

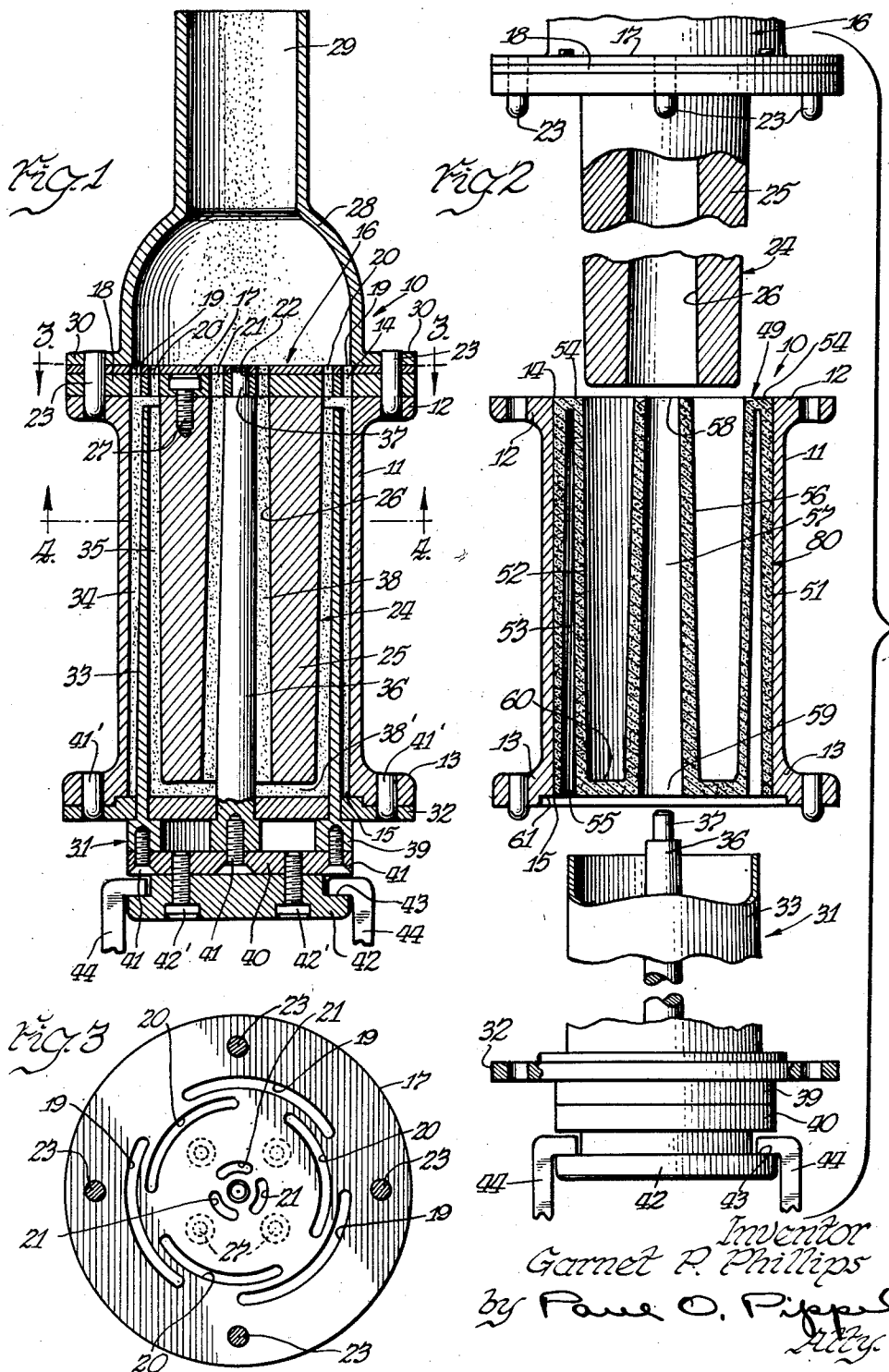
Nov. 20, 1956

G. P. PHILLIPS
APPARATUS FOR MAKING LINER SLEEVES
AND REFRACTORY SHELL TYPE MOLDS

2,770,855

Filed Nov. 14, 1952

2 Sheets-Sheet 1



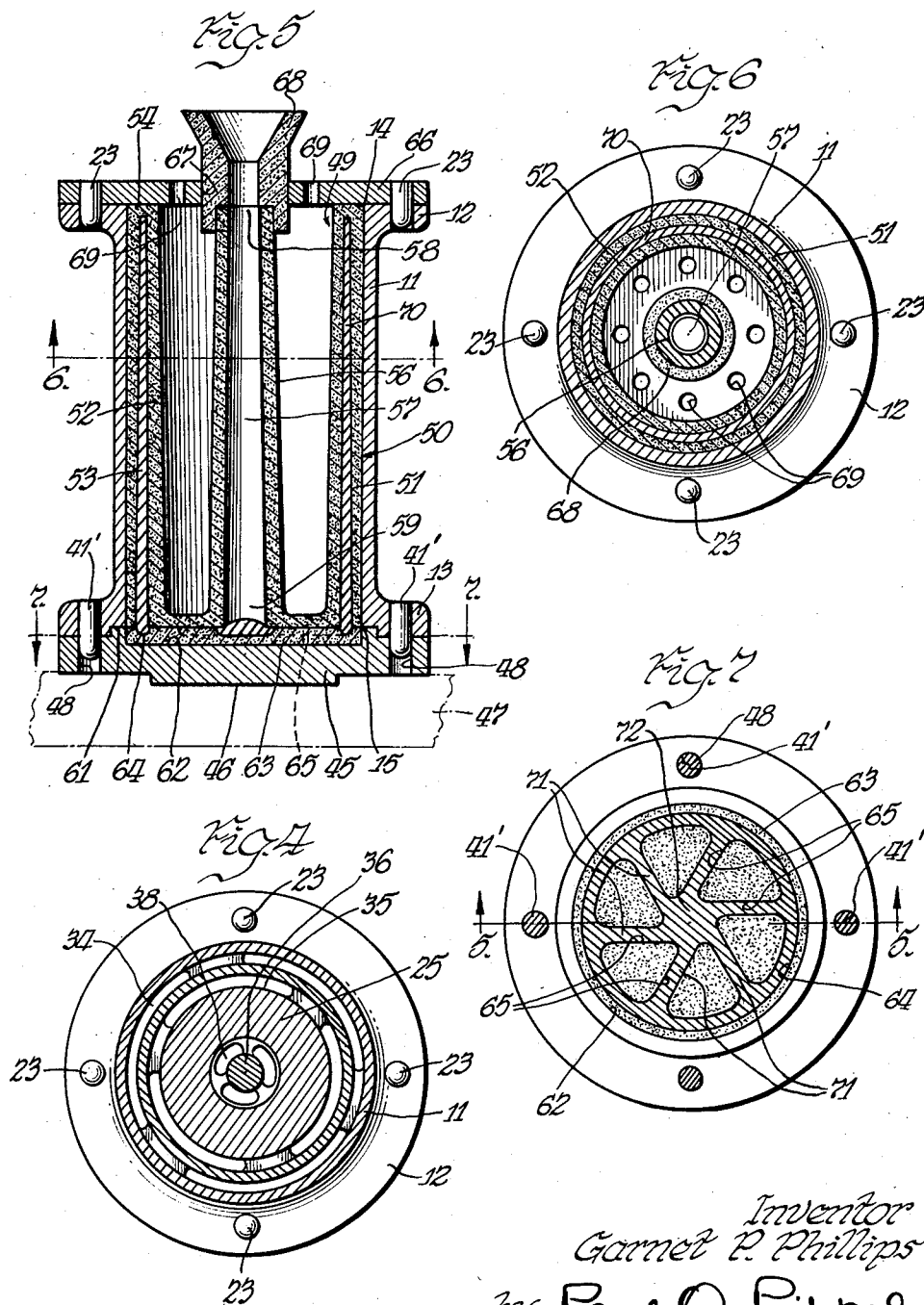
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APPARATUS FOR MAKING LINER SLEEVES AND REFRACTORY SHELL TYPE MOLDS

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8 Claims. (Cl. 22—9)

This invention relates to an improved method and apparatus for founding cylinder sleeves or liners. More specifically this invention relates to an improved process and apparatus for making shell-molds and for centrifugally casting cylinder sleeves with the utilization of the shell-molds.

