diagrammatic form the mold apparatus of the present invention and its relation to the ladle construction for filling the mold. In FIGURE 1 a mold apparatus is indicated at **30** which in the present instance is in mobile form having wheels **32** riding on tracks **34**. A ladle **36** having a pouring tube **47** is disposed in a pit **38**, the arrangement being such that a plurality of molds **30** can be arranged for cooperation with a single stationary ladle.

An opposite arrangement is illustrated in FIGURE 2 where a plurality of mold apparatuses **30** are arranged in

stationary form on an elevated floor **40** while a ladle **36** is provided with wheels **42** riding on tracks **44** on a lower deck or level **46**. As is indicated, the ladle can be moved along the track and utilized for filling the stationary mold apparatuses successively.

For performing the pouring operation the mold is positioned with its pouring gate **45** over the pouring tube **47** of the ladle, and the mold is slightly tilted by raising the rear end thereof with a jack **49**. The pouring tube **47** is raised into pouring engagement with the ingate **45**. Tilting the mold provides for up-flow of the molten metal in all portions of the mold; in keeping with preferred pressure pouring practice, the mold is tilted about 3 degrees.

FIGURE 4 shows a single mold apparatus **30** which includes a mold proper **48** mounted on a carriage **50**, each of which will be described in detail herein below. The mold **48** includes two main parts **52** and **54** which are movable toward and from each other for closing and opening the mold respectively, the mold being shown in open position in this figure, which is from the rear. FIGURE 3 shows a casting or slab **56** being removed from one of a pair of adjacent molds **48** by a crane **58** having tongs **60** gripping the slab. The slab has a riser extension **62** formed by the riser construction described hereinbelow, which is cut off after the casting is removed from the mold, presenting a uniform shaped slab.

Attention is now directed to FIGURE 5, which is a front exploded perspective view, showing the blocks making up the mold, including two main side blocks **64** and **66** having inner castings surfaces **78** and **80**, respectively, and a plurality of inner blocks, including a top block **70**, a bottom block **72** and a rear end block **74**. This figure also shows fragmentarily a portion of the ingate construction designated at **76**, the whole ingate construction, when fitted to the remainder of the mold, forming the front end of the cavity of the mold. For the casting operation the blocks are fitted together with the surfaces **78** and **80** opposed and engaging the inner blocks **70**, **72** and **74** therebetween, which together with the ingate construction **76** define a casting cavity **82**. The blocks of the mold are preferably of graphite, as are at least certain elements of the ingate construction **76**.

The top and bottom blocks **70** and **72** are substantially the same length as the main blocks **64** and **66**. The bottom block **72** extends below the main blocks **64** and **66** throughout most of its length, but has a reduced end portion **73** which may be approximately flush with the lower surface of the main side blocks. The bottom block remains fixed while the other two are adjustable or replaceable, or both, for forming different sized casting cavities. The rear end block **74** is of certain selected length according to the desired depth of the slab to be cast, and is provided with apertures **86** (FIG. 11) which permit gas to pass therethrough. If desired, the end block **74** may be lined with a sand core **88**.

While the bottom block **72** remains fixed, the rear end block **74** may be adjusted longitudinally according to the length of the slabs to be cast, as represented by the full line and dot-dash line positions. Also, the top block **70** is adjustable vertically according to the height of the slab to be cast, and for each such position of the top block, a different rear end block **74** of corresponding length is utilized.

The inner blocks **70**, **72** and **74** are also selected from the standpoint of the thickness of the slab to be cast. For example, customary slabs may be of 5 inches, 6 inches or 7 inches in thickness and for each of those thicknesses a corresponding set of inner blocks **70**, **72**, and **74** is utilized in the mold, and as will be understood, in the case of each of those thicknesses, the top and rear end blocks are adjusted according to the desired width and length respectively of the slab to be cast. The means for supporting and adjusting the inner blocks will be described in detail hereinbelow.

