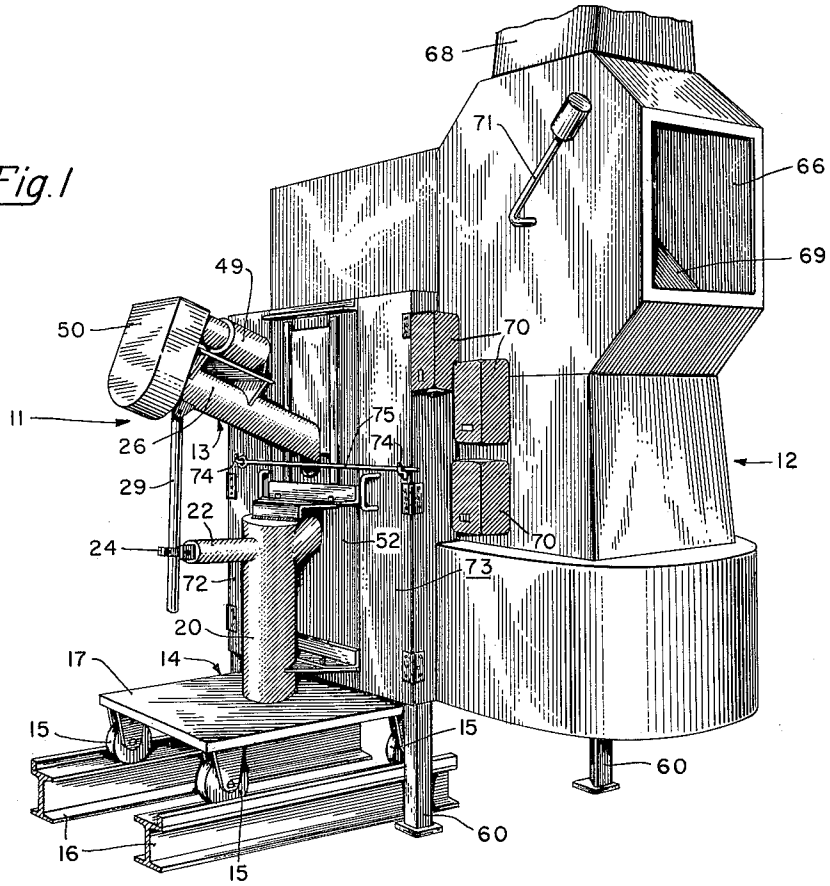
March 1, 1966 W. S. EGGERT, JR., ETAL 3,237,247