In recent times the process of shell-molding has been used effectively in the founding of precision castings. Castings produced with the shell-mold process have been found to have unusual characteristics such as extreme accuracy of dimension and smoothness of surface to an extent which necessitates little machining after the rough casting has been removed from the shell-mold. In the performance of this process a binder of a resinous material is mixed with a sand of predetermined fineness, this composition being distributed over a heated pattern to form a relative thin shell. The pattern and shell are then inserted in an oven whereupon a baking operation takes place. After the pattern and shell have been cooled, the shell is stripped from the pattern and it is then ready for the casting operation. One of the difficulties in this process has been the problem of suitably backing up the outer wall of the shell during the entrance of the heavy molten casting material into the shell-mold. This problem is particularly acute in the production of cylindrical members such as sleeves or liners customarily used in the cylinder blocks of internal combustion engines. Shell-molds of this type necessarily must be properly backed up so that an accurate cylindrical member is obtained.

It is a prime object therefore to provide an improved founding process for producing cylinder sleeves.

Still another object of this invention is to provide an improved process for making shell type molds adapted for a process involved in the casting of cylindrical liners.

Still another object is to provide an improved method of centrifugally casting cylindrical sleeves utilizing a shell type mold.

A still more specific object is to provide a casing with a frangible or refractory shell-mold, including the steps of introducing a casting metal into the shell-mold and simultaneously rotating the casing and the shell to produce cylinder liners.

Still another object is to provide an improved apparatus for producing shell molds of a cylindrical nature.

Another object is to provide an improved apparatus for producing shell-molds, the apparatus comprising a cylindrical casing having upper and lower pattern sections, the pattern sections extending into the casing which is provided with openings for the introductions of a shell-mold compound, the compound forming with the pattern sections a shell-mold, the pattern sections being axially displaceable from the casing to leave the completed shell-mold within the casing.

A still more specific object is to provide an improved apparatus for making shell-molds in connection with the casting of cylindrical liners, the apparatus including a casing having upper and lower pattern sections, the pattern sections including tubular and cylindrical mem-

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bers which are positioned in telescoping relation with respect to each other within the casing, the casing being arranged to receive a shell-mold compound which is packed within the spaces or chambers left by the cylindrical members of the pattern sections and whereupon, upon the removal of the pattern sections from the casing, a shell-mold is constructed within the said casing.

A still further object is to provide an improved shell type mold adapted for the casting of cylinder liners.

A more specific object is to provide an improved shell-mold for cylinder liners the mold including inner and outer wall sections which are integral and which are provided with an axially extending recess or chamber, the chamber in turn communicating with a centrally located inlet tube which is integrally formed with the walls of the shell-mold and is connected to the chamber by means of a passage through which the casting metal may be introduced into the recess or chamber of the shell-mold.

These and further objects will become more readily apparent from a reading of the specification when examined in connection with the accompanying sheets of drawings.

In the drawings:

Figure 1 is a cross sectional view through an improved apparatus for producing shell-molds;

Figure 2 is an exploded view, partially in cross section, showing a shell-mold producing apparatus having upper and lower pattern sections withdrawn from a cylindrical casing member of the apparatus;

Figure 3 is a cross sectional view taken substantially along the line 3—3 of Figure 1;

Figure 4 is a cross sectional view taken along the line 4—4 of Figure 1;

Figure 5 is a cross sectional view through a portion of a shell-mold producing apparatus the apparatus being utilized in connection with the centrifugal casting of a cylinder liner or sleeve;

Figure 6 is a cross sectional view taken along line 6—6 of Figure 5; and

Figure 7 is a cross sectional view taken along the line 7—7 of Figure 5.