Attention is now directed to FIGURES 4, 8, 9, 10 and 13 for the preferred specific means for mounting the mold blocks on the carriage **50**. The main side blocks **64** and **66** are mounted in flasks **90** which are opposite and symmetrical and otherwise substantially identical. Each flask **90** includes a lower horizontal portion **94** (FIGS. 8 and 13) under the corresponding side block and supporting the latter, and a horizontal top portion **96** for supporting the top of the block and for other purposes to be referred to hereinbelow. Each flask includes a main vertical portion **100** which as shown best in FIGURE 9 is made up of a plurality of horizontal and vertical members, certain vertical ones of which, for example **102**, may be utilized for receiving the thrust from the power means for moving the flasks and the blocks therein toward and from each other as described hereinbelow. The flasks **90** are mounted on the carriage **50** as on transverse beams **104** for sliding movement thereon, as shown best in FIGURE 13. These transverse beams **104** are provided with rails **106** in which the bottom elements of the flasks are received for sliding movement in the directions mentioned.

The carriage **50** is provided with a plurality of abutment means **108** on both sides thereof and spaced longitudinally therealong. These abutment means take the form of rigid posts and each is provided with upper and lower supporting decks **110** for supporting power means **112** which preferably are hydraulic cylinder-ram devices. Each has a cylinder **114** mounted on the corresponding post and a piston **116** engageable with the corresponding element **102** of the flask **90**. Upon actuation of the power devices and corresponding extension of the pistons therein, the flasks and the side blocks mounted therein are moved toward each other to closed position. Upon actuation of the power devices in the opposite direction the pistons retract and draw the flasks and blocks therein apart, and thus open the mold. FIGURE 4 shows to good effect the highly developed construction of the flaks and other portions of the apparatus made necessary by the overall size of the apparatus. For example the apparatus may be on the order of 32 feet long and weigh in the neighborhood of 90 tons.

The bottom block **72** which extends below the bottom edges of the side blocks **64** and **66**, and as shown best in FIGURES 8, 11 and 13, is mounted on a rail **118** extending the full length of the bottom block. This rail may be of any desired form and in the present instance includes a T-shape element **120** with side supporting elements **122**.

Because of the size and massiveness of the various blocks, certain of them are preferably formed in sections to facilitate their handling. The bottom block **72** is thus made up of a plurality of sections, two of which are indicated at **72***a* and **72***b* (FIGURE 11) and in order to maintain the sections in endwise abutment, take-up means **124** is provided. This take-up means may be of any desired form such as a spring biased mechanism as here shown which includes a compression spring **126** working on a plunger **128** biasing one of the sections **72***a* into firm endwise engagement with the other section **72***b*. If desired, screw means or power cylinder ram means may be provided for this purpose instead of the spring means shown. The bottom block is limited in forward movement by the friction exerted by the side blocks, and also by engagement with the ingate construction at the forward end of the mold apparatus.

The rear end block **74** is limited against rearward movement as would be caused by the molten metal flowing into the mold by suitable means **130**, which may be constituted by a plurality of devices **132** having plungers **134** engageable with and working against the end block as by screw means or spring means as desired. These end block supports **130** may be mounted on supports **135** on a vertical end member **136** incorporated in the structure of the carriage **50**.

The top block **70** is also made up of a plurality of sec-

tions similarly to the bottom block, two of which are shown at **70***a* and **70***b* and these are retained in endwise abutment by a support **138** which may be similar to the means **124** for retaining the bottom block in position. The support **138** may work against the vertical member **136** while the bottom supporting means **134** may work against an end element of the rail **118** on which the bottom block is supported.

Similarly, the main side blocks **64** and **66** are formed in sections in end-to-end abutment. Two such sections of one of the blocks, **64***a* and **64***b*, are shown in FIGURE 11, while retention means **139** (FIGURE 10), which may be similar to the support **138**, are utilized for retaining these sections in firm engagement.

