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METHOD FOR FORMING SHELL MOLDED CORES

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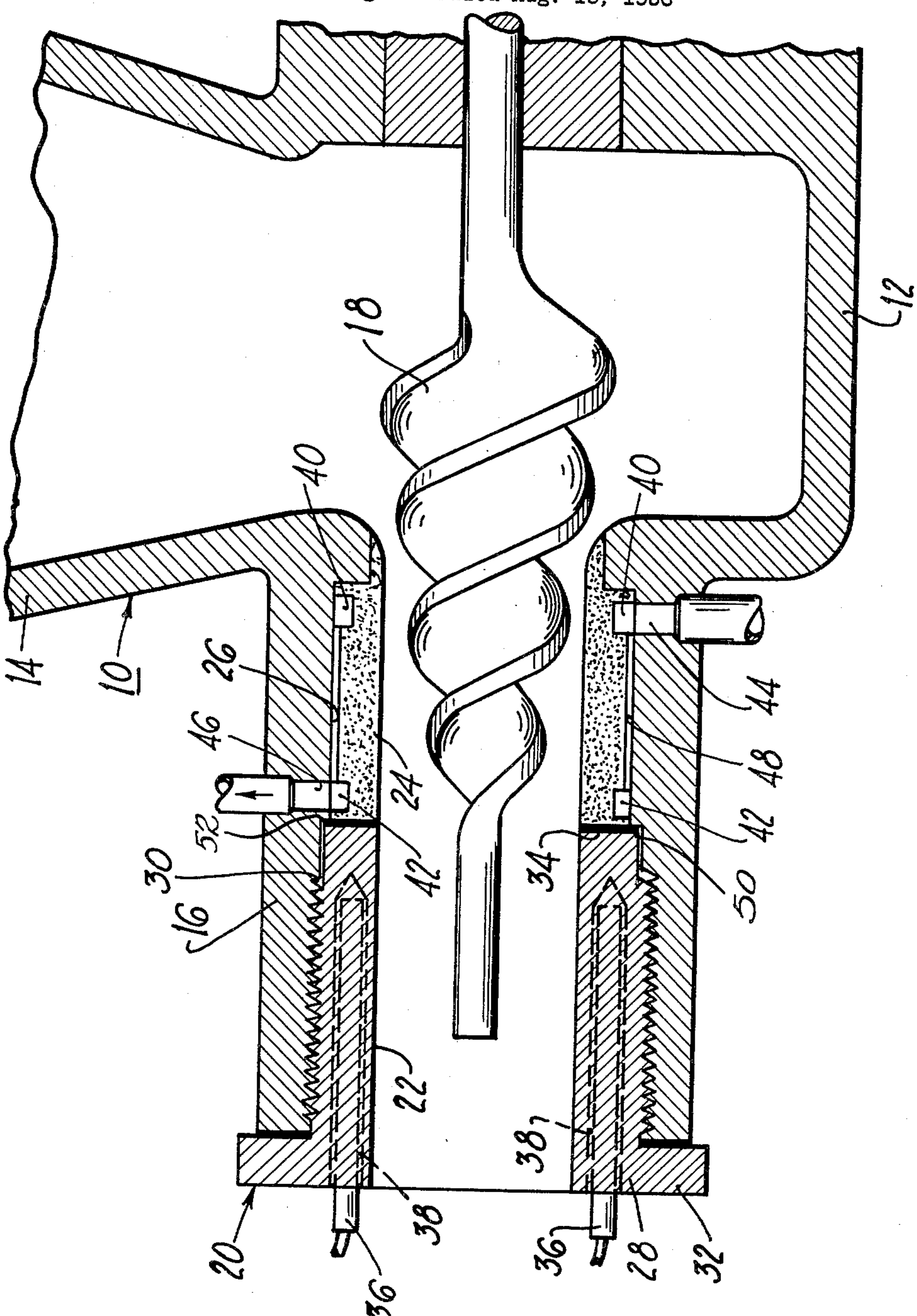

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METHOD FOR FORMING SHELL MOLDED CORES

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Continuation of application Ser. No. 603,720, Aug. 13, 1956. This application Feb. 24, 1960, Ser. No. 10,800 4 Claims. (Cl. 18—55)

The present invention relates to a process for continuously extruding cores, and to a machine for making the same; and more particularly to a continuous process for making shell molded cores, and to a machine for making the same. This is a continuation application of my copending application No. 603,720 filed August 13, 1956 and now abandoned.