Referring now particularly to Figures 1, 2, 3 and 4, a mold forming apparatus is generally designated by the reference character 10. The mold forming apparatus 10 comprises a cylindrical casing 11, which is provided with outwardly extending upper and lower flanges 12 and 13 respectively. The cylindrical casing 11 is provided with an upper opening 14 and a lower opening 15. Adjacent the upper opening 14, an upper pattern section 16 is provided. The upper pattern section 16 comprises a pair of superposed plates 17 and 18. The plates 17 and 18 are provided with a plurality of circumferentially extending aligned outer slots 19. A plurality of circumferentially extending slots 20 are spaced laterally inwardly from the slots 19, the slots 19 and 20 being in communication with the interior of the casing 11 as will become more apparent from the ensuing description. The superposed plates 17 and 18 are also provided with a plurality of central slots 21 in communication with the interior of the casing 11.

The plates 17 and 18 are also provided with aligned bores 22. The flange 12 receives dowel pins 23 which are utilized for centering and for securing portions of the apparatus 10.

A tubular member 24 is securely connected to the upper pattern section 16. The tubular member 24 comprises a relatively thick cylindrical wall 25 and a relatively narrow bore 26. The tubular member 24 extends downwardly into the casing 11 substantially adjacent the lower end of the same. Screws 27 (only one of which is shown) suitably connect the tubular member 24 to the plate 18.

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The upper end of the cylindrical casing 11 is also provided with a funnel 28 which is connected for removal with the upper pattern section 16. The funnel 28 includes an inlet 29 which is in communication with the slots 19, 20 and 21. The funnel 28 also includes a flange 30 to which the dowel pins 23 are connected. The dowel pins 23 extend through the plates 17, 18 and the flange 12 as indicated.

At the lower end of the cylindrical casing 11 a lower pattern section 31 is provided. The lower pattern section 31 comprises a plate 32 which fits over the lower opening 15 of the casing 11. A cylindrical member or sleeve 33 is connected to the plate 32, the sleeve 33 extending into the casing 11 and being telescopically related to or encircling the tubular member 24. The cylindrical member 33 extends upwardly in the casing 11 so as to be substantially coextensive with the length thereof. The outer surface of the cylindrical member 33 is laterally spaced with respect to the inner wall of the casing 11 so as to provide a chamber 34. Likewise, the inner wall of the cylindrical member 33 is laterally spaced from the outer wall of the tubular member 24 so as to provide a chamber 35. The plate 32 also has an elongated post or rod member 36 connected thereto. The post 36 is at its upper end provided with a reduced section 37 which is adapted to mate with or telescopically engage the bores 22 of the plate 17 and 18. The post 36 is of substantially less diameter in cross section than the bore 26 so as to provide an annular chamber 38. The annular chamber 38 is in communication with the chambers 34 and 35 by means of a substantially annular and uninterrupted passage 38'.

As best shown in Figure 1, the tubular member 24 terminates above the lower opening 15 and thus the annular passage 38' is formed. The cylindrical member 33 also terminates below the upper opening 14 and thus communication between the chambers 34 and 35 is had, the chamber 35 of course also communicating with the chamber 38.

The plate 32 is suitably connected to a ring 39. The ring 39 is in turn connected to a plate 40 by means of a plurality of screws 41. Thus, the plate 40 is rigidly connected to the ring 39 which in turn is suitably connected to the plate 32. The plate 32 is suitably held over the lower opening 15 by means of dowel pins 41' which serve to properly center the lower pattern section 31 with respect to the casing 11. A block 42 is connected to the plate 40 by means of screws 42', the block 42 having annular under cut portion 43 which is engaged by a pair of hooks 44.