The top block **70** is supported by a plurality of hangers or supports indicated generally at **140** (FIGS. 8, 10, 11 and 13). The block is provided with grooves **142** in its side surfaces adjacent the top which receive toes **143** on a channel member **144** secured at the lower end of a plurality of screws **148** working in internally threaded sleeves **150** pivotally mounted on arms **152**. Each arm **152** is slidably received in a sleeve **154** in which it is adjustable longitudinally and may be secured in adjusted position by a set screw **156** threaded in the sleeve and engaging the arm. The sleeve **154** is mounted on the top portion **96** of the corresponding flask **90** on a transverse pin **157** for limited pivotal movement thereabout. At the opposite or outer end of the sleeve **154** is a means for lifting the top block **70** a limited amount. This means may take the form of a power cylinder **158** mounted in the flask and having a piston connected with the outer end of the sleeve, and upon actuation of the device and consequent retraction of the piston, that end of the sleeve and arm together as a unit are drawn downwardly, and the opposite end of the arm **152** bearing the block **70** is raised a limited amount. However, the block is raised and lowered greater amounts by turning the screws **148**. The adjustment provided by the sliding relation between the arm **152** and sleeve **154** accommodates inner blocks of different thicknesses. This adjustability will also accommodate slight variations in the thicknesses of the main blocks **64** and **66** due to subsequent resurfacing thereof.

Preferably only the end ones of the power devices **112** are positively connected with the flasks for both pushing and pulling action. Referring to FIGURE 10 it will be noted that the pistons of the end ones of those power devices are provided with quick detachable connecting means **162** which operate to push the flasks into closed position and to pull them into open position. The remaining power devices are merely pushers and do not act to pull the flasks, having disconnected engagement therewith, but they serve the purpose of supporting the flask against expanding action by the molten metal in the mold. Preferably all of the power devices are interconnected for conjoint action, which in the case of hydraulic devices may be connected with a common fluid line.

Provision is made for spraying a coating on the inner surfaces of the mold including the main side blocks **64** and **66** as well as the inner blocks **70**, **72** and **74**. Referring to FIGURES 6 and 7 a spray head **164** is mounted on an overhead rail or beam **166**, which preferably is an I-beam, mounted above the mold. The beam **166** is pivotally mounted on a pair of parallel arms **168** which in turn are pivotally mounted on a pair of posts **170** supported from the bed of the carriage. The arms **168** are swingable about the posts which are located outwardly beyond the corresponding mold block. Because of the parallel arrangement of the arms, the beam **166** is swingable from an inoperative position shown in dot-dash lines in FIGURES 6 and 7 to an operative position shown in full lines, in which it is centrally located in a vertical plane between the mold blocks. The spray head **164** is provided with wheels **171** and mounted on the I-beam **166** and for the spraying operation, the beam is swung to the center operative position and the main blocks

moved apart; the spray head **164** is then moved along the rail between the mold blocks. The spray head **164** includes a plurality of spray units **172** positioned for spraying the various surfaces of the mold. The spray head may be so moved by suitable power means, while the spraying operation is also under the control of suitable power means such as pneumatic or hydraulic power. The spray units **172**, as will be understood, are in sufficient number and so located as to spray all of the desired inner surfaces of the mold including the various surfaces of the inner blocks **70**, **72** and **74**, as well as the main blocks. After the spraying operation the spray head **164** is moved out to the outer end of the rail, and the rail is then swung about the arms **168** into the inoperative position at one side shown in FIGURE 6.

