Dec. 26, 1944. H. C. WINKEL 2,365,740

MOLD

Original Filed Aug. 28, 1940 2 Sheets-Sheet 1

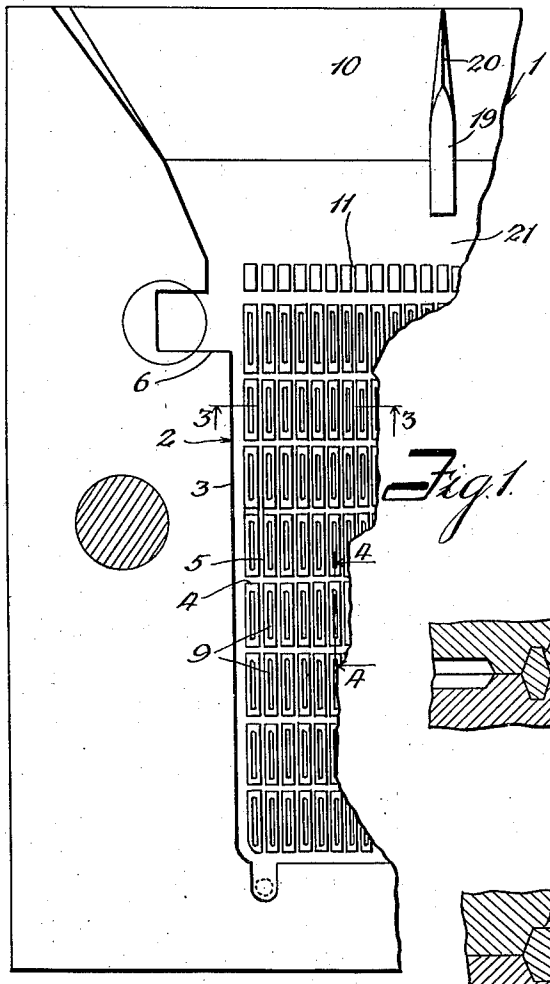



Fig. 1.

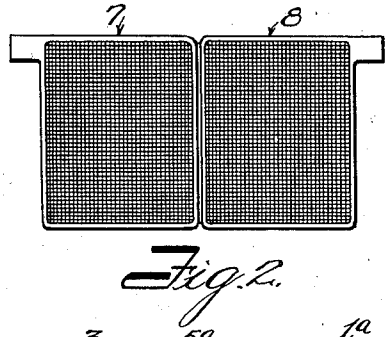



Fig. 2.

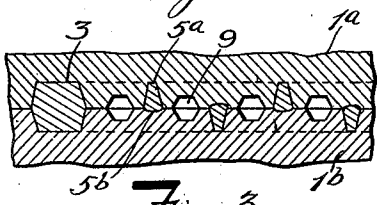



Fig. 3.

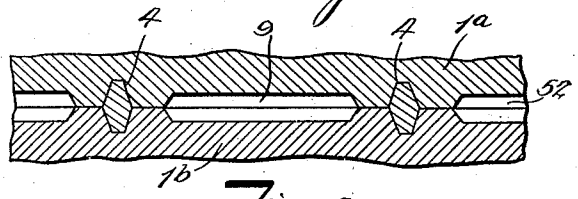



Fig. 4.

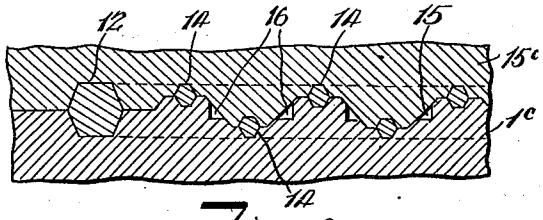



Fig. 6.