ROTATIONAL CASTING APPARATUS

Filed Nov. 8, 1963 2 Sheets-Sheet 1

Fig. 1



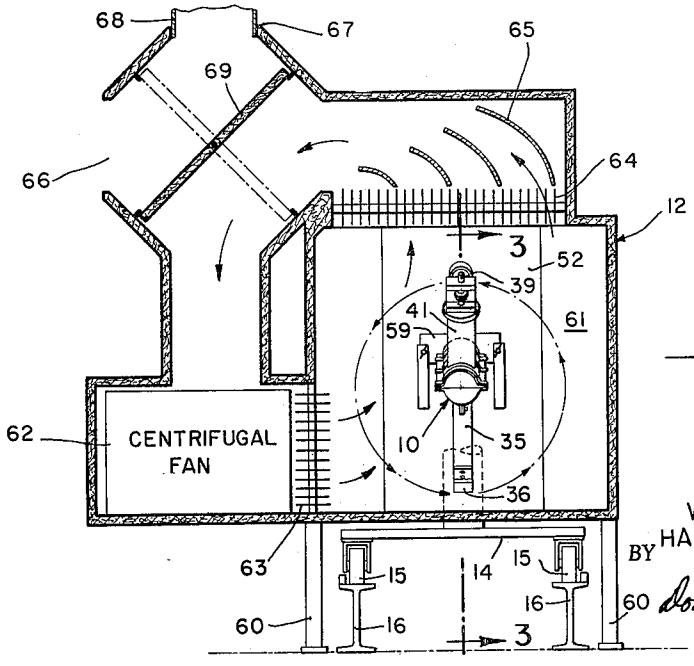


Fig. 2

INVENTORS
WALTER S. EGGERT, JR.
BY HARRY M. RUSSEL-FRENCH
Douglas R McTechnie
ATTORNEY

March 1, 1966 W. S. EGGERT, JR., ETAL 3,237,247

ROTATIONAL CASTING APPARATUS

Filed Nov. 8, 1963 2 Sheets-Sheet 2

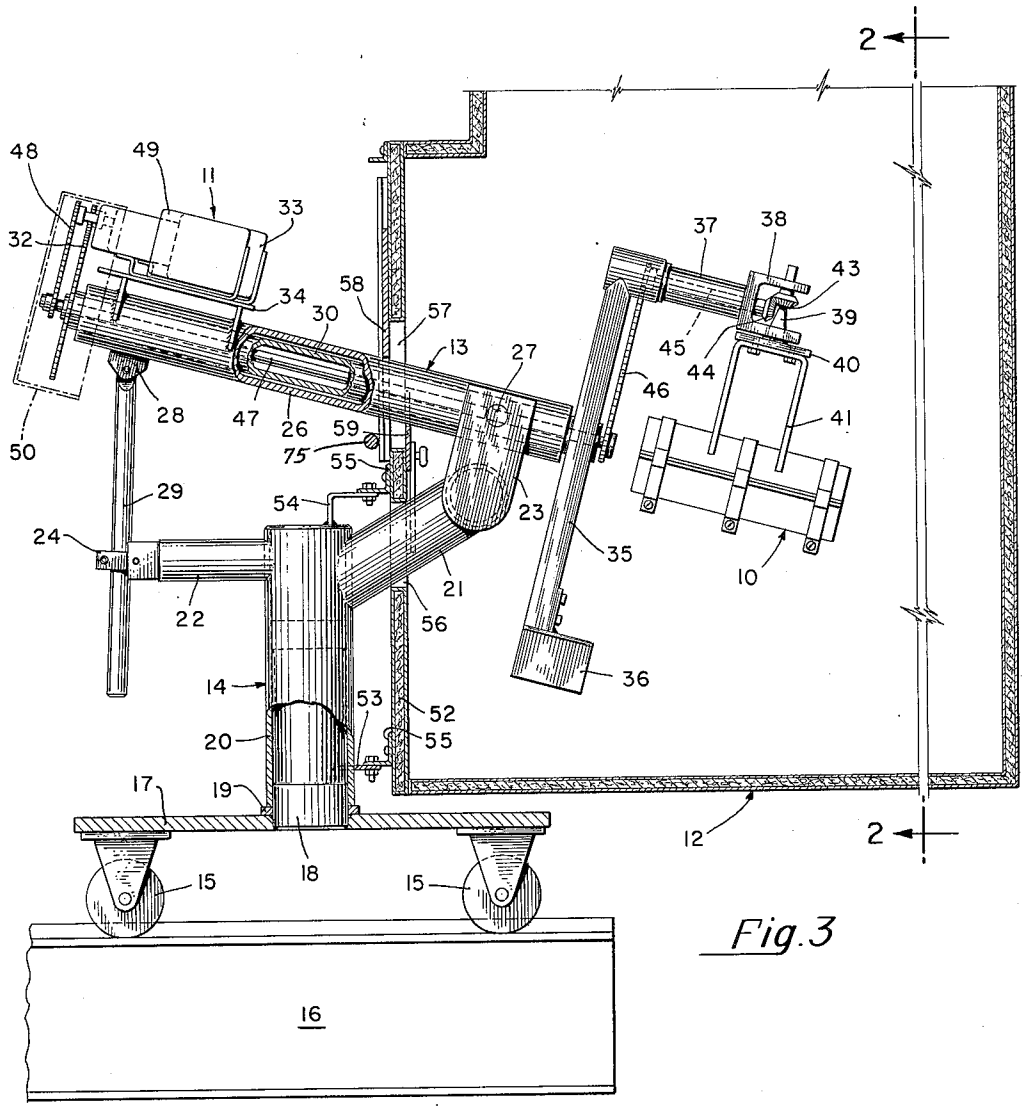


Fig. 3

INVENTORS
WALTER S. EGGERT, JR.
HARRY M. RUSSEL-FRENCH
BY Douglas R McKechnie
ATTORNEY

United States Patent Office 3,237,247 Patented Mar. 1, 1966

3,237,247

ROTATIONAL CASTING APPARATUS

Walter S. Eggert, Jr., and Harry M. Russell-French, Philadelphia, Pa., assignors to The Budd Company, Philadelphia, Pa., a corporation of Pennsylvania

Filed Nov. 8, 1963, Ser. No. 322,287
10 Claims. (Cl. 18—26)

This invention relates to apparatus for rotationally casting hollow objects of moldable materials such as synthetic resins.

