May 5, 1942. A. R. ROWE 2,282,248

MAKING METALLIC INGOTS

Filed June 21, 1941 2 Sheets-Sheet 1

Fig. 1.

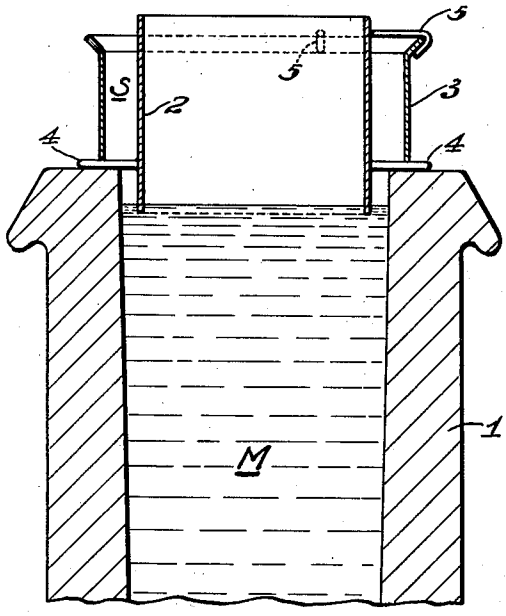


Fig. 3.

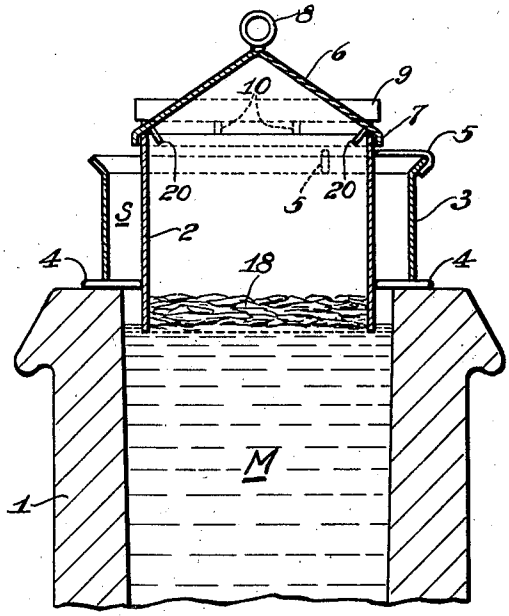


Fig. 2.

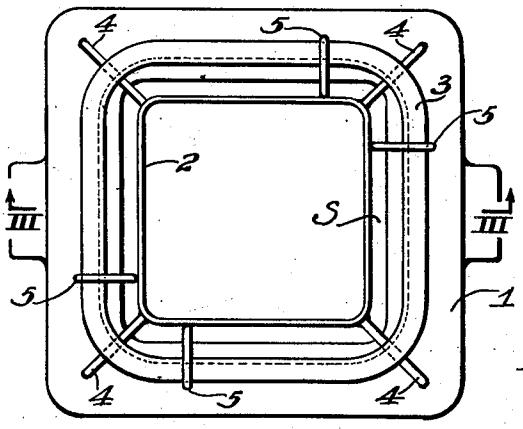
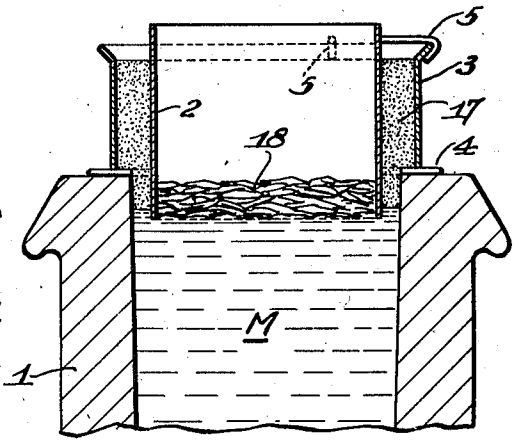


Fig. 4.



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Fig. 5.

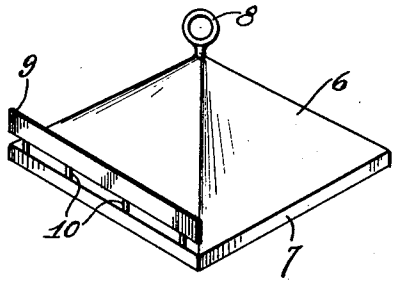


Fig. 6.