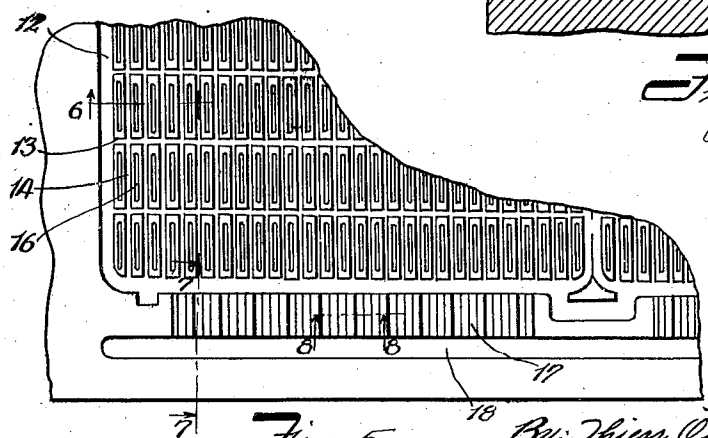



Fig. 5.

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MOLD

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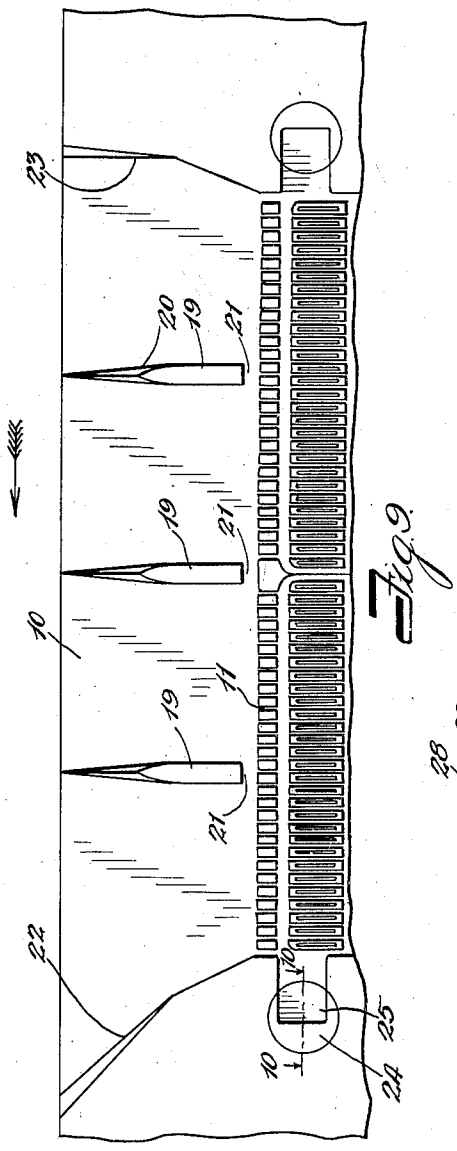



Fig. 9.

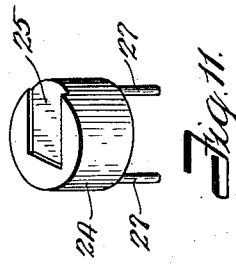



Fig. 11.

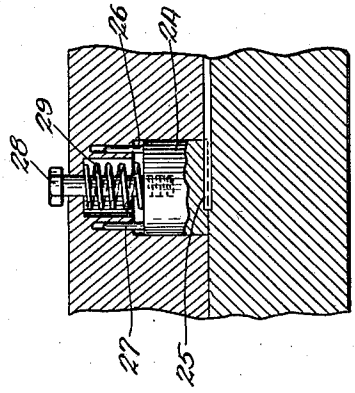



Fig. 10.

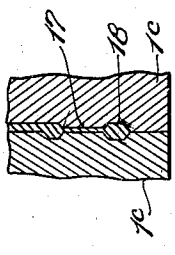



Fig. 7.

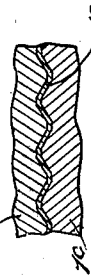



Fig. 8.

