March 16, 1965 K. R. RYBKA 3,173,177

APPARATUS FOR FORMING BRUSHES AND THE LIKE

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FIG. 1

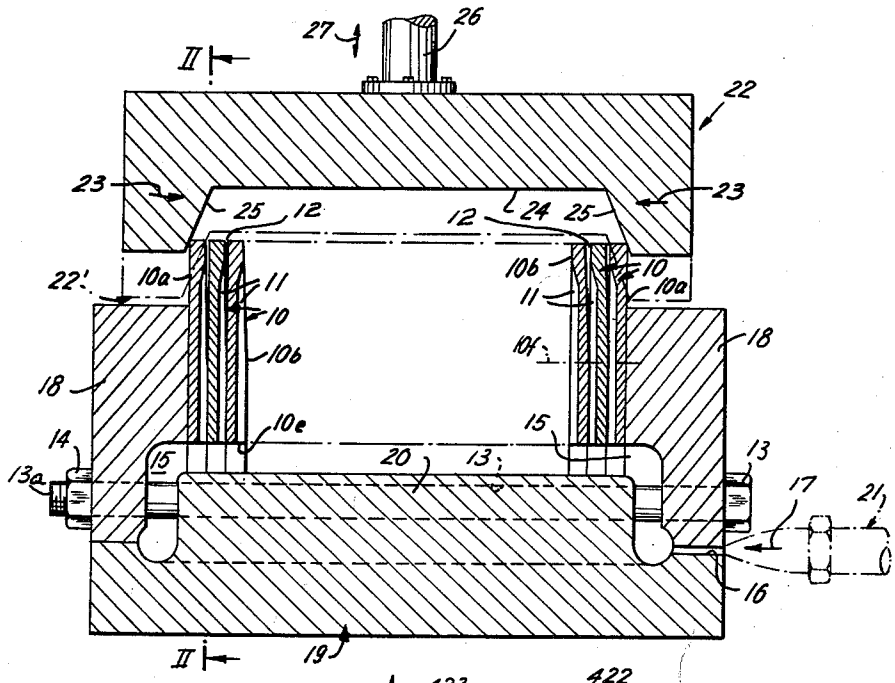
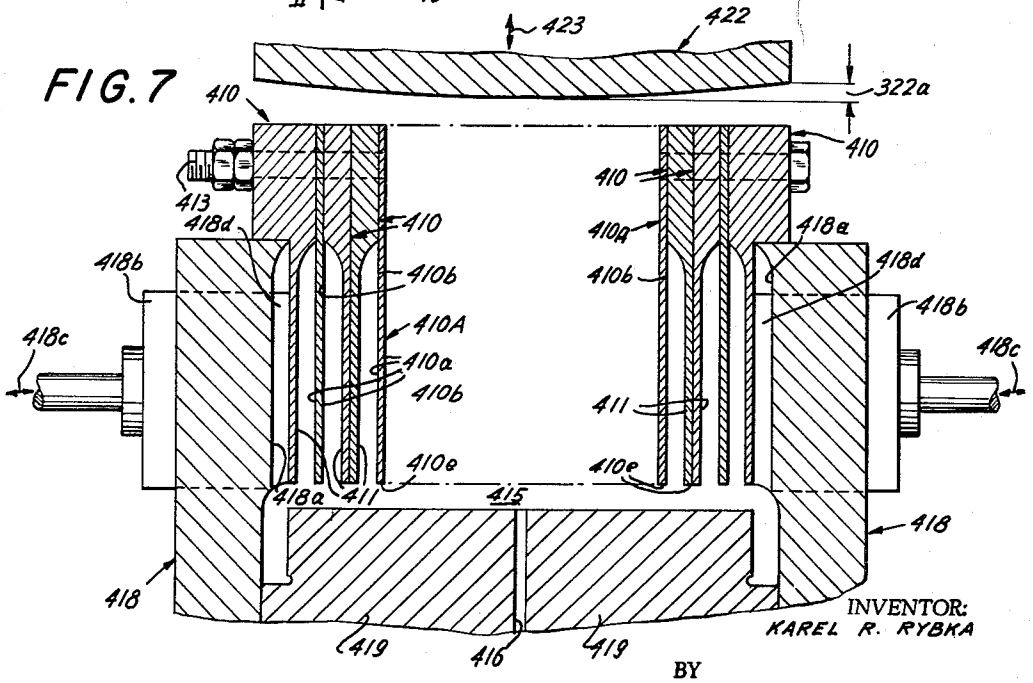