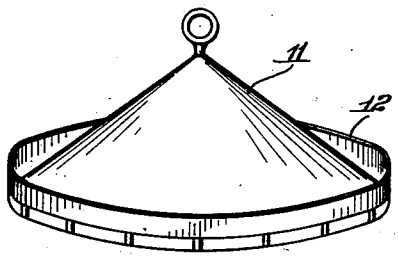


Fig. 9.

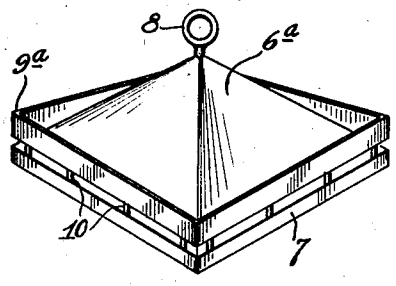


Fig. 7.

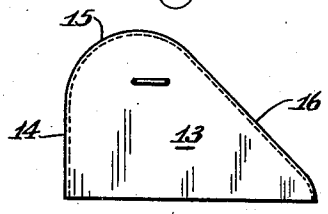


Fig. 8.

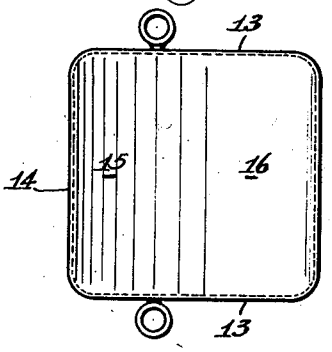


Fig. 10.

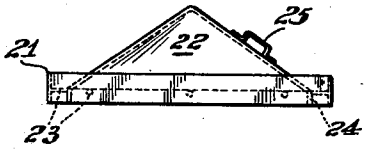
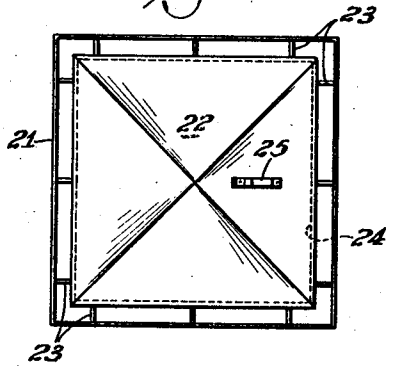


Fig. 11.



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UNITED STATES PATENT OFFICE

2,282,248

MAKING METALLIC INGOTS

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Application June 21, 1941, Serial No. 399,133

7 Claims. (Cl. 22—147)

This invention relates to the production of hot topped metallic ingots.

The purpose of hot tops as used in ingot practice is well known. Also, although various types of hot top devices have been proposed and used in the making of ingots, the general practice has been to use a tubular fire clay member which is supported upon the top of the mold and, in effect, constitutes an extension of it. Such ceramic type hot tops are open to numerous and serious disadvantages such, for example, as their high weight, bulkiness, fragility, and related factors. For these and other reasons it has been proposed to use hot tops consisting of an inner tubular feeder member and an outer sleeve member. The former extends from above the mold downwardly into the mold opening with the mold-enclosed portion spaced close to but out of contact with the mold wall, and with its lower end immersed in the surface of the ingot metal. The outer sleeve member is supported on the top of the mold and surrounds the upwardly projecting portion of the inner member to form an annular space for receiving a subdivided, i. e., granular or powdered, heat insulating material that acts to reduced loss of heat from liquid metal contained within the inner feeder member and thus to keep it liquid for its intended purpose.

Such hot tops, or feeders, may be made from sheet metal so that they are light, strong and cheap, and they perform efficiently. They practically overcome all of the disadvantages of the ceramic type of hot top, and they are advantageous for other reasons, such as the ability to extend the feeder member to any distance into the mold for the making of desired cuts. Experience in the use of such devices has shown that although they embody the stated advantages and are capable of economically reducing piping, some trouble may be encountered in introducing the heat insulating material, which must be done rapidly and so that the space is filled uniformly. This is due to the fact that the annular space between the inner and outer members may be, and usually is, rather narrow in width. For example, with a mold having a top opening of 31 x 31 inches, the annular space between the inner and outer members will usually be only about 2½ or 2¾ inches wide. This makes it necessary to use considerable care in filling the annular space, which is generally done with a shovel, to avoid spilling of the insulating material into the inner member, which may be injurious to the quality of the metal in the upper end of the ingot, or outside of the sleeve, which wastes the insulating material and necessitates unnecessary cleaning of the floor about the pouring platform. Consequently, the addition of the insulating material requires care and some time, and particularly it may be difficult to fill the space uniformly at the back of the mold relative to the pouring platform. The intense heat of the freshly teemed ingot at the time the insulating material is added likewise adds to this difficulty.