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# UNITED STATES PATENT OFFICE

2,365,740

## MOLD

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Original application August 28, 1940, Serial No. 354,495. Divided and this application March 2, 1942, Serial No. 432,993

8 Claims. (Cl. 22—153)

This invention relates to molds and more particularly to molds for casting grids for electric battery plates. It is especially adapted for use in connection with automatic grid molding machines such, for instance, as disclosed and claimed in my copending application Serial No. 354,495, of which this instant application is a division.

It is an object of this invention to provide a grid mold having a new and novel arrangement and relationship of air compression chambers therein so that the mold is completely filled during each molding operation and without the use of air vents. The mold may, therefore, be effectively used in continuously operated molding machines for high speed quantity production to produce substantially finless grids. The molds are constructed to equalize the pressures therein so that the back pressure of trapped gases is just sufficient to counteract the pressure of the metal when all of the passages of the mold are completely filled and without allowing the passage of the molten material into the gas compression spaces. The molds are, therefore, completely filled to form perfect strands in the finished grid and at the same time the grid may easily be removed, automatically or otherwise, from the molds.

In casting grids for battery plates wherein the strands of the labyrinth-like plate are elongated and very small in diameter, it has been very difficult to cause the molten metal to completely fill the mold cavity and form perfect strands throughout the plate and without forming objectionable fins on the strands. This is due to the small size of the grooves in which the strands are molded and the fact that the mold contains air which is usually vented therefrom through air passages. The metal very often flows into these air vents, thereby not only causing fins, but also tending to lock the grid in the mold and prevent proper automatic ejection of the grid therefrom. Furthermore, even if the grid is ejected from the mold, the air passages or vents soon become filled with metal, which prevents proper flow and results in imperfectly formed strands.

It has been found that, by the proper distribution of air compression chambers or grooves closely associated with the strand cavities of the mold, air vents may be entirely dispensed with and a desired flow of metal may be obtained so that perfect grids may be formed without fins on the strands and without permitting any of the metal to enter the compression grooves. By this means the grids are perfectly formed and easily ejected from the molds and the molds do not require frequent cleaning. This is an important feature of this invention, as it enables the use of a simple high speed molding machine suitable for quantity production and with a minimum number of defective grids.

Battery grids are cast in integral pairs, that is, two grids in a single casting with an outstanding terminal lug on each grid. The terminal lugs are oppositely disposed on the double grid and it has been found that, if these lugs can accurately be cast without fins and with clean-cut edges, they may be used as locating lugs in a trimming machine or other grid handling device, to which machine the grids may, if desired, be delivered directly from the molding machine. It is, therefore, an object to provide a simple and effective automatic sealing means for sealing the mold adjacent the edges of the lug cavities whereby accurate clean-cut lugs without fins are provided.

Another object is to provide, particularly in a continuously moving mold, means to enable the molten metal poured into the moving mold from a fixed pump or other suitable means to be properly distributed in the moving mold without being spilled therefrom.

Other objects will be apparent from the specification and the appended claims.

In the drawings:

Fig. 1 is a fragmentary face view of one of the mold sections and illustrates the mold cavity for forming the grid and the compression spaces for gas between the channels for forming the strands of the grid.

Fig. 2 is a diagrammatic side elevation of one of the double grids which may be molded by the mold construction shown in Fig. 1.

Fig. 3 is an enlarged horizontal detailed section through the closed mold after the metal has been poured therein and is taken on a line substantially corresponding to line 3—3 of Fig. 1.

Fig. 4 is an enlarged vertical section through the closed and filled mold and is taken on a line substantially corresponding to line 4—4 of Fig. 1.

Fig. 5 is a fragmentary face view of a slightly different type of mold particularly adapted for forming a grid with so-called staggered strands and constructed to provide a corrugated bottom fin having considerably increased strength without increasing the thickness thereof so that the grid may more easily be handled without distorting the bottom fin.

Fig. 6 is an enlarged fragmentary sectional view through a closed and filled mold of the type

shown in Fig. 5 and is taken on a line substantially corresponding to line 6—6 of Fig. 5.