FIG. 7



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APPARATUS FOR FORMING BRUSHES AND THE LIKE

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FIG. 6

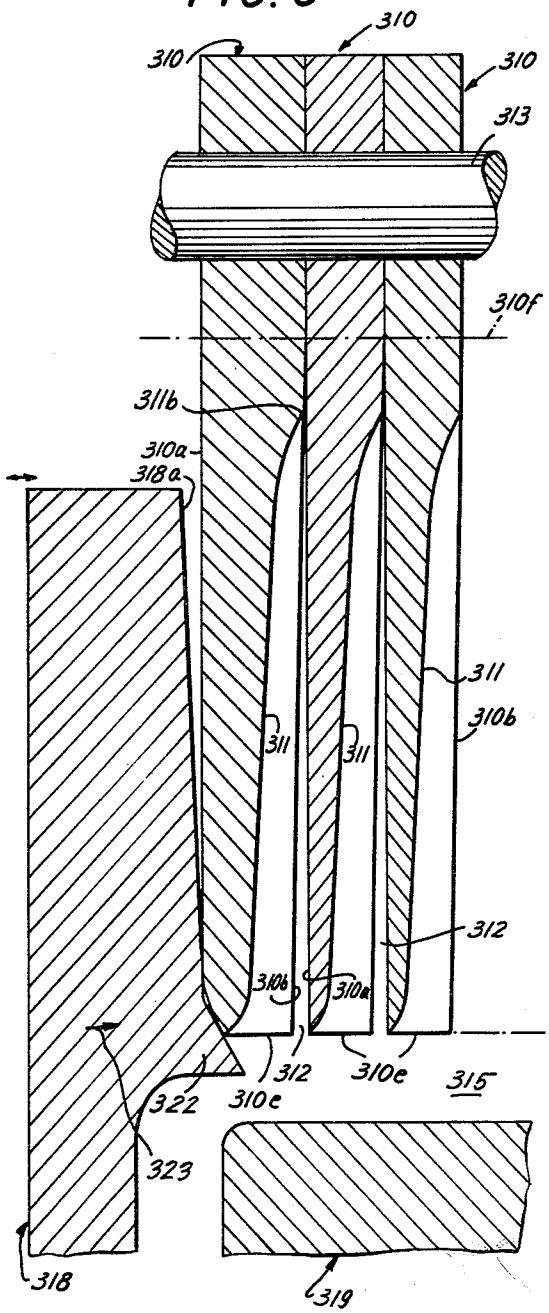


FIG. 2

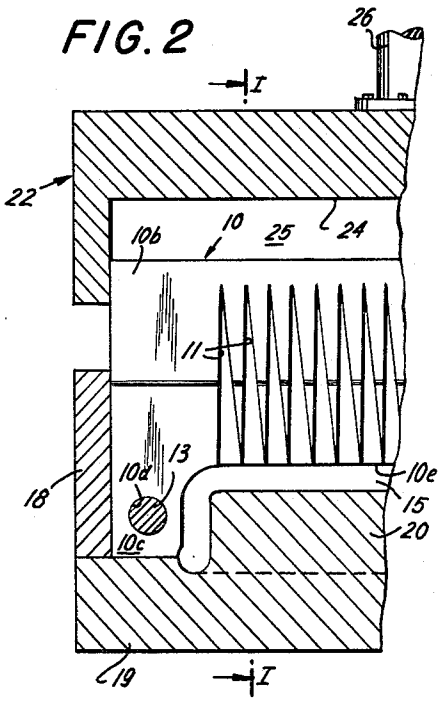
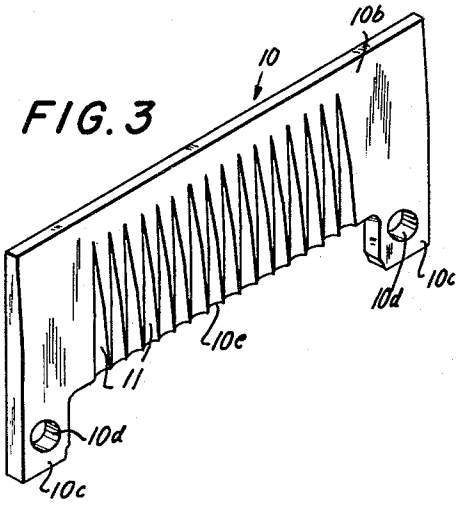


