July 28, 1959 B. F. ANTHONY 2,896,266

APPARATUS FOR PRODUCING A VENEER LINING UPON INNER WALL OF HOT TOPS

Filed April 12, 1955 5 Sheets-Sheet 1

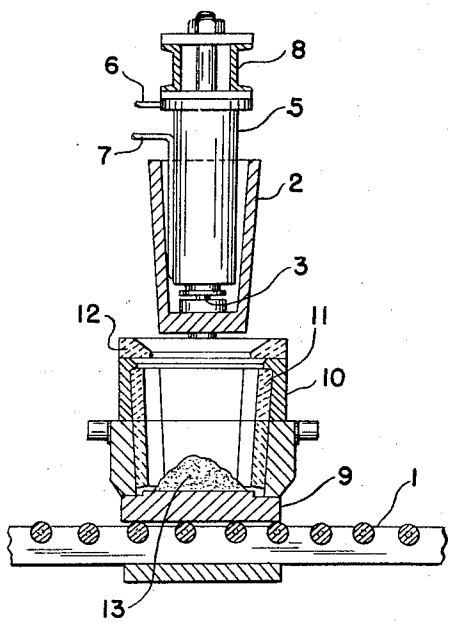


FIG. 1

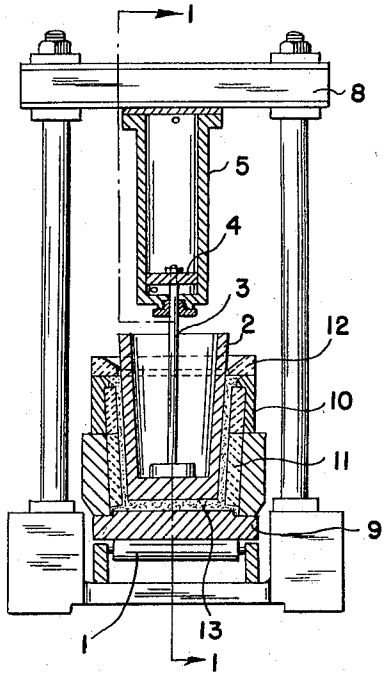


FIG. 2

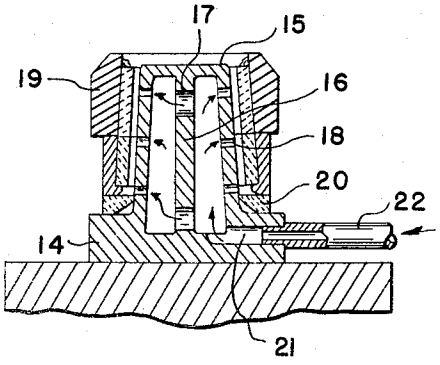


FIG. 3

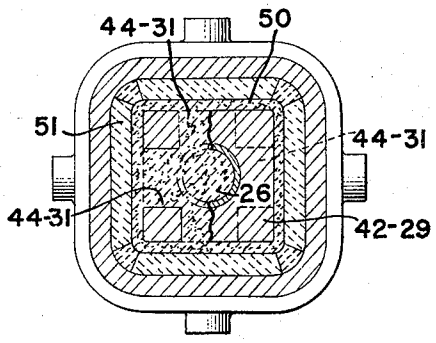


FIG. 4a

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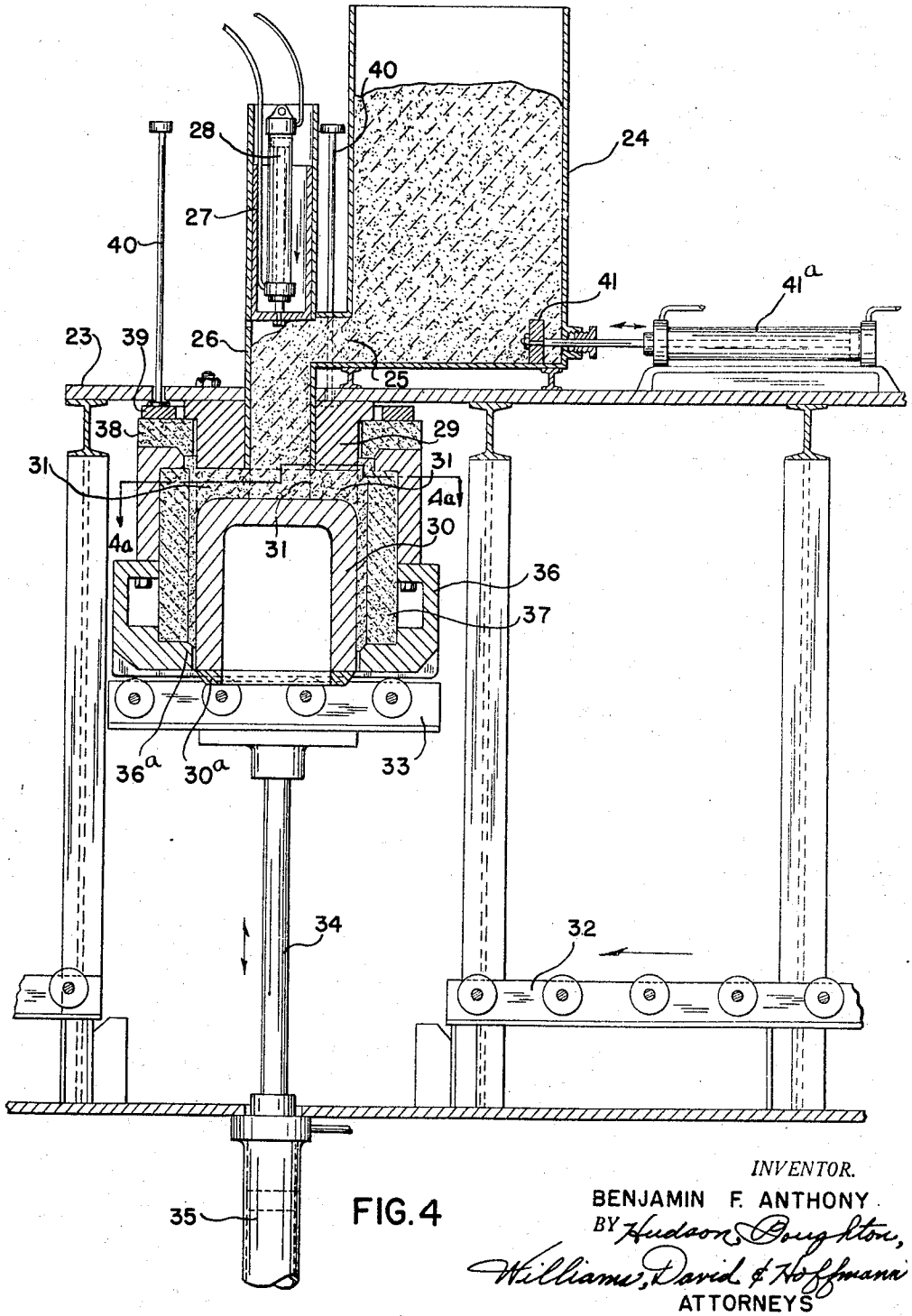