The function of the above apparatus 10 is to produce shell-molds utilized in the casting of cylinder liners. In the performance of this function sand and a suitable binder resin or similar compound is introduced through the funnel 28 on top of the plate 17. The material is thereupon distributed through the openings 19, 20 and 21 into the chambers 34, 35 and 38. The material packs itself thus in the spaces left by the tubular member and cylindrical sleeve, the passage 38' also being suitably filled with this shell-mold compound. The bore 26 or bore chamber 38 also is filled up with this compound which may be in semi-liquid or slurry form. The introduction of the material into the funnel and internal parts of the apparatus 10 may be accomplished by conventional pressure methods which form no pertinent part of the invention. Thus if the sand and resin is in dry form, it may be blown in, or if in slurry form, other pressure means may be utilized. The compound is left in the apparatus until it hardens or it may be suitably baked in an oven provided for that purpose. After suitable hardening of the compound takes place the upper and lower pattern sections 16 and 17 are axially displaced or withdrawn from the casing 11 as indicated in Figure 2. Upon this withdrawal of the pattern sections a shell-mold is formed which is still maintained within the casing 11.

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The casing 11 containing the shell-mold is now placed, as indicated in Figure 5 upon a base plate 45 which covers the lower open end of the casing 11. The base plate 45 is provided with a projection 46 mating with a recess in a rotatable table 47. The rotatable table 47 need not be further described since it is sufficient to indicate that this type of table may be utilized in connection with centrifugal casting. The base plate 45 is provided with a plurality of bores 48 which may suitably mate with dowel pins 41' so as to impart rotating movement of the table 47 to the casing 11. The shell-mold, which is present within the casing 11, upon removal of the upper and lower pattern sections, is designated at 49. The shell-mold 49 now has hardened and may be considered as being frangible or refractory. The shell-mold 49 comprises a cylindrical refractory body 50 having an outer cylindrical wall 51 and an inner cylindrical wall 52 laterally spaced from the outer cylindrical wall 51. The inner cylindrical wall 52 is provided with an annular recess or axially extending chamber 53 which is closed at its upper end by means of an integral wall section 54 connecting the upper ends of the outer and inner cylindrical walls 51 and 52 respectively.

As indicated in Figure 2 upon the removal of the upper and lower pattern sections from the shell-mold 49 the annular recess or chamber is open at its lower end as indicated at 55. The configuration of the pattern sections above described have been such so as to provide an inlet tube 56 in the completed shell-mold 49. The inlet tube 56 includes a longitudinally extending bore 57 which is provided with an upper inlet opening 58 and a lower outlet opening 59. The inlet tube 56 is connected at its lower end by means of a lower annular integral wall portion 60 to the inner cylindrical wall 52.

The lower end of the casing 11 is undercut, as indicated at 61, to conform to the shape of the lower plate 46. The plate 46 is suitably dished as indicated at 62 to accommodate a lower wall portion or cap 63. The wall portion or cap 63 is also formed of a refractory material and may be molded in a separate operation. The cap 63 is provided with an annular recess 64 which is arranged to communicate with the lower end of the chamber 53. The cap 63 is also provided with a plurality of radially extending or spider shaped passages 65 which communicate with the annular recess 64 and with the chamber 53.

The upper end of the casing 11 is provided with a top plate 66 having a central bore 67. The central bore 67 is provided with a ceramic or refractory funnel 68 in communication with the inlet opening 58 of the inlet tube 56. A plurality of vents 69 are also provided in the plate 66, these vents permitting the escape of gases which are incident to the casting operation.

During the casting operation, casting material is introduced into the funnel 68, the molten material descending through the bore 57, throughout the radially extending passages 65, and into the annular recess or chamber 53. During the introduction of the molten metal the table 47 and the casing 11 are centrifugally rotated. Thus, the casting material which is introduced is forced centrifugally outwardly through the passages 65 in an effective and rapid manner so that the annular chamber 53 is quickly filled. After the molten metal has hardened in a conventional manner, the casing is withdrawn from the table 47 and the cylinder liner 70 is removed from the shell-mold 49. The shell-mold 49 is of course expendable and is readily removed from the liner 70 since it consists of an easily destructible material. The liner in its rough cast form includes an integral spider portion, as indicated in Figure 7, which results from the pouring operation. The spider portion 71 also has a central portion 72. The portions 71 and 72 are of course removed prior to the final finishing of the cylinder liner.