It is among the objects of this invention to provide a method of using a two-part hot top of the type referred to which simplifies and expedites the introduction of insulating material into the annular space between the inner and outer members, which assures uniform filling of the annular space, particularly at the back of the mold, and which does not interfere with, but actually improves, existing practice in the use of hot tops of that type, and which does not to any appreciable extent increase ingot costs.

A further object is to provide a feeder of the two-part hot top type described in combination with simple, inexpensive and relatively permanent means for rapidly, easily and certainly filling the annular space between the members with insulating material, particularly at the rear of the mold, without danger of introducing the insulating material into the interior of the inner member, and with minimized likelihood of spillage of insulating material on the outside of the hot top.

The invention will be described with reference to the accompanying drawings in which Fig. 1 is a vertical sectional view through a freshly teemed ingot mold provided with a two-part hot top of the type to which the present invention applies; Fig. 2 a plan view of Fig. 1; Fig. 3 a view similar to Fig. 1 illustrating the preferred embodiment of the invention; Fig. 4 a view similar to Fig. 1 after use of the device shown in Fig. 3; Fig. 5 a perspective of the cover member shown in Fig. 3; Fig. 6 a view of a modified form of cover member; Figs. 7 and 8 side and plan views, respectively, of still another modified cover; Fig. 9 still another modification of the cover shown in Fig. 5; Fig. 10 a section on line X—X, Fig. 11, showing another embodiment; and Fig. 11 a plan view of Fig. 10.

The invention applies, as indicated above, to two-part hot tops comprising an inner tubular feeder member and an outer tubular sleeve member, both formed from fire-resistant material. The feeder member is open at both ends, and it is of such length, shape and size that when associated with a mold a portion projects above

the mold and a portion projects into the mold close to but out of contact with the mold walls and with its lower end immersed in the upper end of the cast metal. The outer sleeve member rests on the top of the mold and surrounds the projecting portion of the inner member to form therewith an annular space for reception of subdivided heat insulating material.

In accordance with the invention the disadvantages which have attended the filling of such an annular space with insulating material are reduced or eliminated by applying to the upper end of the feeder member a closure member, or cap, which is so constructed and arranged that insulating material which comes into contact with it is directed into the annular space between the inner and outer members at least at the back of the mold or, if desired, into any greater portion or all of the annular space. In accordance with the invention this may be accomplished simply by so constructing the cap closure as to provide a surface which slopes downwardly at an angle such as to direct the insulating material placed on it into the desired portion of the annular space, as by shaping the cap member to have a portion of its surface sloping downwardly, the cap being then placed on the feeder member with that surface directed toward the back of the mold. Or, the cover may be shaped conically or pyramidally or otherwise of sloping surface throughout so that insulating material placed on it at any point will be directed into the contiguous portion of the annular space between the inner and outer members whereby the entire annular space may be filled merely by throwing or directing the insulating material progressively about the cap surface. Preferably, however, the cap is provided with one or more sloping surfaces, for instance as just described, and associating at the bottom edge thereof a guard rail which permits the insulating material to flow freely, rapidly and uniformly into the annular space while preventing it from surging outwardly over the edge of the sleeve member.

In the practice of the method provided by the invention, therefore, there is used a two-part hot top of the type described, and the ingot may be cast in accordance with any desired practice. That is, the hot top may be associated with the mold before or after teeming, just so the lower end of the feeder is immersed in the upper surface of the ingot metal when the mold has been teemed to the desired height. After the metal surrounding the inner member has solidified between it and the mold wall, heat insulating material is introduced into the annular space between the two members of the hot top. To this end there is applied to the open, upper end of the feeder member a cap closure in accordance with the invention, and insulating material is then introduced to fill the annular space. In the case of a cover having a single directing surface for uniformly filling the rear portion of the space without spillage, the material may be shoveled or directed from a spout into the easily accessible portions of the space, and the back filled by placing the insulating material on the directing surface, or, where the cap is constructed for directing the material into all portions of the space, it may be shoveled or otherwise placed upon the cap and allowed to flow into the annular space. When the space has been filled the cap may be removed for backpouring the ingot.