During World War II, there was developed in Germany a process for producing sand molds using a thermal setting resin as a binder. The process utilized a heated metal pattern upon which a mixture of sand and resin were placed until the resin partially solidified to produce a thin shell of approximately 1/4" to 1/2" in thickness. The shell is then removed to an oven where the heating process is continued until the resin is completely cured. The casting of metals in molds of the above type has revolutionized the foundry art; and the process has become known as the "shell molding process."

An object of the present invention is the provision of a process whereby shell molded cores can be continuously produced in an extrusion die.

Another object of the invention is the provision of a new and improved process of extruding shell molded cores through an opening in a die having leading and trailing portions and comprising feeding a material comprising sand and a thermal setting resin to the leading portion of the opening, compacting the material in the leading portion of the opening in said die while maintaining the material below the thermal setting temperatures of the resin, and heating the material in the trailing portion of the opening to the thermal setting temperatures of the resin while the material passes through the die.

Another object of the invention is the provision of a new and improved process of extruding shell molded cores as outlined above wherein a lubricant is provided to facilitate the passing of the material through the die.

Another object of the invention is the provision of a new and improved process as outlined above wherein a lubricant is fed to at least a portion of the surfaces of the leading portion of the opening through the die to facilitate the passing of the material through the die.

Another object of the invention is the provision of a new and improved process as set forth above wherein a lubricant is injected through porous surfaces of the leading portion of the die to facilitate the passing of the material through the die.

A further object of the invention is the provision of a new and improved extruding machine comprising a die having an opening therethrough provided with leading and trailing portions, means for feeding granular material to the leading portion of said opening, the leading portion of said die and feed means being adapted to compact the material in the leading portion of said die opening, means for maintaining the leading portion of said die below a predetermined temperature, and means for heating the trailing portion of said die above a predetermined temperature.

A further object of the invention is the provision of a new and improved core extruding machine of the above described type having means in the side walls of the die for feeding a lubricant to the surface of the leading portion of its extrusion opening.

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A still further object of the invention is the provision of a new and improved core extruding machine as described above wherein at least a portion of the surface forming the leading portion of said extrusion opening is made from a porous material through which liquid can be fed to the inside of said opening.

Further objects and advantages will become apparent to those skilled in the art to which the invention relates from the following description of the preferred process and apparatus for performing the same, described with reference to the accompanying drawing forming a part of this specification, and in which:

The single figure of the drawing is a cross-sectional view of a core extruding machine adapted to carry out the process of the present invention and embodying structural features thereof.

The core extruding machine shown in the drawing generally comprises a hopper body **10** having a generally cylindrical lower portion **12** fed by an inverted pyramidal shaped upper portion **14**. A cylindrical shaped die housing **16** projects from the forward face of the lower portion **12**; and a feed screw **18** is positioned in the hopper body **10** coaxial with the longitudinal axis of the die housing **16**. The die housing **16** is bored out to receive replaceable extrusion dies **20** having a die opening **22** therethrough. The die shown in the drawing is formed in two sections. The inner section **24** of the die is a generally sleeve like portion adapted to be seated in the inner end of the bore **26**; and the outer section **28** is a generally annularly shaped portion of slightly larger external diameter adapted to be threaded into a counterbore **30** in the outer end of the die housing **16**. The outer end of die section **28** is provided with a hexagonal nut shaped flange **32** by means of which it can be tightened into place, and a gasket **34** is positioned in the end of the counterbore **30** between the sections **24** and **28** for reasons which will later be apparent.

The core extruding machine shown in the drawing is adapted to continually make annularly shaped or hollow sand cores having a thermal setting resin as a binder. Core extruding machines using feed screws have been used prior to applicant's invention for making green sand molds using a starch or clay as a binder. Processes of this kind have required that the cores be heated subsequent to the extrusion process as for example in core drying ovens in order to harden the binder. Thermal setting resins, and in particular phenolformaldehyde resin, set up into a very hard substance upon heating, and prior to applicant's invention it has been generally thought impossible to both extrude and cure a core having a thermal setting resin as a binder in one operation. It has been discovered by applicant that if the heating of the resin above its thermal setting temperature is confined to the outer portion of a suitable die, cores can be continuously extruded using a thermal setting resin as a binder. It has further been found that auger type feed screws produce a compacting of the sand in a certain leading portion of the die and that damage to the equipment can be averted if certain precautions, hereinafter to be described, are taken.