Thus, it can be seen that a new and improved process for the casting of cylinder sleeves has been pro-

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vided. The process consists of the packing of a sand and suitable shell type mold material into a cylindrical casing provided with a suitable pattern. The shell-mold compound, is hardened or baked within the casing whereupon the pattern is withdrawn leaving the shell-mold within the casing. The casing therefore acts as a backing up member for the shell-mold during the casting process. The casing is then rotated about its axis during the simultaneous introduction of the molten material and the cylindrical form is cast.

An improved apparatus has been described, the apparatus fully achieving the objects of the invention in providing a novel mechanism whereby shell-molds are manufactured. The apparatus is novel in that it includes pattern sections which are removable from the casing thereby leaving the shell-mold within the casing. The casing is effective to provide a backing up or support means for the shell-mold during the casting operation. Furthermore, the casing is effective to prevent damage to the shell-mold during the interim period which takes place from the time of the formation of the shell to the final casting operation. The apparatus which has been described further provides a novel type of shell-mold which is particularly adapted in connection with the centrifugal casting of cylinders liners. Thus, the objects of the invention have been fully achieved.

It must be understood of course that changes in the process, apparatus, and article may be made which do not depart from the spirit of the invention as disclosed or from the scope thereof as defined in the appended claims.

What is claimed is:

1. A foundry mold manufacturing apparatus comprising a cylindrical casing having upper and lower open ends, an upper pattern section connected to the upper end of said casing, said upper pattern section comprising a first plate connected to the casing over the upper open end, said first plate having a plurality of first annularly disposed openings communicating with the interior of the cylinder adjacent the inner wall thereof, said first plate including a second opening substantially centrally disposed and communicating with a central portion of the casing, a tubular member connected to said first plate and projecting into said cylindrical casing, said tubular member having a relatively thick wall and a relatively narrow bore, a lower pattern section connected adjacent the lower open end of said cylindrical casing, said lower pattern section including a second plate connected to said cylindrical casing over its lower open end, a centrally located post connected to said second plate, said post having a lesser diameter than the bore and extending into the bore in telescoping relation to provide a central annular axially extending first chamber in communication with the second of said first plate, a sleeve having a relatively thin cylindrical wall connected to said second plate, said sleeve extending into said cylindrical casing over said tubular member in telescoping relation, the sleeve having its inner wall spaced laterally from the tubular member, and its outer wall laterally spaced from its inner surface of said cylindrical casing to provide a pair of laterally spaced axially extending concentric second and third chambers, said first openings communicating with said second and third chambers, said second opening communicating with said first chamber, an annular uninterrupted passage adjacent the second plate providing for communication between the first, second and third chambers, and means arranged to funnel material through said first and second openings to said chamber and to said passage, said upper and lower pattern sections being axially displaceable with respect to said casing and each other to provide a shell-type mold within the casing having the contours of said pattern sections.

2. A foundry mold manufacturing apparatus comprising a cylindrical casing having upper and lower open ends, an upper pattern section connected to the upper end of

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said casing, said upper pattern section comprising a first plate connected to the casing over the upper open end, said first plate having a plurality of first annularly disposed openings communicating with the interior of the cylinder adjacent the inner wall thereof, said first plate including a substantially second opening centrally disposed and communicating with the central portion of said casing, a tubular member connected to said first plate and projecting into said cylindrical casing, said tubular member having a relatively thick wall and a relatively narrow bore, a lower pattern section connected adjacent the lower end of said cylindrical casing, said lower pattern section including a second plate connected to said cylindrical casing over its lower open end, a centrally located post connected to said second plate, said post having a lesser diameter than the bore and extending into said bore in telescoping relation to provide a first annular chamber in communication with the second opening of said first plate, a sleeve having a relatively thin cylindrical wall connected to said second plate, said sleeve extending into said cylindrical casing over said tubular member in relative telescoping relation, the sleeve having its inner wall laterally spaced from the tubular member, and its outer wall laterally spaced from the inner surface of said cylindrical casing to provide a pair of laterally spaced second and third concentric chambers substantially coextensive with the length of said casing, said second and third chambers being in communication with said first openings, an uninterrupted annular passage adjacent the second plate providing communication between the first, second and third chambers, and funnel means connected to said casing for directing mold material through said first and second openings to fill said chambers and said passage, said upper and lower pattern sections being axially displaceable with respect to said casing to provide a shell-type mold disposed within the cylindrical casing.