Attention is now directed to FIGURES 11, 12, 14, 15 and 16 showing a preferred form of the ingate construction. The ingate, above identified generally as **76**, is mounted to the main mold blocks **64** and **66**, and as mentioned above, defines one end of the cavity **82** which is defined otherwise by the main blocks and the inner blocks **70**, **72** and **74**. The ingate construction **76** is secured to the flasks by means of longitudinal forwardly extending laterally spaced structural elements **174** and **176** (FIGURE 14) at the top of the flasks, and similar elements **178** and **180** (FIGURE 14) at the bottom, together with laterally spaced front vertical elements **182** and **184** (FIGURE 14) secured respectively to the above mentioned horizontal elements. Additional lateral vertical elements **186** and **188** (see especially FIGURE 15) are secured to and between the other flask structural elements mentioned. Incorporated in the ingate construction, and supported by the structural elements just referred to, as well as others, are a pair of front side blocks **190** and **192** and a front end block **193**, the latter being selected as to thickness according to the thickness of the inner blocks **70**, **72**, and **74** utilized in any particular setting of the mold. The side blocks **190** and **192** are butted into firm engagement with the front end block **193**, forming a passage **194** therebetween which communicates with the cavity **82** of the mold throughout the height of the latter as determined by the top block **70**. The front side blocks **190** and **192** are supported at their outer sides by vertical elements **195** and **196**, and confined against forward displacement by the elements **182** and **184**, while being supported at the bottom by elements **197** and **198** (FIGURES 14 and 16). The ingate side blocks **190** and **192** thus normally are carried with the flasks **90** and thus with the main side blocks **64** and **66**, as the latter are moved toward and away from each other, but they can be readily dismounted therefrom if and when desired. Other elements **199** and **200** (FIGURE 15) are secured to the elements **182** and **184** and are provided with locating and locking elements **201** and **202** which serve to secure the ingate side blocks **190** and **192** firmly against the front surfaces of the main side blocks **64** and **66** of the mold.

A series of front end blocks **193** of different thicknesses are provided, one of each thickness of the sets of inner blocks **70**, **72** and **74**, so as to form the passage **194** of the same width as the cavity **82**, regardless of the width of the cavity.

Means is provided for lifting the front end block **193** which includes a channel **204** with its web butted to the block. A plurality of spaced U-shape clamps **206** have legs projecting through openings in the web of the channel and straddling a reduced portion of the block, the legs having toes **208** at their extremities fitted in grooves or notches **210** in the side surfaces of the block. Locking screws **211** are threaded through the clamps and into engagement with the channel, whereby to provide a rigid assembly of the block and channel. The channel is wider than the front end block and thus provides an abutment for engaging the front surfaces of the ingate side blocks **190** and **192** for limiting the movement of the front end block rearwardly. The channel **204** is provided with a

loop **212** (FIGURE 14) for hooking onto a crane for lifting the assembly and otherwise handling it.

A riser box **214** is mounted in the mold in communication with the passage **194** for receiving a head of molten metal for the usual purpose. This riser box may be of any preferred construction within the broad concept of the invention, but a suitable form is that shown in FIGURES 11 and 12. In the construction shown, a box member **216** is positioned atop the main blocks **64** and **66** of the mold and the blocks **190**, **192** and **193** of the ingate, this box member including a surrounding wall element **218** and a bottom element **220** defining a central aperture **222** which is made to register with the passage **194**. A back up plate **224** is interposed between the main blocks **64** and **66** substantially flush with the front end surfaces of those blocks and the top inner block **70**. The back up plate is selected as to vertical length as to engage the upper surface of the top block according to the then position of the top block, a different back up plate thus being provided for every desired vertical setting of the top block. Thereafter core sand **226** is impacted in position to line the box member **216** and ingate passage **194** down to the bottom surface of the top block, thereby forming a riser cavity **228** communicating with and forming a continuation of the lower portion of the ingate passage **194**. A bottom plate **230** secured to a rod **232** may be utilized in impacting the sand in place, being inserted upwardly through the ingate passage and then withdrawn downwardly therefrom after that step is completed. When the mold blocks are separated, the sand is disintegrated and when the mold blocks are again assembled for a successive casting, a new sand liner is made up.

The ingate construction includes a shut-off gate arrangement indicated generally at **234** (FIGURES 11, 14 16). This shut-off gate arrangement includes a spout receptacle **236** having a recess **238** in the bottom surface therein for receiving the upper end of the pouring tube **47** in the usual manner and as referred to generally above.

Above the spout receptacle **236** is a bed plate **240** by which the shut-off gate arrangement is supported, this support being provided by beams **242** and **244** included in the construction of the flasks. Set screws **245** are provided for receiving the downward thrust of the bed plate, these screws providing suitable vertical adjustment for securing the shut-off gate arrangement in firm engagement with the under surface of the blocks of the ingate construction.