The outer section **28** of the die shown in the drawing is confined to the trailing portion of the die assembly following the leading portion **24** in which the compacting operation is confined. In the preferred embodiment shown in the drawing, heat is imparted to the outer section **28** of the die by means of a plurality of bayonet type heating elements each of which are positioned in an individual one of a plurality of longitudinally extending bores **38** spaced around the die opening **22**. By suitably balancing the temperature of the heating elements **36** and the speed of rotation of the feed screw

18, temperature of the material fed to the compacting zone within the inner die section 24 can be kept below the thermal setting temperature of the resin and satisfactory results obtained. In the preferred embodiment of the invention, the inner die section 24 may also be cooled such that the temperature of the heating elements 36 may be raised to provide increased heat transfer to the core material within the outer die section 28 and a faster rate of production achieved. It has further been found that considerably less horse power will be required to drive the feed screw 18, and improved results will be obtained generally, if a lubricant such as a silicon emulsion is provided on the surfaces of the die opening 22 on the inner section 24 of the die.

In the preferred embodiment shown in the drawing, the inner die section 24 is made from a porous material produced by means of powdered metallurgy. Any suitable porous material may be utilized—one such material will be porous bronze. The annular inner die section 24 is provided with annular grooves 40 and 42 in its outer surface—one at each end of the section. A fluid inlet opening 44 is provided in the die housing 16 opposite the annular groove 40, and a similar fluid outlet opening 46 is provided in the die housing 16 opposite the annular groove 42. Fluid communication between the inlet annular groove 40 and the outlet annular groove 42 is provided by means of a plurality of longitudinally extending grooves 48 cut in the outer surface of the die section 24. Cooling of the inner die section 24 may be accomplished by regulating the temperature and amount of fluid circulated past the inner die section through grooves 40, 48 and 42. The fluid pumped through the inner die section 24 will preferably be a lubricant such as a silicon emulsion and by suitably throttling the outlet 46, a back pressure will be exerted on the outer surface of the die section to force the lubricant through the porous die section to coat the side walls of the die opening 22. Lubricant flowing past the die section 24 will of course pick up heat and may be cooled by any suitable means and returned to the pump supplying fluid inlet opening 44. The gasket 34 serves the purpose of preventing the lubricant from leaking into the threads between the outer die section 28 and the die housing and further serves to limit heat transfer from the outer die section 28 to the inner die section 24. Any suitable gasket material may be used, as for example a graphite impregnated asbestos fiber gasket and the outer die section 28 may be provided with a slightly raised annular surface 50 adjacent its outer surface to provide increased bearing pressure with respect to the shoulder 52 in the bottom of the counterbore 30. Other methods of lubricating the internal surfaces of the die might be utilized, as for example by mixing a lubricant with the material fed to the hopper 14, or by providing a plurality of small drilled passageways between the recess 40 and the die opening 22. Each of these methods, however, have some disadvantages over the use of an inner die section made from a porous material.

It will be apparent that the objects heretofore

enumerated as well as others have been accomplished and that there has been provided a new and improved method of continuously producing foundry cores and the like using a thermal setting resin as a binder. It will also be apparent that there also has been provided a new and improved machine for carrying out this process. While the preferred process and machine for carrying out the process have been described in considerable detail I do not wish to be limited to the particular details shown and/or described which may be varied within the scope of the invention, and it is the intension to cover hereby all adaptations, modifications and arrangements thereof which come within the practice of those skilled in the art to which the invention relates.

I claim:

1. A continuous process for forming shell molded cores comprising the steps of continuously supplying a mixture of sand and thermal setting resin with an open chamber, displacing the mixture from said chamber as a continuous flow to within a confining chamber having a surrounding wall with a lubricated heat-insulated surface, effecting a pressure on said mixture developed in a direction transversely to the direction of flow of said mixture to compress the mixture against the surrounding walls of said confining chamber while said mixture is contained therein and developed in a direction of flow to displace the compacted material through said confining chamber and an open ended heating chamber, said pressure developed in said transverse direction being of gradually diminishing value decreasing in the direction of flow and ceasing to exist in said open ended heating chamber, advancing the compacted material by said pressure to within said open ended heating chamber defined by heated walls effecting polymerization of the resin content of the material as it passes therethrough.

2. The core making process in accordance with claim 1 including the steps of forcing a lubricant under pressure through the walls of said confined chamber to provide both lubrication and cooling at the surface thereof.

3. The core making process in accordance with claim 2 wherein said cooling and lubrication medium is comprised of silicon emulsion forming a coating at the interior surface of the confined chamber.

4. The process in accordance with claim 1 including the step of continuously rotating an auger feed screw having the larger diameter flight disposed within the open chamber and the diminishing diameter flights within said confined chamber, said auger screw being rotated to effect flow at a rate providing substantially complete polymerization prior to emergence of said flow from the exit opening of the heated chamber.

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