FIG. 4

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APPARATUS FOR PRODUCING A VENEER LINING UPON INNER WALL OF HOT TOPS

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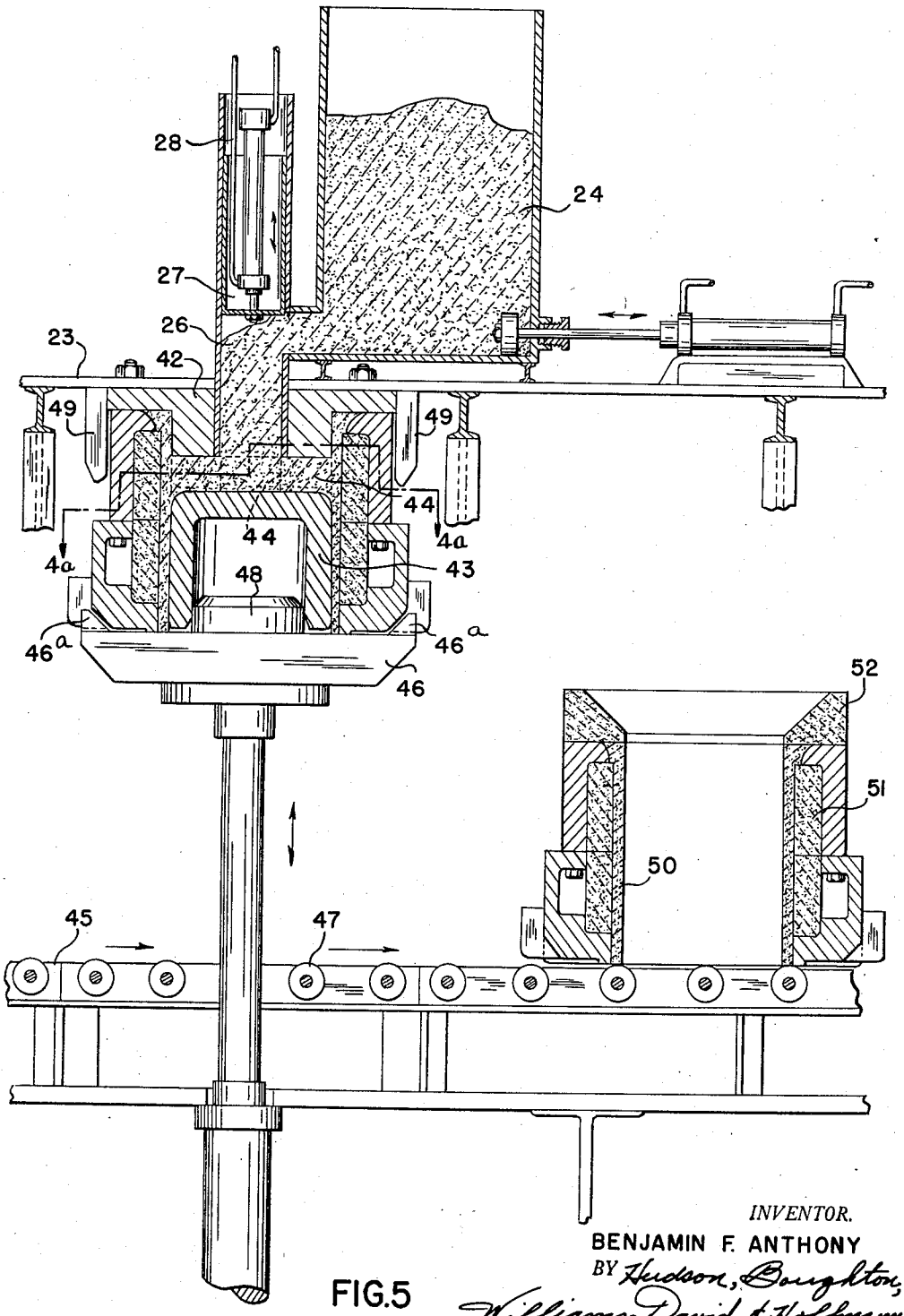


FIG.5

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APPARATUS FOR PRODUCING A VENEER LINING UPON INNER WALL OF HOT TOPS

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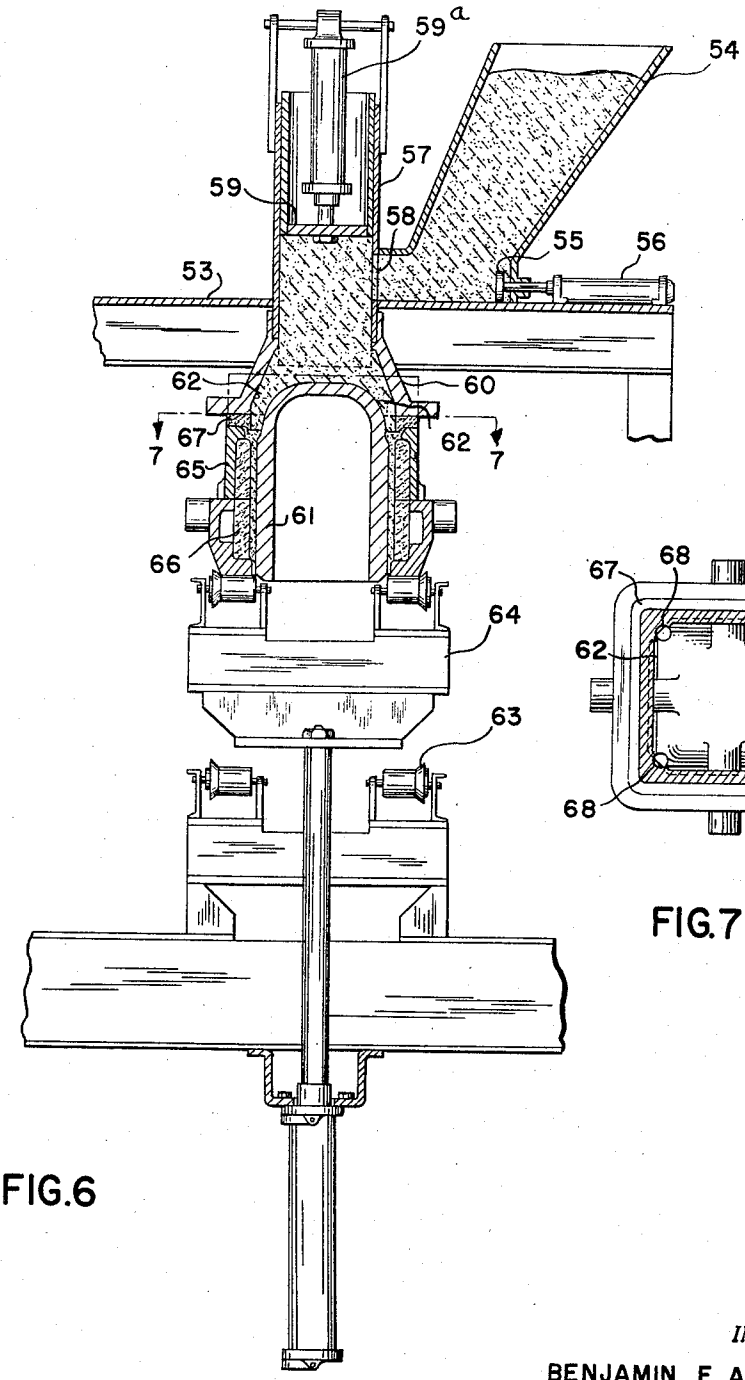