River sand is advantageously used as the insulating material, but other subdivided heat insulators may, of course, be used, for instance, coke breeze, granulated slag and the like.

The invention may be described further, for its better understanding, with reference to the accompanying drawings. As shown in Fig. 1, an ingot mold 1 is filled with metal M, such as steel, to a desired level and is provided with a two-part hot top comprising an inner tubular member 2 and a surrounding outer sleeve member 3. Members 2 and 3 are made from any suitable fire-resistant material, desirably sheet metal in most cases. The feeder member is tubular and open at both ends, and as seen in Fig. 1 a portion projects above the mold and the remainder is disposed within the mold to lie close to but out of contact with the mold walls, and with its lower end immersed in the upper surface of metal M. The outer member 3 is likewise tubular and open at both ends, and it surrounds the portion of member 2 which projects above the mold and forms an annular surrounding space S therewith.

The two members of the hot top are preferably concentrically associated and they are supported relative to one another and to the mold, which may be done in a variety of ways. Preferably inner member 2 is supported from the mold top by providing it with fingers 4 which are connected, as by welding, to the corners of the feeder member. The sleeve member may be positioned concentrically relative to the feeder member by means of two pairs of inwardly projecting fingers 5 which are connected, as by welding, adjacent the sides of two diagonally positioned corners of the feeder member. When the sleeve is placed over feeder 2 fingers 5 engage the side portions of the feeder so that the two members will be uniformly spaced from one another. The advantage of this mode of associating the elements of the hot top with respect to one another and to the mold is that fingers 4 and 5 are out of the normal line of travel of the ladle and are not likely to be struck by metal from the ladle and thus destroyed with possible displacement of the hot top parts.

The ingot having been teemed as shown in Fig. 1, a cap closure in accordance with the invention is then applied to the upper end of feeder member 2, as shown in Fig. 3. Cap 6 is of pyramidal shape, as appears most clearly in Fig. 5, so that insulating material which is to be introduced into annular space 6 may be thrown onto the surfaces of the cover and will then be guided downwardly into the annular space S. To certainly prevent the insulating material from entering the feeder, the cap advantageously is provided with a downwardly depending skirt 7 which loosely surrounds the top of the feeder. The cover may be provided with a ring 8 for lifting and lowering it.

In most cases the greatest difficulty is encountered in filling the space at the back of the mold relative to the pouring platform. Because of the distance through which the insulating material must be thrown to reach the back of the mold, as when it is handled by a shovel, there may be a tendency for some of the material to surge over the edge of sleeve member 3 and fall outside of the mold. This may be prevented, in accordance with a modified embodiment of the invention, by connecting a guard rail to the lower edge of the cap in such manner as to permit the insulating material to flow downwardly freely

into the annular space but to prevent it from surging beyond sleeve member 3. In the form shown this comprises a rail 9 which is supported from the lower edge of one of the faces of cap 6 by pins 10 which are spaced so as to hold the rail securely in position but without interfering materially with the flow of insulating material through the spaces provided between the pins. Suitably pins 10 are welded at their ends to the rail and to the cap. When such a cap is used in the practice of the invention it is positioned, of course, with the guard rail at the back of the mold. If desired for any reason, however, the guard rail may be associated with two or more faces of the cover, advantageously with all of the faces as shown in Fig. 9, which shows a pyramidal cover 6a having a guard rail 9a surrounding its lower edge and mounted as described in connection with Fig. 5.

The advantage of a pyramidal cover such as shown in Figs. 5 and 9 is that insulating material may be introduced into the annular space by applying all of it to the surface of the cover and relying upon the sloping faces to direct the material properly, smoothly and rapidly into the annular space. Thus the filling of the space is expedited and simplified because it is unnecessary to exercise the care which would be necessary in attempting to fill the space directly from a shovel if closure cap 6 were not used. The cap may, of course, be shaped otherwise to the same end. For instance, if feeder 2 is cylindrical the cap may be of conical form 11, Fig. 6. Such modified shapes may, if desired, be provided also with guard rails around a portion or all of their periphery, that shown in Fig. 6 being provided with a guard rail 12, constructed like that described above, which extends around the entire periphery of the cover.