FIG. 3



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FIG. 4

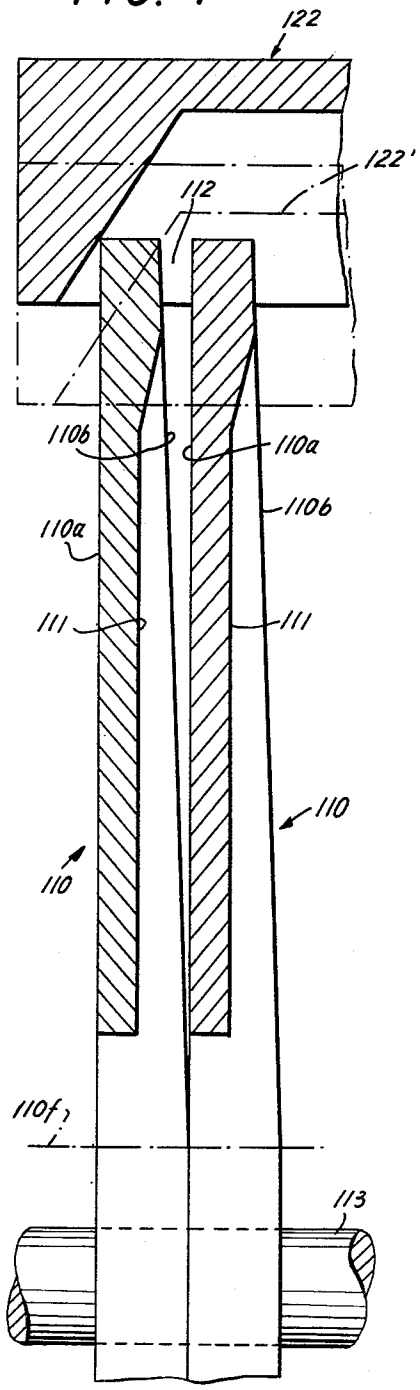
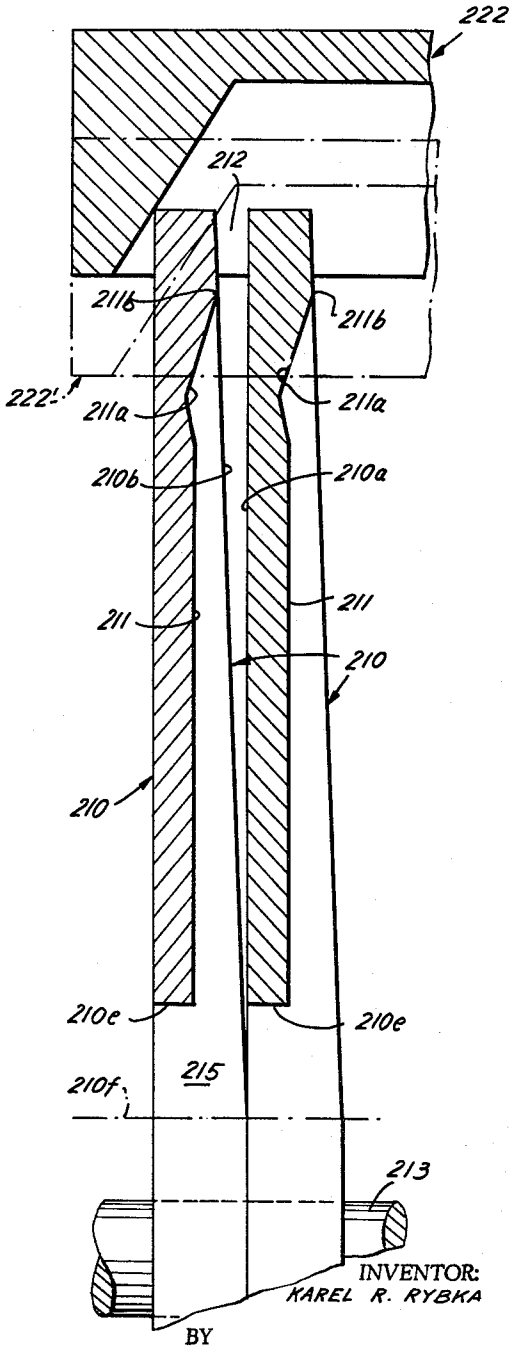