FIG.6

FIG.7

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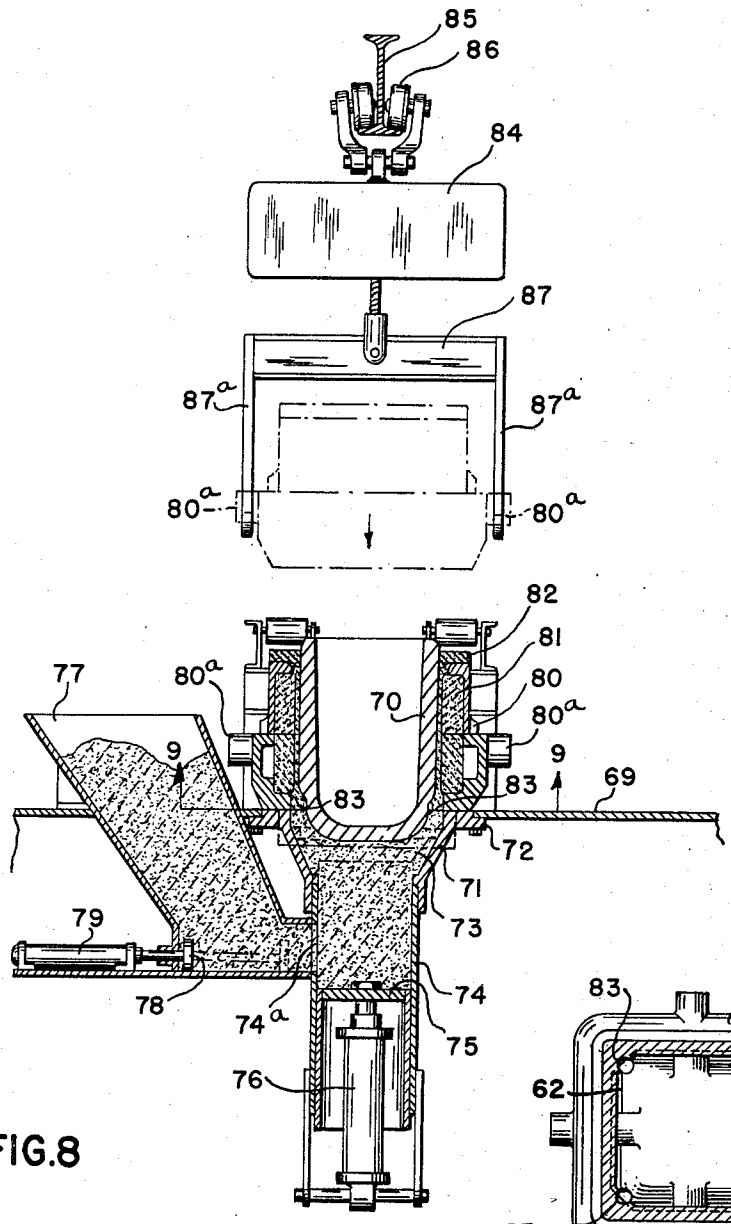


FIG.8

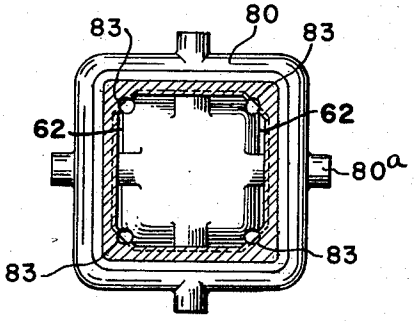


FIG.9

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United States Patent Office 2,896,266 Patented July 28, 1959

2,896,266

APPARATUS FOR PRODUCING A VENEER LINING UPON INNER WALL OF HOT TOPS

Benjamin F. Anthony, Cleveland Heights, Ohio, assignor to Oglebay Norton Company, Cleveland, Ohio, a corporation of Delaware

Application April 12, 1955, Serial No. 500,914

10 Claims. (Cl. 18—59)

It is common practice, in pouring molten steel into ingot molds, to use a hot top which is associated with the upper end of the mold into which metal is to be poured, and when such a hot top is positioned upon a mold, the molten metal is poured through the hot top into the mold, filling the mold and also filling, to a desired extent, the hot top, thereby forming upon the ingot a sinkhead which, while the metal is molten, feeds metal to the shrinkage cavity which usually forms along the central axis of the ingot as it solidifies.

A well-known form of hot top which is in quite general use in the steel industry is one which comprises an outer metallic casing of such dimensions as to fit within the upper portion of the mold into which metal is poured, having upon its inner walls a lining made up of refractory shapes cemented together so as to provide a substantially homogeneous lining. Supported on the lower end of the metallic casing by means of frangible clips is a refractory ring which prevents the molten metal of the ingot from coming in contact with the metallic casing, this refractory ring also serving as a parting means to provide for the easy removal of the hot top from the sinkhead of the ingot after the ingot has solidified.

The successful use of hot tops in connection with the casting of steel ingots depends upon the ability of the hot top to maintain in liquid form the molten metal which it contains for a sufficient length of time so that the molten metal will flow downwardly to feed the shrinkage cavity or pipe that would otherwise form along the vertical axis of the ingot.