A conventional way of making hollow plastic objects is by rotational molding or casting techniques wherein a charge of a moldable material is placed in a hollow mold that is simultaneously rotated about a plurality of axes and heated to set the material in a relatively uniform coating deposited inside the mold. The present invention is directed to rotational casting apparatus that is designed to carry out such a process, the apparatus comprising a rotary casting machine for rotating the mold and an oven for heating the mold, and one of the objects of the invention is to provide a novel rotary casting machine and oven that is easy to use, versatile, and can be operated to mold materials of different molding characteristics.

Another object of the invention is to provide rotational casting apparatus wherein a mold is loaded and unloaded outside of an oven yet it can be readily placed in the oven and rotated to carry out steps of the molding process.

Still another object of the invention is to provide a novel rotary casting machine for rotating a mold within an oven wherein the casting machine comprises electric motors that are disposed outside of the oven for operation at room temperature.

A further object is to provide a novel forced circulation oven which provides rapid temperature changes within the oven.

Other objects and advantages of the invention will be apparent from the following description taken in connection with the accompanying drawings wherein:

FIG. 1 is a perspective view of rotational casting apparatus embodying the invention;

FIG. 2 is a vertical elevational view, generally along lines 2—2 of FIG. 3, partly in section, looking towards the inside of the front of the oven and;

FIG. 3 is an enlarged vertical, longitudinal, sectional view, with portions removed, taken generally on lines 3—3 of FIG. 2.

Referring now to the drawings, the illustrated rotational casting apparatus comprises a hollow, sectional mold **10**, a rotary casting machine **11**, and an oven **12**. The shape of mold **10** and the manner in which it is mounted and rotated is dependent, obviously, on the shape of the article being formed. For simplicity of illustration, mold **10** is shown as a cylindrical mold formed in two detachable sections having a longitudinal parting line. Such a mold is designed to form a hollow cylinder.

The purpose of rotary casting machine **11** is to support and rotate mold **10** about a plurality of mutually perpendicular axes that intersect within the mold. To accomplish this, machine **11** comprises a rotary head **13** mounted on a base or carriage **14** having a plurality of wheels **15** that roll on guiding rails **16** which extend perpendicularly to and in front of oven **12**. Carriage **14** further comprises a base plate **17** on which is mounted, in addition to wheels **15**, a vertical pin **18** having its lower end welded into a hole in the center of plate **17**. The lower end of pin **18** extends through an annular, upwardly facing thrust bearing **19** that engages and supports the lower end of a rotatable, vertical sleeve **20** fitted over pin **18** for rotation about the axis thereof. The upper end of sleeve **20** carries a pair of cylindrical arms **21** and **22** whose axes are coplanar with the axis of sleeve **20** and pin **18**. Using the front of the oven as a reference, that is, the face of the oven facing to the left as viewed in FIG. 1, it will be seen that arm **21** extends rearwardly of sleeve **20** and arm **22** extends forwardly, the free ends of these arms carrying a yoke **23** and an adjustable socket or gripper **24**, respectively.

Rotary head **13** comprises a tubular cylindrical housing **26** that is pivotally attached by trunnions **27** at the rear end of the housing to yoke **23** for pivotal movement about a horizontal axis extending through trunnions **27**. The other end of housing **26** has a pair of dependent lugs **28** pivotally connected to the upper end of a downwardly extending rod **29** that passes through and is detachably secured to gripper **24**. By loosening and tightening gripper **24**, arm **29** can be moved vertically to rotate or pivot housing **26** and rotary head **13** to the desired angular position. In the illustrated embodiment, the range of angular adjustment is approximately thirty-five degrees from a horizontal position and an inclined position. Obviously, this range can be varied to suit the particular application desired.

Rotary head **13** further comprises a main tubular cylindrical drive shaft **30** rotatably supported, by suitable bearings, in housing **26** in coaxial relationship thereto. The length of shaft **30** is greater than the length of housing **26** and the ends of shaft **30** extend beyond the ends of housing **26**. The front end of shaft **30** carries a sprocket driven by a chain **32**, that in turn, is driven by a sprocket connected to the output shaft of a variable speed, integral gear box and electric motor **33** mounted on a support plate **34** welded to the upper front end of housing **26**, the gear box having an overriding clutch permitting manual rotation in the direction opposite to the driven direction.

The rear end of shaft **30** is connected to a transversely extending arm **35** of rectangular tubing, having a counterweight **36** attached to one of its ends and a tubular, rearwardly extending arm **37** attached to its other end. Arm **37** supports, at its rear end, a yoke **38** that rotatably supports a rotary shaft **39** having a mold mounting plate **40** attached to its radially inner end. Mold **10** comprises a U-shaped mounting member **41** that is mounted on plate **40** by suitable releasable fasteners, e.g., bolts, and supports mold **10** so that the axes of rotation of shafts **30** and **39** pass through the center of the mold and intersect each other at right angles.