Where it is desired merely to insure uniform and safe filling of the annular space at the back of the mold it is only necessary, as indicated above, to provide a single directing surface. One form of such a cover is shown in Figs. 7 and 8. This comprises a pair of vertical side walls 13 between which a covering member rises vertically at the front portion 14 to a curved peak 15 and then slopes downwardly toward the bottom of the cap to form a sloping face 16. When this cap is applied to the feeder member it is positioned with surface 16 facing the back of the mold so that insulating material applied to the top will slide down surface 16 into the annular space S, Figs. 1 to 3.

In the practice of the invention the cap closure is removed after the space S has been filled with granular insulating material 17, as shown in Fig. 4. The handling of the ingot thereafter may be in accordance with desired practice. For instance, promptly after the ingot has been teemed as shown in Fig. 1 the metal within feeder member 2 is covered with a heat insulating cover slab 18, Fig. 2, of the type disclosed in United States Patent No. 2,165,945, to Kenneth Seaver, and which briefly comprises a slab of combustible material of low mass to volume ratio which becomes charred or ashed during solidification of the ingot but resists such destruction for a substantial period of time. When the surface metal between feeder 2 and the mold wall has solidified the cap closure is positioned, as shown in Fig. 3, and the space S is filled with insulating material. The cap may then be removed, to provide the condition shown in Fig. 4, the cap being then ready to be used again. Slab 18 has acted to prevent freezing of the metal lying directly under it, i. e., within the feeder, and if it has not yet been charred sufficiently, a hole may be knocked in it and the ingot backpoured, preferably by filling feeder 2. The ash formed from the slab floats on the surface of the metal in feeder 2 and insulates it against unduly rapid loss of heat from the top, while the insulating material 17 acts in the same manner to retard loss of heat laterally from the feeder, thus maintaining the backpoured metal molten long enough to feed the ingot during its solidification. In this manner any pipe or shrinkage cavity is confined to the neck of the metal within feeder 2. After solidification sleeve 3 is removed for reuse; feeder 2 welds to the ingot head but is recovered when the crop is remelted.

The invention has been illustrated as applied to the pouring of big-end-up ingots. In the casting of such ingots it is necessary for the feeder member to project a substantial distance above the top of the mold, as shown in Fig. 1, to provide a relatively long neck of solid metal for engagement by tongs in removing the ingot from the mold. It is equally applicable to the casting of small-end-up ingots, as will be understood, although in such instances it is unnecessary to have the feeder extend as far above the top of the mold as is necessary in casting big-end-up ingots. Also, an advantage of two-part hot tops of the type described is that they may be used for the making of cuts, in which case feeder member 2 extends into the mold a distance greater than is shown in Fig. 1. It will be understood, accordingly, that to take care of these variations in mode of use or to permit the making of cuts, the feeder member may be supported with a greater or lesser proportion of its length within or outside of the mold as the case may be.

The cap closure is made from fire-resistant material so that it may be used repeatedly. Advantageously it is strongly constructed from metal so as to have a long useful life, whereby its cost becomes negligible in figuring ingot costs. Also, sleeve 3 should be of heavy enough section to have a long life, for the same reason. Inasmuch as feeder 2 becomes welded to the metal within it, it should be of as light gauge as is consistent with satisfactory operation, say of 16-gauge sheet steel.

Various modifications other than described are, of course, possible. For example, the cap closures should have openings large enough that they may be used with feeders of a range of sizes, which is desirable for standardization and economy. However, when a cap is then placed on a feeder of relatively smaller size it is possible for the cap to be pushed too far to one side or the other and thus to block, at least to some extent, the opening between the feeder and the sleeve. This may be avoided by affixing spacer pins inside the cap near its lower edge. Thus, inwardly projecting pins 20, Fig. 3, are welded to the inside corners of cap 6; when the cap is placed on any feeder that it will accommodate the pins act to position it properly thereon.

Again, the guard rails may be positioned otherwise than as shown in Figs. 5, 6 and 9. For example, as seen in Figs. 10 and 11, guard rail 21 is spaced outwardly from and connected to cap 22 by spaced pins 23, the lower edge of the rail being substantially in the plane of the bottom edge of cap skirt 24. In this embodiment a handle 25 is connected to one face of the cap instead of at the apex. The rail is shown as ex-

tending about the entire cap, but it may be applied to only one, two or three sides if desired.