A hot top, therefore, must have as its primary requisite a lining having a satisfactory heat conductivity factor to maintain the metal within the hot top in a molten state until its function has been accomplished. This refractory lining must also withstand the thermal shock incident to contact with the teeming temperatures of steel ranging from 2700° to 3000° F. Frequently also, if the metal stream which is introduced into the hot top and through the hot top into the ingot is not well centered, it may contact the lining within the hot top and cause deterioration of the lining.

Suitable lining for such a hot top to which reference has been made may consist of high quality fire brick, and hot tops so lined have proven entirely satisfactory. In connection with the use of such hot tops it has been common to provide a thin coating of what in the art is known as slurry covering the interior surface of the brick lining of the hot top, such slurry filling the interstices between the brick, if there be any, and also providing for a more facile stripping of the hot top from the sinkhead when that operation is performed.

However, there are occasions when it is desirable to provide on the inner walls of the refractory lining a veneer of appreciable thickness as, for instance, approximately one-half inch or even greater, for the purpose of affording extra protection for the interior surface of the brick lining. This veneer may be of such composition as will, when the molten steel is poured and the sinkhead

finally formed, produce a roughened surface upon the outer surface of the sinkhead which will be of advantage in withdrawing the ingot from the mold, with the subsequent stripping operation.

Where the hot top is what is known as a low volume hot top, it comprises a metallic casing which is lined with an insulating fire brick and utilizes in combination with the casing a bottom refractory ring similar in construction and purpose to that to which reference has before been made. Such a hot top, as is well known, provides advantages by reducing the amount of metal necessarily contained within the top top to provide for the feeding of metal to the pipe in the ingot.

This favorable situation with regard to the low volume hot top is obtained because of the use of a refractory lining of insulating fire brick which is highly nonconductive of heat but which has the disadvantage of being somewhat fragile and offering poor resistance with respect to thermal shock incident to the pouring of the molten steel through the hot top and also having rather poor wearing qualities so far as abrasion is concerned.

The fragile insulating fire brick lining must be covered on its inner face with a suitable veneer to protect from excessive thermal shock and from erosion by the spraying stream of metal and from mechanical abrasion upon stripping of the hot top from the ingot.

It will be apparent that such a veneer of substantial thickness may be formed by a hand method upon the interior face of the brick lining of a hot top, either where high grade fire brick or insulating fire brick are used, but such hand method of application will frequently result in certain inaccuracies of application of the veneer, such as variation in veneer thickness, which would be detrimental to its subsequent use.

Therefore, it is an object of the present invention to provide apparatus whereby there will be formed upon the inner surface of the brick lining of a hot top a veneer of accurate thickness, the apparatus receiving the veneering material in mobile or plastic form, molding it against the inner face of the brick lining and then, removing the hot top from the apparatus so that the hot top may be moved to a place where the veneer may become thoroughly dried, which is essential before the hot top can be utilized in connection with the ingot mold in the pouring or teeming of ingots.

Another object provided by the apparatus is the saving of man power and time required to apply the veneer by machine versus manual make-up plus the ability of the apparatus to produce an accurate size cavity of fixed dimensions within the hot top to eliminate unecessary molten metal from being poured therein.

It will be readily realized by anyone familiar with the art that the average size of the heat or the quantity of the steel which is melted and prepared either in open hearth or electric furnaces are of such size that they are poured or teemed not into one mold, but into a number of ingot molds. The size of the heat will vary, but generally, there are from fifteen to thirty-five molds used for each heat of steel. These molds, in most cases, are carried on cars which can be moved to a point adjacent to the furnaces for the pouring operation. It is the practice in some plants to set the molds into pits by the use of an overhead crane and the steel is then teemed into these molds in these pits. In any event, each such mold must be equipped with a hot top, and the matter of conditioning the hot top for use with these molds is, therefore, so to speak, a continuous operation, each hot top being fully prepared at a given point or station, then moved along by conveyers or overhead cranes or some other suitable mechanical means to a point or place where the veneer is placed within the hot top and then

again moved to a place where the veneer is thoroughly dried.

This operation is essentially a continuous one and, therefore, the apparatus which functions to form the veneer coating upon the refractory lining on the inside of the hot top must be such an apparatus as will accurately and quickly form the veneer so that a string of hot tops may be processed without undue delay.

Reference should be had to the accompanying drawings, in which:

Fig. 1 is an elevation, with portions in section, upon the line 1—1 of Fig. 2 showing an apparatus embodying the invention;

Fig. 2 is an elevation showing an apparatus with parts in section and with the parts of the apparatus in position for the forming operation;

Fig. 3 is an elevation, with portions in section, showing a hot top in position to receive a veneer coating;

Fig. 4 is an elevation, with portions in section, showing apparatus for receiving and positioning a hot top with respect to apparatus for supplying and placing the moldable material upon the inner surface of a hot top;

Fig. 4*a* is a section upon the line 4*a*–4*a* of Fig. 4; it is also essentially a sectional view along the lines 4*a*–4*a* of Fig. 5;

Fig. 5 is an elevation, with parts in section, showing a modified form of apparatus;

Fig. 6 is an elevation, with portions in section, showing apparatus of modified form;

Fig. 7 is a plan view of a hot top to be used in connection with the apparatus shown in Fig. 6;

Fig. 8 is an elevation, with portions in section, of apparatus which is a modification of the apparatus of Fig. 6; and

Fig. 9 is a bottom plan view of a hot top to be used with apparatus shown in Fig. 8.

Referring to Figs. 1 and 2 of the drawing, **1** indicates a conveyor upon which hot tops are moved into position below a ram head **2**, which ram head is carried by a rod **3**, which rod at an end is provided with a piston head **4** within a cylinder **5** which is fluid operated by the introduction of fluid either below or above the piston **4**, such fluid for operation being introduced through pipes **6** and **7**. The cylinder **5** is carried upon a framework which generally may be represented at **8** and which is shown in side elevation in Fig. 2 of the drawing.

Each hot top which is to be presented to the apparatus for receiving the veneer is mounted upon a plate **9**, which, as will be apparent, may be moved along the conveyer in a manner which needs no particular description. The hot top with its casing, which is generally represented at **10**, is provided with a refractory lining of brick which is indicated at **11**. A hot top ring is shown at **12** and means are provided for attaching the ring to the casing **10** by means of clips or otherwise, which forms no part of the present invention. When the hot top is beneath the ram **2**, a quantity of granular plastic material of which the inner veneer is to be formed is placed within the hot top and rests upon the platform **9**, which material is indicated at **13** and the material, as will be appreciated, is in plastic form.