FIG. 5



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APPARATUS FOR FORMING BRUSHES AND THE LIKE

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Filed Apr. 17, 1962, Ser. No. 188,213
11 Claims. (Cl. 18—34)

The present invention relates to an apparatus for forming brushes and the like, and more particularly to an apparatus for molding one-piece plastic brushes wherein the base of the brush is integral with the bristles.

In recent years, brushes consisting of plastic material are manufactured by injection of mold material into mold assemblies comprising grooved die plates which are tightly clamped or bundled together so that the individual grooves form mold cavities for the bristles or tines. An apparatus of this general character is disclosed in U.S. Patent No. 3,004,291 to R. D. Schad.

With increasing length and decreasing thickness of the bristles which arises from the requirements of best adaptability to the cleaning tasks of the brushes, serious difficulties are encountered when the brushes are withdrawn from such mold assemblies because the slender bristles adhere to the faces of the die plates and are frequently damaged by excessive tension during withdrawal from the respective mold cavities. Such difficulties normally arise regardless of whether the bristles are of constant thickness or whether the bristles taper from the roots toward the tips thereof. The shrinkage of bristles after the mold material sets in the mold cavities is insufficient to permit convenient withdrawal of the product.

Accordingly, it is an important object of the present invention to provide a molding apparatus for brushes and the like which is constructed and assembled in such a way that the bristles may be withdrawn from the mold cavities without any damage thereto and regardless of whether the bristles taper from the roots to the tips thereof or are of constant thickness throughout.

Another object of the invention is to provide an apparatus of the just outlined characteristics for the manufacture of plastic brushes wherein the thickness of the bristles at the tips thereof may equal or exceed the thickness at the roots without in any way hindering withdrawal of such bristles from the mold cavities.

A further object of the invention is to provide an apparatus of the above described type wherein the die plates forming the mold cavities are constructed and assembled in such a way that they become automatically separated from the bristles as soon as the curing of mold material in the mold cavities is completed.

An additional object of the invention is to provide an improved mold assembly for use in molding apparatus of the above outlined characteristics, this mold assembly being adapted to automatically assume a position in which its die plates are separated from the bristles to permit rapid and convenient withdrawal of the brush from the apparatus.

A concomitant object of the invention is to provide an apparatus of the above outlined characteristics wherein the die plates are assembled in such a way that the length of bristles formed in the mold cavities defined by the die plates may exceed the length of bristles which can be formed in conventional molding apparatus of which I am aware at this time.

A further object of my invention is to provide a molding apparatus for the manufacture of brushes and like products wherein the mold assembly may be utilized for extended periods of time without requiring dismantling for the purpose of cleaning or maintenance of grooves.