According to the provisions of the patent statutes, I have explained the principle and method of practicing my invention and have illustrated and described what I now consider to represent its best embodiment. However, I desire to have it understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

I claim:

1. In a method of casting an ingot in a mold which comprises casting metal into the mold to a level such as to immerse the lower end of a tubular fire-resistant feeder member which extends from above the mold top downwardly into the mold opening with its mold-enclosed wall disposed close to but out of contact with the mold wall and whose portion extending above the mold is surrounded by a tubular fire-resistant sleeve member which forms an annular space therewith for reception of subdivided insulating material, the steps of applying to the upper open end of said feeder member a cap closure constructed and arranged to direct subdivided heat insulating material placed on it into said annular space at least at the back of the mold whereby the annular space may be filled uniformly, rapidly and easily without substantial spillage outside of the mold, and then introducing said granular material into said annular space.

2. In a method of casting an ingot in a mold which comprises casting metal into the mold to a level such as to immerse the lower end of a tubular sheet metal feeder member which extends from above the mold top downwardly into the mold opening with its mold-enclosed wall disposed close to but out of contact with the mold wall and whose portion extending above the mold is surrounded by a tubular metallic sleeve member which forms an annular space therewith for reception of subdivided insulating material, the steps of applying to the upper open end of said feeder member a cap closure having its outer surface sloping upwardly and inwardly from the base toward the apex to direct material applied thereto into said annular space whereby said annular space may be filled uniformly, rapidly and easily without substantial spillage outside of the mold, and then applying subdivided heat insulating material to said surface to fill the back of said annular space.

3. In a method of casting an ingot in a mold which comprises casting metal into the mold to a level such as to immerse the lower end of a tubular sheet metal feeder member which extends from above the mold top downwardly into the mold opening with its mold-enclosed wall disposed close to but out of contact with the mold wall and whose portion extending above the mold is surrounded by a tubular metallic sleeve member which forms an annular space therewith for reception of subdivided insulating material, the steps of applying to the upper open end of said feeder member a cap closure having a pyramidal surface and provided adjacent its lower edge with a guard rail which permits subdivided heat insulating material placed on said surface to flow freely into said annular space but prevents it from surging outside of said sleeve member, and then introducing insulating material into said annular space by applying it to said surface.

4. The combination with an ingot mold of a feeder comprising a tubular fire-resistant feeder member open at both ends extending from above the mold downwardly into it with a mold-enclosed portion positioned close to but spaced from the mold walls, a fire-resistant tubular sleeve member supported by the mold disposed about the portion of said feeder projecting above the mold and forming an annular space therewith for receiving subdivided heat insulating material, and a cap closure member removably associated with the upper end of said feeder member and constructed and arranged to direct insulating material placed thereon into at least that portion of said annular space at the back of the mold.

5. The combination with an ingot mold of a feeder comprising a tubular sheet metal feeder member open at both ends extending from above the mold downwardly into it with a mold-enclosed portion positioned close to but spaced from the mold walls, a tubular metallic sleeve member supported by the mold disposed about the portion of said feeder projecting above the mold and forming an annular space therewith for receiving subdivided heat insulating material, and a cap closure member removably associated with the upper end of said feeder member, said cap member having its outer surface tapered upwardly and inwardly from the base toward the apex and acting to direct insulating material placed thereon into said annular space.

6. A combination according to claim 5 in which at least that surface portion of said cap member at the back of the mold is provided adjacent its lower edge with means for allowing said insulating material to flow freely into said annular space while preventing it from surging outwardly over said sleeve member.

7. The combination with an ingot mold of a feeder comprising a cylindrical sheet metal feeder member open at both ends extending from above the mold downwardly into it with a mold-enclosed portion positioned close to but spaced from the mold walls, a tubular metallic sleeve member supported by the mold disposed about the portion of said feeder projecting above the mold and forming an annular space therewith for receiving subdivided heat insulating material, and a cap closure member removably associated with the upper end of said feeder member, said cap member having a pyramidally formed surface provided adjacent at least a portion of its lower edge with a guard rail held in spaced relation to the cap surface by spaced members which permit insulating material applied to the surface of the cap to flow freely into said annular space, and said rail acting to prevent said insulating material from surging outwardly over said sleeve member.

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