When the parts of the apparatus are associated with respect to each other, as shown in Fig. 1, and the material **13** placed within the hot top, the ram head **2** is operated by means of the fluid cylinder **5**, moving the ram head into the hot top, which causes the material **13** to flow around the ram head **2**, pushing the material up between the ram head and the lining of the top so that it completely fills the space intervening between the ram head and the inner surface of the hot top lining.

After this operation, the ram **2** is withdrawn slowly so as not to injure the veneer which has been formed by the operation which has just been described.

After the foregoing operation, the hot top and the platform **9** are moved along the conveyer **1** to a position

where the formed veneer lining may be dried and a succeeding hot top may be pushed in to position beneath the ram **2**.

It will be obvious that the descent of the ram **2** is to a certain extent guided by virtue of its contact with the inner edge of the hot top ring **12**, which will effect an even distribution of the plastic material around the ram **2** thereby producing a veneer coating upon the inner wall of the hot top which will be of constant thickness. Any excess material within the hot top after completion of the above described operation will remain on the mounting member **9** from whence it will be removed before the hot top is inverted, in which inverted position it will, after drying, be placed upon the ingot mold.

In Fig. 3 there is shown a variant of the apparatus and the method which is incident to operation of the apparatus of Figs. 1 and 2. In this form there is provided what may be called a base member **14**, which is provided with an upstanding projection or mandrel **15**. This mandrel is hollow except for a central wall **16** which is provided with suitable openings, one of which is indicated at **17**. Also, the wall of the mandrel is provided with a number of openings **18** which are distributed so that they will be located throughout the height of the mandrel **15**.

The hot top, which is generally indicated at **19** and with which is associated the ring **20**, when assembled, will be placed so that the ring **20** rests upon a portion of the support **14** and the mandrel **15** extends upwardly through the central portion of the hot top, the hot top being provided with a refractory brick lining, as before described. It will be noted that the ring **20** engages upon its inner edge with the mandrel **15** and thus serves to position the hot top so that the surface of the mandrel **15** is essentially equidistant from each inner wall of the lining of the hot top.

The base **14** is provided with a chambered portion **21**, which is connected with a pipe **22** through which will be forced by some appropriate means a plastic mixture of the same character as the mixture **13** heretofore referred to, which will be forced through the interior chamber of the mandrel **15** and out through the openings **18**, thus filling the space between the outer wall of the mandrel and the inner wall of the brick lining.

The hot top will be stripped from the mandrel **15** by any suitable apparatus, such as a shop crane, and the hot top removed to a place where the lining can be dried.

Referring to Fig. 4, **23** represents a platform or floor which, so far as the apparatus herein disclosed is concerned, is a stationary floor. Upon this there is supported a receptacle **24** which is adapted to contain a batch of plastic refractory mixture such as will be utilized in forming the veneer coating upon the interior of the hot top. At one side of the receptacle **24** is an exit opening **25** which communicates with a vertical cylindrical conduit member **26**. Within the upper portion of the member **26** there is a movable plunger **27** which is operated by means of a fluid motor **28**. By operation of the fluid motor, it will be obvious that the plunger **27** may be moved downwardly and upwardly.

Mounted upon the underside of the platform **23** is a mandrel which is indicated at **29**, this mandrel having a hollow extension which is indicated at **30**. The mandrel is provided with radial passageways **31**, there being as many radial passageways as are desirable. The hollow extension **30** to which reference has been made has properly been termed a mandrel because it is in connection with the mandrel that the inner lining of the hot top is formed. The mandrel **29** and the extension **30** are stationarily mounted.

The numeral **32** indicates a conveyer over which hot tops will be moved until in position upon a platform **33** which forms, in its lowermost position, a part of the conveyer **32** but which is mounted upon a post **34** which may be raised and lowered by means of a fluid motor **35**. The hot top casing is indicated at **36** and the inner lining

therefor at 37. At the upper end of the hot top, as shown in the drawing, is the refractory ring 38, and in order to assist in positioning and keeping the ring in position, there is a heavy metallic ring 39 which rests upon the upper surface of the refractory ring 38 and is guided by means of rods 40 which extend upwardly through openings in the platform 23.

The lower end of the mandrel 30 is provided with a ring-like head portion 30*a* which is beveled and which is useful in centering the mandrel 30 with respect to the inwardly extending adjacent portion 36*a* of the hot top casing.

With the hot top elevated, as shown in Fig. 4, so that the mandrel 30 is within the hot top and the refractory ring 38 is positioned so that it bears against a ledge of the mandrel head 29, the plastic mixture will be forced through the passages 31 into the space between the outer surface of the mandrel 30 and the inner surfaces of the hot top lining by operation of the movable ram 27.

Returning again to the receptacle 24 which contains the plastic material, and recalling that there is an exit opening 25 which communicates with the hollow member 26, there is provided in connection with the receptacle 24 a pusher element or member 41 which may be operated by a fluid motor 41*a*. The member 41 when operated pushes material within the receptacle 24 toward the opening 25 where, of course, by gravity it will fall into the conduit member 26.

When the plunger 27 is operated, its initial movement will cut off the exit 25 and when that is accomplished, pressure will be applied by further movement of the plunger 27 to push plastic material in the conduit 26 through the mandrel head 29 and radially out through the openings 31. When this is done, the plastic material will be forced around the portion 30 of the mandrel so that it will occupy the space between the inner wall of the lining brick of the hot top and the face of the mandrel.

The lower portion of the hot top casing is provided with an inwardly extending ridge 36*a*. The lower beveled portion 30*a* of the mandrel will engage the aforesaid ridge, thus centering the mandrel with respect to the hot top casing and so providing a constant width space between the inner wall of the hot top and the surface of the mandrel.

It will be noted that there is a very slight clearance between the inner ridge extension at the lower end of the hot top wall which is adjacent the mandrel so that when material is forced, as just described, and the mandrel completely fills the space between the mandrel and the inner wall of the hot top, there will be a chance for some of this material to escape at the lower end of the mandrel and this, of course, will indicate that the molding operation has been completed.

Upon completion of the operation to which reference has just been made, the platform 33 is lowered until it again becomes a part of the conveyor 32, the hot top being withdrawn or stripped with respect to the mandrel 30.

The hot top may then be moved along the conveyor 32 and a new hot top, to be veneered, moved into position upon the platform 33.