Shaft **39** is rotated about its own axis by a bevel gear **43** mounted thereon, the bevel gear being engaged with another bevel gear **44** mounted on a shaft **45** that is rotatably mounted coaxially to and within arm **37**. At its front end shaft **45** carries a sprocket driven by a chain **46** which, in turn, is driven by a sprocket carried on the rear end of a drive shaft **47** rotatably mounted within and coaxial to shaft **30**. Drive shaft **47** is longer than shaft **30** and its ends project beyond the ends of shaft **30**. The front end of shaft **47** carries a sprocket driven by a chain **49** connected to a sprocket carried by the output shaft of a variable speed gear box and electric motor **49** mounted on plate **34** alongside motor **33**, the gear box having a manual override. Chains **32** and **49** and the sprockets can be covered by a protective cover **50**. Motors **33** and **49** can be separately or simultaneously operated to rotate mold **10** about the axis of shaft **30** and about the axis of shaft **39**, respectively.

Carriage **14** further supports a flat, vertical enclosure member or oven panel **52** by means of a support plate **53** and an angle plate **54** mounted on sleeve **20** and bolted

to a pair of vertically-spaced, angle members **55** attached to the panel. Panel **52** has a first opening **56** through which arm **21** passes, the opening being shaped to seal as much as possible the space around the arm where it passes through the panel. The panel also has a second opening **57** vertically spaced above opening **56** through which housing **26** passes, this opening being shaped to permit angular adjustment of head **13**. Opening **57** is partially sealed by an adjustable seal comprising two, vertically slidable plates **58** and **59** mounted in tracks on opposite sides of the panel and adjustable vertically so that their adjacent edges, cut out to conform to the exterior of housing **26** as much as possible, abut housing **26**.

Oven **12** is an electrically-heated, forced-air oven and is suported by a plurality of legs **60** above the floor whereby rails **16** and carriage **14** extend beneath, in the manner illustrated in the drawings, when the panel is in place. As best seen in FIG. 2, oven **12** has a main heating chamber **61** in which mold is rotated and heated and through which forced air is circulated by means of a centrifugal fan **62**. The circulated air is heated by an electric resistance heater **63** placed at the outlet of fan **62** and the inlet into chamber **61**, and an electric resistance heater **64** mounted at the outlet of the chamber **61**. Mounted above heater **64** are a plurality of arcuate deflectors **65** that aid circulation of the air through the oven.

Oven **12** further comprises a fresh air inlet **66** and an exhaust outlet **67** connected to a suitable exhaust stack **68**. The flow of air through the inlet and outlet is controlled by a movable valve member or damper **69** that is movable, upon actuation of a handle **71**, between the positions shown in full lines and dotted lines in FIG. 2 to recirculate air through or dump air from the heating chamber. The controls for the centrifugal fan and heaters can be contained in suitable control boxes **70** mounted on the outside of the oven.

Mounted on the front of the oven are two doors **72** and **73** hinged for rotation about vertical axes. The doors are laterally spaced to define an opening which panel **52** is adapted to cover when it is in the position illustrated in the drawings. Doors **72** and **73** support a pair of hooks **74** that cooperate with a latch bar **75** to allow doors **72** and **73** and panel **52** to be locked to close the front of chamber **61**.

Operation

At the start of a molding cycle, carriage **14** is rolled away from oven **12** to a position where the rotary head **13** can be pivoted to a loading station at one side of the tracks where mold **10** is attached to the casting machine. The mold can be either charged prior to attaching or after it has been attached with a charge of a moldable plastic material. Thereafter, the sleeve **20** is rotated back to the position where panel **52** extends parallel to the front of the oven. Then, carriage **14**, is rolled along rails **16** until panel **52** abuts the oven, doors **72** and **73** are shut, and latch bar **75** is placed in position to lock the doors and panel. Next, motors **33** and **49** are actuated to rotate mold **10** in the desired manner and the centrifugal fan **62** and heaters **63** and **64** are energized to circulate heated air through chamber **61**. During the heating cycle, valve member **69** is located in the position shown by full lines in FIG. 2 so that air is merely recirculated through the oven. As the material is heated and as it passes over the inner surfaces of mold **10**, it sets, in a manner dependent on the particular material. After the material initially sets, the rotation can be stopped and the mold kept in the oven until the material fully sets such as by polymerizing. Thereupon, heaters **63** and **64** can be deenergized and valve member **69** is rotated to the position shown in the dotted lines whereupon cool air is sucked into the oven through inlet **66** and is blown through chamber **61**, outlet **67** and stack **68**. When the oven and mold have been cooled sufficiently, the centrifugal fan is stopped, latch bar **75** is removed, and the carriage is withdrawn or moved away from the oven. Thereupon, the mold along with the formed object, are removed.