With the above objects in view, the invention resides in the provision of a molding apparatus which comprises a mold assembly including a plurality of adjacent mold members in the form of die plates which define between themselves bristle-forming mold cavities, and means for connecting the mold members in the region of one end of each mold cavity. The mold assembly is adapted to assume a closed position in which the mold members are in contact with each other and an open position in which the mold members are at least partly spaced from each other, and the mold assembly normally assumes one of these positions but is elastically deformable into the other position. The molding apparatus further comprises means for elastically deforming the mold assembly into the aforementioned other position whenever required so that, in its closed position, the mold assembly is ready to receive a liquid dispersion of mold material because the mold cavities are separated from each other and that, in its open position, the mold assembly permits convenient withdrawal of bristles from the respective mold cavities because the die plates are at least slightly spaced from each other.

The mold assembly of my invention may comprise a stack of elastically deformable splayed die plates or the connecting means for the die plates may assume the form of one or more elastically deformable tie bolts which permit the unconnected end portions of the die plates to move apart in response to deforming stresses exerted by a piston, a ram or another type of deforming means. If the mold assembly utilizes elastically deformable connecting means, the thickness of the die plates may remain constant throughout.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following detailed description of certain specific embodiments with reference to the accompanying drawings, in which:

FIG. 1 is a partly schematic longitudinal section through a brush molding apparatus which embodies one form of my invention, the section of FIG. 1 being taken in the direction of arrows as seen from the line I—I of FIG. 2;

FIG. 2 is a fragmentary transverse section as seen in the direction of arrows from the line II—II of FIG. 1;

FIG. 3 is a perspective view of a single mold member of the type utilized in the apparatus of FIGS. 1 and 2;

FIG. 4 is a greatly enlarged fragmentary longitudinal section through a slightly modified molding apparatus, showing a pair of mold members whose thickness diminishes through a distance exceeding the length of the mold cavities defiined by these mold members;

FIG. 5 is an enlarged fragmentary longitudinal section through a molding apparatus whose mold members define mold cavities each having an enlarged portion so that the bristles formed and cured in such mold cavities may be provided with bulbous or otherwise configurated enlarged portions or beads;

FIG. 6 is a fragmentary longitudinal section through a molding apparatus whose mold members are formed and assembled in such a way that their normally spaced end portions are adjacent to the mold space for the base of the brush; and

FIG. 7 is a further partly schematic longitudinal section through a different molding apparatus which comprises a stack of alternating grooved and ungrooved mold members of constant thickness and wherein the mold members are connected by one or more elastically deformable tie bolts.

Referring now in greater detail to the illustrated embodiments, and first to FIGS. 1 to 3, there is shown an apparatus for molding one-piece plastic brushes, combs or the like (hereinafter called brushes) which, in accordance wilth my invention, comprises a mold assembly including a plurality of adjacent flexibly deformable mold members in the form of die plates **10** which form a stack and each of which is provided in one of its side faces with a series of elongated mold cavities or grooves **11**. The other side face of each die plate is smooth and is adjacent to the mold cavities **11** of the die plate **10** nearest thereto. The thickness of each die plate **10** diminishes from the upper toward but short of the lower end portion thereof, as viewed in FIGS. 1 and 2, so that on upwardly opening clearance or gap **12** develops between the side faces of adjacent die plates when the mold assembly is in open position, i.e., when the die plates are in unstressed condition (FIG. 1). In the illustrated embodiment, the die plates are assumed to have normally flat or plano ungrooved side faces **10***a* and tapering grooved side faces **10***b*. It will be noted that the gaps **12** communicate with the respective mold cavities **11** when the die plates are not under stress.

The die plates **10** are connected by two or more tie bolts **13** (only one shown in each of FIGS. 1 and 2) which have externally threaded end portions **13***a* mating with nuts **14**. Each die plate **10** has a pair of downwardly extending projections **10***c* which are provided with apertures **10***d* for the respective tie bolts **13**. It will be noted that the taper or splaying of the die plates **10** terminates at a point above their lower end faces **10***e* (see the line **10***f*) and that the apertures **10***d* are provided in non-tapered portions of the die plates, i.e. in such sections of the die plates whose thickness is constant, to make sure that the tie bolts **13** permit automatic separation of splayed portions of the die plates whereby the mold assembly consisting of die plates **10** and tie bolts **13** is free to assume the open position of FIG. 1 in which the die plates define the gaps **12**.