It will be noted that before the hot top is lowered, the inner wall of the ring is essentially in the same vertical plane as the wall of the mandrel 30. Therefore, as the platform 33 is lowered and the hot top descends with the platform 33, the inner wall portion of the ring 38 acts as a stripper so that material which has been molded in place against the inner wall of the brick lining will not be displaced by virtue of any dragging action incident to lowering the hot top where the molded veneer is in contact with the surface of the mandrel 30.

Inasmuch as the refractory ring such as is indicated by the reference numeral 38 is to be used in conjunction with the hot top when the same is placed upon a mold into which molten metal is to be poured, its presence in the combination which has above been described gives a special function to the refractory ring as a part of the combination for successfully placing the veneer upon the inner wall of the hot top lining.

As the hot top is lowered by the lowering of the platform 33, the metallic ring 39, which rests upon the refractory ring 38, will follow the downward movement of the hot top structure and the refractory ring 38. This will, of course, prevent any dislocation of the ring 38 during the lowering operation and insure its effective operation and functioning as a stripper, as above described.

The extent of downward movement of the ring 39 is limited by the provision of heads upon each of the rods 40, the heads ultimately engaging with the platform 23.

There is shown in Fig. 5 a variant of the apparatus which has heretofore been described, in which variant apparatus the refractory ring, which has been referred to by the numeral 38, is not associated with the hot top during the operation of forming the veneer lining upon the inner surface of the hot top but rather the refractory ring is added to the hot top after the formation of the inner veneer lining upon the interior wall of the hot top.

Referring to the drawings of Fig. 5, the apparatus for supplying the granular plastic material which is ultimately to form the veneer lining and the mechanism for moving the same under pressure into its final position against the inner lining of the hot top are to all intents and purposes the same as that which has been described in connection with the apparatus shown in Fig. 4. A platform 23 has attached thereto and depending therefrom the mandrel 42, which is provided with a head portion which is flanged and which head portion is supported upon the underside of the platform 23. The mandrel 42 has a body portion, the lower portion of which is hollow, as indicated at 43, and the mandrel portion is provided with an opening through which material is moved under pressure and which material is extruded through radial passageways 44, in this respect being similar to the mandrel which is disclosed in Fig. 4 of the drawing.

The flange portion of the mandrel is somewhat wider than that which is shown in Fig. 4 and is sufficiently wide so that when the hot top is in its most elevated position, as shown in Fig. 5, the hot top casing will be in contact with the flange portion at the top of the mandrel.

As will be apparent, the hot top when moved along the conveyor 45 moves onto a platform 46. In order to accommodate this platform in its lowermost position, the rollers, which are indicated at 47, are not continuous transversely extending rollers, but are short rollers 47 extending inwardly upon each side of the conveyor far enough to engage with the hot top when the hot top is moving along the conveyor. The platform 46 is narrow enough so as not to interfere with the short rollers 47 on opposite sides of the conveyor structure.

The platform 46 is provided with an extension 48 which serves as a guide, engaging with the lower open-ended portion 43 of the mandrel 42, resulting in a positioning of the mandrel such that it will not move sidewise but will remain in its proper position. This proper position, of course, means that it is centrally located with respect to the inside wall of the hot top lining and so provides a space of uniform width between the mandrel and the inner wall of the hot top.

In order to prevent side movement of the hot top when in its elevated position, depending guides such as those illustrated at 49 are provided, which guides are secured to and depend below the platform 23 and are so positioned as to substantially engage the upper portion of the hot top as it is elevated by the raising of the platform 46.

In order to properly position that portion of the hot top which is in engagement with the platform 46, the

platform is provided with members 46*a* which will engage with the outer portion of the hot top casing and correctly position it upon the platform 46.

The apparatus thus described may employ a source of granular plastic material the same as shown in connection with Fig. 4, i.e., a receptacle 24, a vertical conduit member 26, and a plunger 27 operated by a motor 28.

Depression of the plunger 27 will force the granular mobile material through conduit 26, through the radial passageways 44 and into the space between the mandrel and the inner wall of the hot top.

At the right-hand portion of Fig. 5 the hot top casing is shown upon the conveyor after the veneer has been applied upon the inner wall of the hot top lining, the veneer being indicated at 50 and the refractory lining of the hot top at 51. The ring which is to be associated with the hot top in use is placed upon the top of the hot top casing, this ring being indicated at 52, and will be attached thereto by any suitable means, such as clips, which are commonly used. The particular ring herein shown is a beveled ring, but the ring may have other forms than that of a beveled ring.

Referring to the structure which is shown in Fig. 6 of the drawing, a different form of apparatus is shown which, however, has from the functional standpoint, the same common features with respect to apparatus which has already been disclosel.

The platform 53 supports a container 54 which is adapted to receive the plastic material which is to be molded as a veneer upon the interior wall of the hot top lining. This container 54 is supported upon the platform 53 and adjacent the lower portion of the container 54 is a pusher 55 which may be operated by a fluid-operated motor 56. The platform carries a vertically extending conduit member 57 which has a side opening that communicates with an opening in the container 54, which side opening is indicated at 58. Within the member 57 there is a plunger 59 which is depressed or elevated by means of a fluid motor such as indicated at 59*a*.

From what has been described so far, it will be apparent that the member 55 will function to push material from the lower portion of the receptacle 54 through the opening 58 and into the lower part of the conduit member 57.

Carried by and depending from the underside of the platform 53 is a mandrel which comprises the head portion 60 and the depending portion 61. The head portion 60 is provided with a plurality of exit passageways which are indicated at 62 and the lower portion 61 of the mandrel is hollow as is clear from the showing in Fig. 6.

As shown in Fig. 6 of the drawing, a conveyor is indicated at 63, and, in the form here shown, a portion of the conveyor is carried by the platform 64, in this connection being similar to the construction shown in Fig. 4 of the drawing.

The hot top, which is indicated at 65 with its lining 66, is moved along conveyor 63 onto the part of the conveyor on the platform 64 and, when so positioned, will be correctly positioned to cooperate with the mandrel, which has been described. The platform 64 is raised until the refractory ring 67 engages with a flanged portion upon the head portion 60 of the mandrel. The refractory ring 67 is mounted upon the top portion of the hot top, i.e., the top portion thereof as viewed in Fig. 6.

In Fig. 7 there is shown the hot top casing 65 with the refractory ring 67 placed thereon, and it will be noted that the refractory ring is provided with channeled or cut-out portions 68 at the four corners of the inside periphery of the opening in the hot top.

When the hot top is in the position as shown in Fig. 6, these channels 68 which are formed in the refractory ring are in positions in alignment with the channel members 62 formed in the upper portion of the mandrel.