Fig. 7 is a vertical section through the bottom fin portion of the closed and filled mold and is taken on a line substantially corresponding to line 7—7 of Fig. 5.

Fig. 8 is a horizontal sectional view through the corrugated bottom fin portion of the closed and filled mold and is taken on a line substantially corresponding to line 8—8 of Fig. 5.

Fig. 9 is a face view of the upper portion of the inner mold section.

Fig. 10 is an enlarged detail sectional view taken on line 10—10 of Fig. 9 and illustrates the automatic sealing means for casting clean-cut locating lugs without fins.

Fig. 11 is a perspective view of the sealing plug shown in Figs. 9 and 10.

It is extremely important for the successful operation of an automatic grid molding machine such, for instance, as disclosed in my previously mentioned copending application that the molds should be so constructed that perfect grids may be produced in such a manner that they may easily be ejected therefrom. It has been found that this is best accomplished without the use of the usual vent holes or air passages and by the use of compression chambers of sufficient size and distribution with respect to the strand cavities that the back pressure of the gases is just sufficient to permit complete filling of the mold without forming fins on the strands. The drawings illustrate molds suitable for this purpose wherein both sections of the mold are substantially identical in so far as the mold cavities are concerned. In some cases, a flat-face mold is desired, that is, wherein the parting line is in a single plane. This type of mold is illustrated in Figs. 1, 3, and 4. In other cases it is desirable to provide a so-called staggered mold, that is, wherein adjacent strands are offset on opposite sides of the control plane of the grid, and a mold producing grids of this type is illustrated in Figs. 5 to 8, inclusive.

In the embodiment shown in Figs. 1, 3, and 4, a portion of a mold section 1 is illustrated and comprises a mold cavity 2, which cavity includes a marginal casting groove 3, horizontal rib grooves 4, and intersecting vertical strand grooves 5. Terminal lug cavities 6 are also provided.

Fig. 2 is a diagrammatic elevation of a double grid produced by this type of mold and shows the grid after it has been trimmed. The view illustrates two integral grids 7 and 8 which are cast in the same mold and may be separated after being cast and trimmed to provide two smaller grids. The transverse rib grooves 4 of the mold are larger than the strand grooves and are of substantially the same depth as the marginal casting grooves 3. The vertical strand grooves 5, however, are much smaller and are preferably deeper in one side of the mold than in the other to provide offset strands in the manner shown in Fig. 3 so that a deep groove 5a is in one mold section and the opposing shallow groove 5b is in the opposite section. This provides staggered strands in a flat-faced mold.

In Figs. 3 and 4 the two mold sections 1a and 1b are shown clamped together in their proper relationship for molding. In order to enable the molds to be completely filled by molten metal, compression chambers are provided wherein the entrapped gases are just sufficiently compressed by the weight of the molten metal to enable the mold to completely fill without the formation of fins and without permitting the metal to flow into the compression chambers. In order to accomplish this, elongated grooves 9 are provided in each facet formed in the mold between the strand grooves 5 and the transverse reinforcing rib grooves 4. These compression grooves 9 are preferably provided in each mold section, as illustrated in Figs. 3 and 4, and are preferably substantially of the shape illustrated. It will be apparent, however, that the grooves may be of any convenient shape and in only one mold section if desired, the only requirement being that they should be of sufficient size and so related to the strand grooves as to enable a proper gas compression to provide for completely filling the mold without fins. The mold is provided with an inlet opening 10 and with gate grooves 11 to facilitate the introduction of molten metal.