The molding apparatus of FIGS. 1 and 2 further comprises a composite backing mold means which defines with the end faces **10***e* of the die plates **10** a mold space **15** and which is formed with a passage **16** serving as a means for admitting a liquid dispersion of mold material in the direction indicated by the arrow **17** so that the mold material admitted into the space **15** forms the base of the brush. The space **15** communicates with each of the mold cavities **11** because its upper side, as viewed in FIGS. 1 and 2, is bounded by the lower end faces **10***e* of the die plates **10**.

The composite backing mold means comprises two or more upper components or side walls **18** and a bottom component or base **19** which latter supports the side walls and whose central portion or boss **20** extends upwardly to define the inner wall of the mold space **15**. The tie bolts **13** extend through the side walls **18** to press these side walls against the outermost die plates **10** and to thereby prevent flashing of mold material during the injection molding operation.

The means for injecting a liquid dispersion of mold material into the passage **16** may assume the form of a nozzle **21** (shown in phantom lines in FIG. 1), and this nozzle forms part of any well known injection molding machine whose exact construction forms no part of this invention.

The molding apparatus of FIGS. 1 and 2 further comprises a specially configurated deforming element **22** which serves as a means for deforming the splayed upper end portions of the die plates **10** by compressing the die plates in directions indicated in FIG. 1 by the arrows **23** so as to flex them into abutment with each other to make sure that the gaps **12** are eliminated before the start of a molding operation. This deforming element **22** is formed in its underside with a recess **24** which is bounded by two upwardly and inwardly inclined cam faces **25** each of which engages the upper end portion of the adjacent outermost die plate **10**. For example, the deforming element **22** may be connected with a ram **26** which forms part of a hydraulic, pneumatic, mechanical, electromagnetic or other reciprocating device and which is adapted to move the deforming element in directions indicated by the double arrow **27**.

Of course, the deforming element **22** and the backing mold means **18–20** are mounted in a suitable press of any known design, for example, of the type disclosed in the aforementioned U.S. Patent 3,004,291 to Schad. The construction of the press forms no part of this invention and, therefore, this press is not shown in the drawings.

The apparatus of FIGS. 1 and 2 is assembled and utilized as follows:

In the first step, the die plates **10** are stacked so that their projections **10***c* rest on the base **19**. After placing the side walls **18** onto the base **19**, the operator introduces the tie bolts **13** into the apertures **10***d* of the respective projections **10***c* and through the aligned apertures of the side walls **18** to thereupon apply the nuts **14** whereby the lower portions of the die plates whose thickness is constant are held in firm abutment with each other and, together with the backing mold means **18–20**, define the mold space **15**.

In the next step, the ram **26** is actuated to move the deforming element **22** in downward direction, as viewed in FIGS. 1 and 2, in order to compress the splayed upper end portions of the die plates **10** into full face-to-face abutment with each other (arrows **23**) and to thereby eliminate the gaps **12** so that the mold cavities **11** are completely sealed from the atmosphere and communicate only with the mold space **15**. The element **22** then assumes the phantom-line position **22'**. The injection molding machine is caused to inject a liquid dispersion of mold material through the nozzle **21** (arrow **17**) in order to fill the mold space **15** and each of the mold cavities **11**. After elapse of a period of time necessary to allow the plastic material to set, the deforming element **22** is caused to move upwardly, as viewed in FIG. 1, so that the cam faces **25** permit the mold assembly including the die plates **10** and tie bolts **13** to return to the open position of FIG. 1 in which the side faces of the die plates are at least partially separated from the bristles formed and cured in the mold cavities **11**. The inherent resiliency of the die plates **10** is sufficient to insure that their upper portions move apart and to again form the gaps **12**. It is then relatively simple to remove the finished brush from the apparatus. All that is normally necessary is to move the base **19** in downward direction and the product readily follows such movement of the base because, during curing, it automatically contracts in all directions so that it may be removed without special ejecting means, such as pins or the like, not shown. Of course, and as a precautionary measure, the molding apparatus of my invention may be provided with suitable ejecting means to make sure that the brush may be removed if it should adhere to the one or the other part of the mold after curing.