It will be clear, therefore, that when the plunger 59 is operated in a downward direction, the material within the member 57 will be pushed downwardly through the passages 62 and the passages 68 and into the space between the inner wall of the lining of the hot top and the wall of the hollow portion 61 of the mandrel. By this operation, the entire space between the inner face of the mandrel and the inner wall of the hot top is filled with the plastic material which forms the veneer lining.

When the above-described operation is completed, the platform 64 is lowered, carrying with it the hot top casing and the parts associated therewith and the hot top casing is stripped from the mandrel, leaving the veneer coating in place upon the inner wall of the hot top.

The hot top when in its lowered position is moved along the conveyor 63 and a hot top to be veneered is moved into position upon the platform 64 and the operation heretofore described is repeated.

A modified form of apparatus for accomplishing the same results as heretofore set forth is shown in Fig. 8, wherein the mandrel and the apparatus for supplying the mobile refractory material are stationarily mounted upon a platform and the hot top, which is to have the veneer lining applied to its inner surface, is brought, by means of an overhead trolley type of hoist, to a position above the location of the mandrel and then the hot top is lowered so that the mandrel telescopes within the hot top and the mandrel is in spaced relation with respect to the inner wall of the hot top.

Obviously, a series of hot tops may thus be brought to the station where the mandrel is located, and when the operation of providing the veneer lining is completed, each hot top may be withdrawn from its telescoped relation to the mandrel and removed to a place where the veneer lining may be thoroughly dried.

In Fig. 8, a platform 69 is provided upon which is mounted a mandrel 70 and which is formed as a part of a head 71, which head has a flange 72 bolted to the platform, thus definitely positioning the mandrel with respect to the platform. The head 71 is provided with a number of channels, one of which is indicated at 73, and the head 71 communicates with a cylindrical conduit member 74 equipped with a plunger 75 which is operated by means of a fluid motor 76. Supported by means of the platform 69 and located at one side of the mandrel and its associated structure is a hopper 77, which is adapted to contain a refractory mobile mixture which will be supplied to the interior of the member 74. For this last-mentioned purpose, the lower end of the hopper has an exit passage which communicates with an opening 74*a* in the member 74.

Also associated with the hopper is a pusher member 78 which is operated by means of a fluid motor 79.

The hot top comprises its casing 80 with its inner lining 81 and a refractory ring 82 assembled upon the said hot top casing and attached thereto by any suitable means, such as by clips. The lower part of the hot top casing, as indicated at 83, is provided with notches which will align with the channel member 73, to which reference has before been made.

In Fig. 9, the hot top casing is shown at 80 and the notched portions at 83. The number of such notched portions as shown is four, but obviously a greater or lesser number may be provided. However, the number of notches 83 and their positioning with respect to the channels 73 in the head member 71 must be observed.

The hot top is brought by means of a hoist 84 which is mounted upon an I-beam track 85 by means of rollers 86. The hoist carries a yoke 87 which has side members 87*a* adapted to engage with trunnions 80*a* which are formed as a part of the hot top casing. When the hot top is brought, by means of the hoist 84, to its position above that which is occupied by the mandrel, the hoist

is lowered so that the mandrel will telescope within the hot top casing and the hot top is positioned so that the notched portions 83 are in alignment with the channel 73 in the head 71. The transverse dimension of the mandrel is such that it is less than the interior dimension of the hot top with its lining and, therefore, when the mandrel is telescoped within the hot top casing, there is a space between the surface of the mandrel and the surface of the hot top lining. Obviously, this may be varied in accordance with the desire of the operator, but it should be approximately one-half inch, or slightly greater.

From the foregoing, it will be seen that the inside dimensions of ring 82 are such that the ring is essentially wiping against the outer surfaces of the mandrel 70 so that during the telescoping operation, the engagement between the surface of the mandrel and the inner periphery of the ring 82 is effective to correctly position the mandrel within the hot top.

It will be obvious from the description that the refractory mobile material in the hopper 77 may be moved by means of the pusher 78 into the interior of the conduit 74. The plunger 75 may be moved upwardly, which will, as it rises, cut off the entrance 74*a* and force the material in the chamber 74 through the passageway 73 and the notched-out portions 83 of the lower rim of the hot top casing and into the space between the inner lining of the hot top and the surface of the mandrel 70.

When the above-mentioned operation is completed, the yoke 87 will be employed to engage with the trunnions 80*a* and the hot top withdrawn axially from its association with the mandrel 70. The ring 82 will act as a wiper against the surface of the mandrel, enabling the mandrel to make a clean release with respect to the material of the veneer which has been placed on the inner lining of the hot top.

In all of the structures of the applicant which have been shown in Figs. 4, 5, 6 and 8, the mandrel has an outer surface which is not tapered but is straight-sided, and the same is true with respect to the lining of the hot top. Therefore, after the veneer material has been forced into place between the surface of the mandrel and the surface of the hot top, the parting between the mandrel surface and the surface of the veneer which has been forced into place is along a plain, untapered surface, so that the wiping action will be clear and no forces will be present to tend to tear the placed veneer material from its deposited position.

As will be apparent by examination of the different forms of apparatus which have been described, there is always present in some form or other a member which provides for a stripping action. That is to say, the member engages with the surface of the mandrel so as to assist in stripping the mandrel away from the material which has been placed to form the veneer upon the inner lining of the hot top.

The refractory mobile material which has been referred to in the prior description is a composition of granular material together with a silicious material and a binder, to which water has been added in sufficient quantity to render the material mobile so that it may be moved into position by instrumentalities of the various forms of the apparatus which have been described so that the granular material may be forced into the space between the mandrel and the inner surface of the hot top. The consistency of this material can, of course, be controlled by the operator so that it will have the proper consistency for efficient operation with respect to the apparatus.

It will be obvious that where in the specification we have referred to the use of fluid motors or hydraulic motors, other types of motors than those specifically referred to may be used with equal facility.

Also it is to be understood that other means than those shown and described for holding the granular material and for moving such material to the mandrel and its passageways may be employed.