Above the bed plate **240** is a shut-off slide plate **246** guided between guide bars **248**, and operable for shutting off the passage through the shut-off gate arrangement. Above the slide plate **246** is a top plate **250** on top of which are clamps **252** engaging a shoulder **254** and the bottom surface of a groove **256** in a central sleeve **258**. All of the foregoing members of the shut-off slide arrangement are provided with aligned holes which receive sections of a tubular core **260** or sleeve of refractory material defining a passage **262** communicating with the passage **194** in the ingate and with the passage of the pouring tube when the ingate construction is in filling engagement with the pouring tube. One of the sections of the core **260** is movable with the shut-off slide plate **246**. Screws **264** are inserted in holes in the clamps **252** and threaded into the top plate **250**, for securing the sleeve **258** and shut-off slide plate **246** in rigid assembly with the other elements, namely, **236**, **240**, **248** and **250**, the latter being secured together as by welding. It will be observed that the passage **262** in the core **260** is of greater diameter than the width of the ingate passage **194**, the core passage being adapted to cooperate with ingates of different widths. The shut-off slide **246** is preferably actuated by a cylinder-ram device **266** reacting against a fixed element **268** of the carriage **50**, this arrangement containing all of the acting and reacting forces within the mold apparatus.

The bottom surface of the spout receptacle **236**, and the recess **238** therein, are disposed at a slight angle to the horizontal, as will be noted in FIGURE 11, this angle being that to which the rear end of the mold is raised in the pouring operation, namely, 3 degrees, as mentioned above, so that the spout receptacle is level and in cooperative position with the pouring tube in the pouring operation.

While I have disclosed herein a preferred form of the invention, it will be understood that changes may be made therein within the scope of the appended claims.

I claim:

1. Mold apparatus of the character disclosed comprising opposed side blocks, means for moving the side blocks toward and away from each other, a plurality of removable inner blocks including top, end and bottom blocks, said removable inner blocks positioned between the side blocks and engageable therewith to define a cavity when said side blocks are moved toward each other, and an ingate detachably mounted to the assembly of said blocks, said ingate including a passage between the exterior and a remaining open portion of said cavity to permit the flow of molten metal into the cavity.

2. The construction set out in claim **1** wherein said end block is adjustably positionable along the length of the mold between the ends thereof and wherein said end block is disposed between the top block and bottom block and in engagement therewith in all positions thereof.

3. The construction set out in claim **1** wherein said top block is adjustable vertically between the side blocks, and wherein a plurality of different-length end blocks are provided to accommodate various heights of cavity according to the adjustments of the top block.

4. The mold apparatus set out in claim **1** in which a plurality of sets of inner blocks are provided, each of the sets including a top block, an end block and a bottom block, and the blocks of the various sets being of different selected thicknesses to accommodate different widths of cavity in direction between the side blocks.

5. The invention set out in claim **1** wherein the passage in the ingate construction communicates with the cavity throughout the full height of the cavity.

6. The invention set out in claim **5** wherein a riser construction is incorporated in the ingate construction, and is adjustable vertically whereby to place its lower end in engagement with the front end of the top block and the riser construction includes a riser hole communicating with said passage but closing the space between the side blocks above the top block whereby to enable molten metal to flow into the cavity from said ingate passage but preventing it from flowing into the space between the side blocks above the top block.

7. Mold apparatus of the character disclosed comprising a base, a pair of side blocks movable toward and from each other, a flask supporting each side block, the flasks with the side blocks being movable toward and from each other, a plurality of adjustable inner blocks disposed between the side blocks and positioned for engagement by the side blocks when the latter are moved toward each other, means on the base forming rails for the flasks to ride thereon, power means for moving the flasks with the side blocks toward and from each other, the inner blocks being relatively adjustable for forming different size cavities between the side blocks and the inner blocks, and means forming a pouring passage into the cavity and otherwise substantially closing the cavity.

8. The invention set out in claim **7** wherein said base includes a movable carriage rendering the mold apparatus bodily movable from one location to another, the carriage includes abutments outwardly of the flasks, and the power means are interposed between and react between the abutments and flasks, whereby to render the forces exerted on the side blocks self-contained within the mold apparatus.

9. The invention set out in claim **7** wherein at least one of said blocks is made up of a plurality of sections

butted end to end, and wherein means is provided for holding said sections in tight end-to-end engagement.