3. A foundry mold manufacturing apparatus comprising a cylindrical casing having upper and lower open ends, an upper pattern section connected to the upper end of said casing, said upper pattern section comprising a first plate connected to the casing over the upper open end, said first plate having a plurality of first openings communicating with the interior of the cylinder adjacent the inner wall thereof, said first plate including a second opening communicating with a central portion of the casing, a tubular member connected to said first plate and projecting into said cylindrical casing, said tubular member having a relatively thick wall and a relatively narrow bore, a lower pattern section connected adjacent the lower open end of said cylindrical casing, said lower pattern section including a second plate connected to said cylindrical casing over its lower open end, a centrally located post connected to said second plate, said post having a lesser diameter than the bore and extending into the bore in telescoping relation to provide a central annular axially extending first chamber in communication with the second opening of said first plate, a sleeve having a relatively thin cylindrical wall connected to said second plate, said sleeve extending into said cylindrical casing over said tubular member in telescoping relation, the sleeve having its inner wall spaced laterally from the tubular member, and its outer wall laterally spaced from the inner surface of said cylindrical casing to provide a pair of laterally spaced axially extending concentric second and third chambers, said first opening communicating with said second and third chambers, said second opening communicating with said first chamber, an annular uninterrupted passage adjacent the second plate providing for communication between the first, second and third chambers, and means arranged to funnel material through said first and second openings to said chambers and to said passage, said upper and lower pattern sections being axially displaceable with respect to said casing and each other to provide a shell-

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type mold within the casing having the contours of said pattern sections.

4. A foundry mold manufacturing apparatus comprising a cylindrical casing having upper and lower open ends, an upper pattern section connected to the upper end of said casing, said upper pattern section comprising a first plate connected to the casing over the upper open end, said first plate having a plurality of first openings communicating with the interior of the cylinder adjacent the inner wall thereof, said first plate including a second opening communicating with a central portion of the casing, a tubular member connected to said first plate and projecting into said cylindrical casing, said tubular member having a relatively narrow bore, a lower pattern section connected adjacent the lower open end of said cylindrical casing, said lower pattern section including a second plate connected to said cylindrical casing over its lower open end, a centrally located projecting member connected to said second plate, said projecting member having a lesser diameter than the bore and extending into the bore in telescoping relation to provide a central annular axially extending first chamber in communication with the second opening of said first plate, a sleeve having a relatively thin cylindrical wall connected to said second plate, said sleeve extending into said cylindrical casing over said tubular member in telescoping relation, the sleeve having its inner wall spaced laterally from the tubular member, and its outer wall laterally spaced from the inner surface of said cylindrical casing to provide a pair of laterally spaced axially extending concentric second and third chambers, said first openings communicating with said second and third chambers, said second opening communicating with said first chamber, an annular uninterrupted passage adjacent the second plate providing for communication between the first, second and third chambers, and means arranged to funnel material through said first and second openings to said chambers and to said passage, said upper and lower pattern sections being axially displaceable with respect to said casing and each other to provide a shell-type mold within the casing having the contours of said pattern sections.