Having thus described my invention, I claim:

1. Apparatus for molding the veneer upon the inner lining of a hot top comprising a mandrel having sides substantially parallel to the axis thereof provided with radially extending passageways, a conduit member the interior of which is connected with the said radial passageways in the mandrel, a platform located in axial alignment with the mandrel and adapted to support a hot top thereon and relatively movable with respect to said mandrel, the said hot top at the portion thereof adjacent to the platform being provided with an inner extension, the platform supporting the hot top and the mandrel itself being axially aligned so that relative movement of the platform and the mandrel will relatively move the hot top so that the mandrel telescopes within the hot top from the end thereof remote from said platform, the lower portion of said mandrel having means which will engage with the inner extension upon the hot top to thereby position the mandrel centrally with respect to the inner lining of the hot top thereby to provide a space between the inner lining of the hot top and the outer surface of the mandrel which defines a mold cavity corresponding in size and shape to the veneer to be molded, a ring-like member associated with said end of said hot top and adapted to extend inwardly from said hot top substantially into engagement with said mandrel when telescoped into said hot top to close the mold cavity at said end of said hot top, said mandrel being withdrawable from said hot top outwardly from said end with the last said member in place, means for supplying granular mobile material to the conduit member which connects with the mandrel, and piston means associated with said conduit member for pressurizing the said granular material moving it through said conduit and the radial passageways in the mandrel into the space between the surface of the mandrel and the inner lining of the hot top.

2. Apparatus for molding a veneer upon the inner lining of a hot top comprising a mandrel which is stationarily mounted, said mandrel having a head portion which is provided with a plurality of passageways which have exit openings positioned upon the outer wall of the mandrel proper, a conduit member the interior of which is connected with the said passageways in the mandrel, a supporting means for the hot top with its inner lining and refractory ring placed at the upper end of the said hot top, the supporting means for the hot top and the mandrel itself being axially aligned so that the hot top may be moved into cooperating position with the mandrel whereby the mandrel telescopes within the hot top in spaced relation to the inner wall of the hot top thereby to provide a space between the inner lining of the hot top and the outer surface of the mandrel, the said ring carried by the hot top being provided with passageways which are positioned to align with the exit ends of the passageways in the mandrel when the mandrel and hot top are in associated relation, the said openings in the ring being positioned to communicate with the space between the hot top lining and the mandrel, means for supplying granular mobile material to the conduit member, and means associated with said conduit member for pressurizing the granular material through said conduit and the passageways in the mandrel and in the ring of the hot top to occupy the space between the surface of the mandrel and the inner lining of the hot top.

3. Apparatus for molding a veneer upon the inner lining of a hot top comprising a mandrel which is stationarily mounted, said mandrel having a head portion which is provided with a plurality of passageways, the exit portions of said passageways lying upon the outer surface of the mandrel proper, means for supporting the hot top having an inner lining, the said support and the mandrel itself being axially aligned so that movement of the supporting means for the hot top into cooperative rela-

tion with the mandrel will cause the mandrel to telescope within the hot top in spaced relation to the inner lining of the hot top, thereby providing a space between the inner lining of the hot top and the outer surface of the mandrel, the lower portion of the hot top being provided with an inwardly extending portion which is provided with a plurality of ports, the said ports aligning with the exit portions of the passageways in the mandrel when the hot top and mandrel are in assembled relation, the said ports in the hot top being positioned to communicate with the space between the inner lining of the hot top and the outer surface of the mandrel, means for supplying granular mobile material to the conduit member, and means associated with the conduit member for pressurizing the granular material through said conduit and the passageways in the mandrel and the ports in the portion of the hot top before mentioned into the space between the surface of the mandrel and the inner lining of the hot top.

4. Apparatus for molding a veneer upon the inner lining of a tubular hot top comprising a mandrel having sides parallel to the axis of the mandrel, means for supporting a hot top in axial alignment with the axis of the mandrel, the hot top supporting means and the mandrel being mounted for relative movement so that the hot top and mandrel may be relatively moved to telescope the mandrel into said hot top from one end thereof until the mandrel is telescoped within the hot top with said sides disposed in spaced relation to the inner lining of the hot top to define with the hot top a mold cavity corresponding in size and shape to the veneer to be molded, there being passageways formed in the mandrel which communicate with the space between the inner lining of the hot top and the mandrel when the same are in assembled condition, a ring-like member associated with the hot top at said one end and extending inwardly of the hot top substantially into engagement with said mandrel when the mandrel is telescoped therein to close said cavity at said one end of said hot top, said mandrel being withdrawable from said hot top through said member and outwardly of said one end while the ring-like member is maintained in place with respect to said hot top, and pressure means communicating with said passageways in the mandrel for forcing a mobile granular refractory material under pressure through the said passageways in the mandrel to fill substantially the entire space between the mandrel and the lining of the hot top.

5. An apparatus as defined in claim 4 wherein said one end of said hot top is the bottom end thereof when in use and said ring-like member is a bottom refractory ring.

6. An apparatus as defined in claim 4 wherein said mandrel includes a conduit member communicating with said passageways and said pressure means comprises a piston disposed within said conduit member.

7. An apparatus as defined in claim 6 wherein said one end of said hot top is the bottom end thereof when in use and said ring-like member is a bottom refractory ring.

8. The method of readying a tubular hot top having an inner refractory lining for use which comprises assembling a bottom refractory ring on the bottom of the hot top with the inner portion of the ring extending inwardly of said lining, relatively moving in an axial direction said hot top and a mandrel having sides parallel to the axis of the mandrel to axially telescope the mandrel into the hot top from said bottom to dispose said sides of said mandrel opposite the lining of the hot top to define with the lining and the bottom ring the three sides comprising the end wall and the spaced inner and outer side walls of a continuous mold cavity for said veneer extending completely around the interior of the hot top, closing the mold cavity at the upper end of said hot top, supplying under pressure to said cavity a wet plastic granular material having a tendency to adhere to the mandrel and to the hot top lining to fill said cavity and form said veneer, and relatively moving said hot top and mandrel axially to withdraw said mandrel through said ring before said veneer has dried and while maintaining said ring in place on said hot top.

9. The method of readying a tubular hot top having an inner refractory lining for use which comprises assembling a ring-like member on one end of the hot top with the inner portion of the ring extending inwardly of said lining, relatively moving in an axial direction said hot top and a mandrel having sides parallel to the axis of the mandrel to axially telescope the mandrel into the hot top from said one end to dispose said sides of said mandrel opposite the lining of the hot top to define with the lining and the ring-like member the three sides comprising the end wall and the spaced inner and outer side walls of a continuous mold cavity for said veneer extending completely around the interior of the hot top, supplying under pressure to said cavity a wet plastic granular material having a tendency to adhere to the mandrel and to the hot top lining to fill said cavity and form said veneer, and relatively moving said hot top and mandrel axially to withdraw said mandrel through said ring-like member before said veneer has dried and while maintaining said ring-like member in place on said hot top.

10. The method as defined in claim 9 wherein said mobile refractory granular material is forced into the mold cavity by applying piston pressure thereto.

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