10. The invention set out in claim **7** wherein the inner blocks include a top block extending substantially the length of the mold, and support means is provided for the top block including a plurality of arms mounted on the side and movable into and out of an operative position in which they extend over the corresponding side block and terminate beyond the inner surface of that side block whereby to overly the space between the two side blocks, and hanger means depending from said arms directly supporting said top block.

11. The invention set out in claim **10** wherein said support means is mounted on one of the flasks and movable with that flask in the movements of that flask with its side block toward and from the other flask and side block.

12. The invention set out in claim **10** wherein said hangers are adjustable vertically in said arms for enabling vertical adjustability of the top block for selectively defining different heights of the cavity formed by the side blocks and inner blocks.

13. The invention set out in claim **10** wherein said arms are adjustable longitudinally with respect to themselves and in direction transversely of the main side blocks whereby to provide adjustability of the extended terminal ends of the arms to accommodate different thicknesses of inner blocks and also to accommodate variation in thickness dimension of the main side blocks due to resurfacing thereof.

14. The invention set out in claim **10** wherein said top block is made of graphite and composed of a plurality of longitudinally spaced sections, and a continuous beam extends longitudinally the length of the top block and disposed thereabove, the beam serving as means interconnecting the sections of the top block and the hangers.

15. The invention set out in claim **7** wherein said base includes supporting elements engaged by and supporting said main side blocks, and also includes supporting elements directly engaged by and supporting said bottom block, said bottom block extending below the lower surface of the main side blocks.

16. Mold apparatus of the character disclosed comprising a carriage mounted on wheels for movement along tracks, said carriage having a base, a mold mounted on said base, said mold including a pair of main side blocks movable transversely of the carriage toward and from each other, a plurality of inner blocks between the main side blocks, said inner blocks including a top block, a rear end block, and a bottom block, said top block and bottom block extending substantially the full length of the main side blocks, said inner blocks being detached from the main side blocks and adjustable relative thereto for selectively defining cavities of different dimensions, said side blocks when moved toward each other engaging the inner blocks and forming therewith a cavity, and ingate construction mounted to the front end of the mold blocks and defining a pouring passage from the exterior to said cavity and otherwise closing the front end of the cavity, said pouring passage having an external terminal adjacent the base and the carriage being movable into and out of a pouring position wherein said passage is adapted for communication with a ladle.

17. The invention set out in claim **16** wherein the rear end of the carriage is capable of being elevated for correspondingly elevating and inclining the rear end of the mold thereon, and the rear end block is porous to gas but impervious to molten metal.

18. The invention according to claim **1** wherein a plurality of mold apparatuses are provided and are movable along a line into and out of a pouring position and in that position are each adapted for successive communication with a ladle.

19. The invention according to claim **1** wherein a plurality of mold apparatuses are provided, the respective ingate constructions thereof being arranged along a line; and wherein a ladle is provided and is movable along said line under said ingate constructions, said ladle being adapted for successive communication with said ingate constructions.

20. The invention set out in claim **1** wherein said ingate construction includes opposed blocks engageable with said side blocks and an end block between said opposed blocks, said end block being interchangeable with other end blocks of varying sizes.

21. The invention according to claim **20** wherein said ingate end block is substantially the same thickness as said inner blocks, whereby a pouring passage substantially equal in thickness to the casting cavity is provided.

References Cited

UNITED STATES PATENTS

1,495,728	5/1924	Dostal	22—192
1,514,053	11/1924	Keeter	249—158
2,343,842	3/1944	Hatcher	22—192
2,498,264	2/1950	Goldhard	18—30
3,015,863	1/1962	Strom et al.	22—69
3,060,531	10/1962	Maring	22—90
3,114,947	12/1963	Sylvester	22—134
3,162,912	12/1964	Sylvester	22—134
3,192,594	7/1965	Fougea	25—121
3,262,164	7/1966	Meves	22—75

J. SPENCER OVERHOLSER, *Primary Examiner.*

R. D. BALDWIN, *Assistant Examiner.*