Although it will be apparent that the apparatus can be used to rotationally cast a wide variety of materials and synthetic resins, such as the vinyl polymers, polyethylene, etc. the particular apparatus disclosed was designed for rotationally casting caprolactum which upon polymerization produces nylon–6. With this particular material, the oven was designed to circulate air at a maximum rate of 5,000 cu. ft. per minute, at a pressure head of ¼ p.s.i. and at a maximum temperature of 500° F. To achieve such temperatures, heaters were provided having capacities of 15.3 kw. and 25.5 kw.

While only a single embodiment has been illustrated, it will be apparent to those skilled in the art that many changes can be made in the details and arrangement of parts without departing from the scope of the invention as defined in the appended claims.

What is claimed is:

1. In apparatus for rotationally casting a hollow plastic object in a hollow sectional mold, the combination comprising: an oven provided with a heating chamber and an opening communicating with the said chamber; a base disposed adjacent to said oven; an enclosure member mounted on said base and adapted to close said opening; and a rotary casting machine mounted on said base and extending through said enclosure member, said machine comprising rotatable support means located on one side of said enclosure member and adapted to support and rotate the mold in said chamber about a plurality of axes, and motor means mounted on the other side of enclosure member and operatively connected for rotating said support means.

2. The combination of claim **1** wherein said base comprises a wheled carriage moveable toward and away from said oven, and said oven comprises means for locking said enclosure member in place so as to prevent movement of said carriage and enclosure member away from said opening.

3. Rotational casting apparatus, comprising: an oven provided with a heating chamber, an opening extending into said chamber, means for circulating air through said chamber, and means for heating air circulated through said chamber; guide rail means disposed adjacent to said oven and aligned with said opening; a carriage mounted on said guide rails means for movement relative to said oven between a first position spaced from said oven and a second position adjacent to said oven; an oven panel mounted on said carriage and adapted to close said opening when said carriage is in said second position; and a rotary casting machine mounted on said carriage and adapted to support a mold on one side of said panel for rotation about a plurality of axes, said rotary machine extending through said panel and comprising motor means located on the other side of said panel and operatively connected for rotating said mold.

4. Rotational casting apparatus comprising: an oven provided with a main heating chamber and an opening communicating with said chamber; a carriage mounted for movement towards and away from said opening; an oven panel mounted on said carriage and adapted to close said opening on movement of said carriage theretowards; and a rotary machine mounted on said carriage and adapted to support and rotate a mold in said heating chamber, said machine comprising mounting means for the mold disposed on one side of said panel, motor means disposed on other side of said panel, a housing extending through said panel, and means driven by said motor means for driving said mounting means and extending through said housing.

5. In an apparatus for rotationally casting, the combination comprising: a forced air, electric resistance oven having a main heating chamber and an opening communicating directly with said chamber; a rotary casting machine

adapted to support and rotate a mold about a plurality of mutually perpendicular axes in said chamber, said rotary casting machine having a housing extending through said panel, motor means mounted on one end of said housing, a mold mount, and means connected to said motor means and said mold mount for rotating said mold mount in response to operation of said motor means; support means disposed outside of said oven supporting said rotary casting machine and including means for adjusting the inclination of said housing; and an oven panel mounted on said support means and adapted to close said opening.

6. The combination of claim **5** wherein said panel comprises an adjustable seal for sealing the space where said housing passes through said panel.

7. The combination of claim **5** wherein said support means comprises a wheeled carriage movable towards and away from said oven, and the combination further includes releasable lock means engageable with said panel for preventing movement of said carriage away from said oven.

8. The combination of claim **7** and further including

guide rail means aligned with said opening and supporting said carriage for movement therealong.

9. The combination of claim **8** wherein said support means comprises a support member rotatable about a vertical axis and supporting said panel and said rotary casting machine.

10. The combination of claim **5** wherein said oven comprises a flow passage having an inlet and outlet communicating with said main heating chamber, an exhaust outlet and a fresh air inlet; said oven further comprising a valve member movable between first and second positions wherein air is recirculated through said heating chamber and is dumped from said chamber, respectively.

References Cited by the Examiner

UNITED STATES PATENTS

2,629,130	2/1953	Remble	18—26
2,681,472	1/1954	Remble	18—26
2,958,907	11/1960	Mumford et al.	18—26
3,072,965	1/1963	Miller	18—26

WILLIAM J. STEPHENSON, *Primary Examiner.*