A very desirable form of grid is provided with so-called offset or staggered strands. This is important where it is desired to cast lighter strands, as it is necessary that the strands should be flush with the sides of the casting. A mold for producing this construction is illustrated in Figs. 5 to 8, inclusive. Fig. 5 illustrates a portion of a mold having a marginal casting groove 12, horizontal reinforcing rib grooves 13, and vertical strand grooves 14. This type of mold is provided with a corrugated face forming a zigzag parting line as shown at 15 (Fig. 6). This is accomplished by forming each mold section by milling or otherwise in the direction of the strands to form the corrugated parting line and the strand grooves 14, complementary grooves 14' being formed in each mold section. Compression chambers in the form of elongated grooves 16 are then formed, one groove in each facet of the mold between each pair of strands. These chambers are preferably angular in cross section, as illustrated in Fig. 6, as this shape provides for convenient milling without undercutting. The compression grooves 16 are preferably in only one section of the mold. However, it will be apparent that complementary grooves may be cut in both sections if desired, the only requirement being that they should be of sufficient size and extent to allow for the proper amount of gas compression to enable the mold to fill without forming excessive fins in the same manner as in the flat-faced mold previously described.

The use of compression chambers instead of vents enables continuous operation of the machine in quantity production, as substantially all of the grids are perfectly molded, and it is only very infrequently necessary to stop the machine for cleaning the molds.

After the grids have been molded, it is necessary to trim at least the top and bottom edges to remove the sprue and any outwardly extending fins which may have formed on the grid. This requires more or less handling of the grid, and it is desirable that a reinforcing fin be provided on the bottom edge of the grid for that purpose.

In the embodiment last described, the cutter which forms the corrugated parting line in the mold continues the cut beyond the bottom of the grid cavity as shown at 17. These extended corrugations terminate in a marginal slot 18, which latter forms a horizontal reinforcing rib on the fin formed by the extended corrugations 17. A very light additional cut is taken on the terminal corrugations 17 so that a very thin corrugated fin is formed as shown in Figs. 7 and 8, and, as this fin terminates in the horizontal channel 18, this channel forms a compression chamber which

is not required to be completely filled with the molten metal. The thin corrugated fin forms a sufficiently rigid reinforcement so that the fin is not bent when the grid drops from the mold. Therefore, this fin provides a rigid element for handling the grid during the trimming operation and provides more area for chilling the fin and for venting during pouring, which is desirable as the heavy border portion usually fills first and air is trapped in the center portions. This reinforcement is accomplished without any material waste of metal over the usual methods.

The two mold sections form what may aptly be termed die plates, and these die plates are preferably formed with complemental mold cavities. The compression grooves in either embodiment shown may be in only one die plate or, if desired, complemental grooves may be formed so that each pair of grooves forms a single compression chamber of sufficient size and relationship to the adjacent casting grooves to perform the required function.

Fig. 9 is a face view of the upper portion of the drag die plate which co-operates with the complemental cope plate. The present invention is adapted for continuous operation in suitable molding machines whereby, if desired, the molds may be continuously moved past a fixed filling station, at which station a predetermined amount of molten metal is dropped into the inlet or sprue opening **10**. Heretofore it has been found necessary to move the filling spout with the mold during the filling operation for the reason that, when the metal is dropped into the mold opening, the movement of the mold tends to cause the metal to overflow at the rear of the mold opening. With a mold construction such as illustrated in Fig. 9, the mold may be filled during its continuous movement in the direction of the arrow, past a fixed filling spout, without danger of overflow of the mold, while at the same time a substantially even distribution of the metal into the mold cavity is provided. This is accomplished by means of transverse baffles **19** which are formed by complemental ribs or partitions in the sprue openings of the die plates and with the sharp upper edges **20** of the baffles somewhat below the upper edge of the mold.

The transverse baffles **19** are somewhat widely spaced and distributed over the length of the mold opening in a manner to separate the incoming molten metal sufficiently to prevent overflow by the movement of the mold. The baffles terminate closely adjacent the mold cavity, but sufficiently above the cavity to provide a passage **21** under each baffle to enable flow of the metal thereunder and provide a uniform distribution of the metal to the mold cavity. The advancing end of the mold cavity is preferably angularly inclined forwardly as shown at **22**, while the rear wall **23** is more nearly vertical to prevent overflow of any of the molten metal from the space between this end wall and the adjacent baffle **19**.