5. A foundry mold manufacturing apparatus comprising a cylindrical casing having upper and lower open ends, an upper pattern section connected to the upper end of said casing, said upper pattern section comprising a first plate connected to the casing over the upper open end, said first plate having a plurality of first openings communicating with the interior of the cylinder adjacent the inner wall thereof, said first plate including a second opening communicating with a central portion of the casing, a tubular member connected to said first plate and projecting into said cylindrical casing, said tubular member having a bore, a lower pattern section connected adjacent the lower open end of said cylindrical casing, said lower pattern section including a second plate connected to said cylindrical casing over its lower open end, a centrally located projecting member connected to said second plate, said projecting member having a lesser diameter than the bore and extending into the bore in telescoping relation to provide a central annular axially extending first chamber in communication with the second opening of said first plate, a sleeve having a relatively thin cylindrical wall connected to said second plate, said sleeve extending into said cylindrical casing over said tubular member in telescoping relation, the sleeve having its inner wall spaced laterally from the tubular member, and its outer wall laterally spaced from the inner surface of said cylindrical casing to provide a pair of laterally spaced axially extending concentric second and third chambers, said first openings communicating with said second and third chambers, said second opening communicating with said first chamber, an annular passage means providing for communication between the first, second and third chambers, and means

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arranged to funnel material through said first and second openings to said chambers and to said passage, said upper and lower pattern sections being displaceable with respect to said casing to provide a shell-type mold within the casing having the contours of said pattern sections.

6. A foundry mold manufacturing apparatus comprising a cylindrical casing having upper and lower open ends, an upper pattern section connected to the upper end of said casing, said upper pattern section comprising a first plate connected to the casing over the upper open end, said first plate having a plurality of first annularly disposed openings communicating with the interior of the cylinder adjacent the inner wall thereof, said first plate including a substantially second opening communicating with the casing inwardly from said first openings, a tubular member connected to said first plate and projecting into said cylindrical casing, said tubular member having a relatively thick wall and a relatively narrow bore, a lower pattern section connected adjacent the lower end of said cylindrical casing, said lower pattern section including a second plate connected to said cylindrical casing over its lower open end, a centrally located post connected to said second plate, said post having a lesser diameter than the bore and extending into said bore in telescoping relation to provide a first annular axially extending chamber in communication with the second opening of said first plate, a sleeve having a relatively thin cylindrical wall connected to said second plate, said sleeve extending into said cylindrical casing over said tubular member in relative telescoping relation, the sleeve having its inner wall laterally spaced from the tubular member, and its outer wall laterally spaced from the inner surface of said cylindrical casing to provide a pair of laterally spaced second and third concentric chambers, said second and third chambers being in communication with said first openings, an uninterrupted annular passage adjacent the second plate providing communication between the first, second and third chambers, and funnel means connected to said casing for directing mold material through said first and second openings to fill said chambers and said passage, said upper and lower pattern sections being axially displaceable with respect to said casing to provide a shell-type mold disposed within the cylindrical casing.

7. A foundry mold manufacturing apparatus comprising a cylindrical casing having upper and lower open ends, upper and lower pattern sections respectively connected over the upper and lower open ends of said casing, the upper pattern sections having openings providing for communication with the interior of the casing, a tubular member connected to one of said pattern sections, said tubular member projecting into said casing, a sleeve connected to the other pattern section, said sleeve and said tubular member being disposed in relative telescoping and laterally spaced relation to provide first and second concentric chambers, one of said pattern sections including a post substantially coextensive within said tubular member to provide a third chamber in communication with said openings, and means adapted to direct mold material through said openings into said chamber, said first and second pattern sections being relatively displaceable from the mold material thereby leaving a cylindrical shell-type mold in said casing.

8. A foundry mold manufacturing apparatus comprising a cylindrical casing having upper and lower open ends, upper and lower pattern sections respectively connected over the upper and lower open ends of said casing, the upper pattern sections having openings providing for communication with the interior of the casing, a tubular member connected to one of said pattern sections, said tubular member projecting into said casing, a sleeve connected to the other pattern section, said sleeve and said tubular member being disposed in relative telescoping and laterally spaced relation to provide first and second concentric chambers, one of said pattern sections

including a post substantially coextensive within said tubular member to provide a third chamber in communication with said openings, said casing having a passageway disposed at its lower end for connecting said chambers, and means adapted to direct mold material through said openings into said chamber, said first and second pattern sections being relatively displaceable from the mold material thereby leaving a cylindrical shell-type mold in said casing.

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