As previously stated, terminal lug cavities **6** are provided in the complemental sections of the mold, and it is desirable that at least the outer portions of these lugs be free of fins and that the edges be clean-cut and accurate so that the lugs on the casting may be used for locating the casting in a trimming machine or any suitable grid handling device. In order to accomplish this, one of the die plates, preferably the drag plate, is provided with a plug **24** slidably mounted therein and having a cavity **25** in the face thereof forming a part of the lug cavity of the mold. The plug or movable mold section **24** is slidably mounted in an opening **26** in the die plate and is provided with rearwardly extending guide pins **27** slidably mounted in complementary guide holes, thus preventing any rotary movement of the plug **24** while permitting axial movement thereof. A stop bolt **28** is threaded into the plug **24** from the rear of the die plate, as illustrated, and a spring **29** tends to move the plug outwardly whenever the mold is open, the outward movement being limited by the head of the bolt **28**. It will be apparent that, when the mold is closed, the outer surface of the plug will be snugly pressed against the opposite die plate and the pressure of the spring **29** will cause the parting line around the edge of the grid lug cavity to be effectively sealed and an accurate clean-cut lug without fins will be formed on the grid.

It is intended, of course, that the invention should not be limited to the specific embodiment or embodiments disclosed herein, since modifications may be made, and it is contemplated therefore, by the appended claims to cover any such modifications as fall within the true spirit and scope of this invention.

Having thus described this invention, what is claimed and desired to be secured by Letters Patent is:

1. In a grid mold of the character described, a die plate having a facet with a casting groove bounding said facet, said facet having a compression cavity therein, said compression cavity communicating only with the face of said facet.

2. In a grid mold of the character described, a die plate having a facet with a casting groove bounding said facet, said facet having a compression cavity therein, said compression cavity communicating only with the face of said facet and being substantially equidistant from all of said casting grooves.

3. In a grid mold, a mold section having closely adjacent vertical strand casting grooves and transverse rib casting grooves therein, said casting grooves bounding small elongated facets, said facets having elongated air grooves therein spaced from said casting grooves to form compression chambers when said mold is closed for casting.

4. A sectional grid mold having a central parting line and closely adjacent complementary strand casting grooves in said sections, said mold having air compression chambers communicating only with the parting line between said casting grooves and of a size and distribution to enable the entrapped air to be compressed sufficiently therein during casting to permit the metal to completely fill said mold without flowing into said compression chambers.

5. In a grid casting mold, a die plate having a corrugated face, rib casting grooves extending transversely of said corrugations, a longitudinal strand casting groove in the top and bottom of each corrugation and forming with the adjacent rib grooves a facet inclined to the plane of said plate, and a compression groove in the inclined face of said facet remote from said casting grooves and communicating only with the face of said facet.

6. A grid mold comprising two complemental die plates, said plates having complemental corrugated faces forming a corrugated parting line, complemental transverse rib casting grooves in said corrugated faces, longitudinal strand casting grooves in the peaks and valleys of said corrugations to form inclined or substantially angular facets bounded by said casting grooves, and com-

pression grooves in the inclined faces of said facets and communicating only with the parting line faces thereof.

7. A grid mold comprising die plates having vertically corrugated complemental faces forming a corrugated parting line, complemental strand grooves in the peaks and valleys of said corrugations, and transverse reinforcing rib grooves, all of said grooves terminating in an enlarged marginal casting groove, said corrugations extending beyond the bottom marginal casting groove and being slightly relieved to form a very thin corrugated fin cavity.

8. A grid mold comprising die plates having vertically corrugated complemental faces forming a corrugated parting line, complemental strand grooves in the peaks and valleys of said corrugations, and transverse reinforcing rib grooves, all of said grooves terminating in an enlarged marginal casting groove, said corrugations extending beyond the bottom marginal casting groove and being slightly relieved to form a very thin corrugated fin cavity, said fin cavity terminating in an enlarged transverse compression groove.

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