FIG. 4 illustrates a slight modification of my invention according to which the molding apparatus comprises a mold assembly including a stack of mold members in the form of die plates **110** each of which tapers from its upper end portion toward but short of its lower end through a distance which exceeds the length of the mold cavities **111**. In other words, when the die plates **110** shown in FIG. 4 are deformed by being compelled to move into full face-to-face abutment with each other, they tend to separate and to form gaps **112** of a depth exceeding the length of the mold cavities **111**. The die plates **110** assume such positions when the deforming element **122** is moved to its phantom-line position **122'**.

An important advantage of the construction shown in FIG. 4 is that the bristles formed in the mold cavities **111** are more likely to become fully separated from the adjacent side faces **110***a*, **110***b* of the respective die plates **110** because the die plates tend to assume the positions shown in FIG. 4 and thereby insure that each bristle is fully separated from at least one of the adjacent side faces, i.e. from the face **110***a* and/or the face **110***b*. The tie bolts **113** are again applied below the line **110***f* at which the taper of the die plates **110** terminate.

It will be readily understood that the taper of die plates **10** and **110** shown in FIGS. 1 and 4 has been greatly exaggerated for the purpose of clearer illustration.

FIG. 5 illustrates another molding apparatus wherein the mold assembly consisting of mold member or die plates **210** and connecting members or tie bolts **213** (only one shown) is constructed and assembled in such a way that the bristles formed in the mold cavities **211** may be provided with enlarged portions which may but need not be adjacent to their tips. The taper of the die plates **210** is assumed to terminate at the line **210***f*, i.e. the length of tapering sections of the die plates exceeds the length of the mold cavities **211**, and each mold cavity comprises an enlarged portion **211***a* which may assume the shape of a bulb, an arrowhead, or any other desired configuration.

When the mold assembly consisting of stacked die plates **210** and the conencting tie rods **213** is permitted to assume its normal open position in which the pairs of adjacent side faces **210***a*, **210***b* define between themselves elongated clearances or gaps **212** terminating at the line **210***f*, the bristles formed and cured in the mold cavities may be readily removed in downward direction, as viewed in FIG. 5 (i.e. toward the mold space **215**), because the combined width of each mold cavity **211** and of the associated groove **212** between the enlarged portion **211***a* and the mold space **215** is calculated in such a way that it exceeds the maximum width of the enlarged portion **211***a*. Of course, since the bristles may consist of elastically deformable plastic material and since they contract at least slightly after curing, they may be conveniently withdrawn from the respective mold cavities even if the width of the enlarged portions **211***a* exceeds the width of the channel through which the enlarged portions of the bristles must be moved toward the mold space **215**.

The construction of the deforming element **22** is the same as that of the deforming element **22** shown in FIGS. 1 and 2. The operative position **222'** of this deforming element is shown in phantom lines.

For example, the apparatus of FIG. 5 may be utilized for manufacturing brushes with bristles say 2 inches in length and 0.4 inch in width at the root, i.e. adjacent to the end faces **210***e*. Each bristle tapers to 0.2 inch near its free end (to wit: at the closed end **211***b* of the respective mold cavity). For certain reasons, it may be desired to provide a slightly bulbous terminal on the bristle. The width of the bulbous terminal (that is, the depth of the enlarged portion **211***a*) may be about 0.4 inch or, if necessary, the width of the bulbous terminal may exceed 0.4 inch because, and as shown in FIG. 5, the gaps **212** may extend beyond the open ends of the mold cavities **211**.

Bulbous temrinals are desirable to prevent excessive bending or premature breakage of the bristle tips, to stimulate the scalp if a brush provided with such bristles is used as a hair brush, and for certain other purposes.

Referring to FIG. 6, there is shown a molding apparatus wherein the upper end portion of each mold member or die plate **310** is of constant thickness and wherein each die plate tapers between its lower end face **310***e* and the line **310***f*. The die plates are connected by tie bolts **313** in such a way that their upper end portions whose thickness is constant are in face-to-face abutment with each other and that their lower end portions which are adjacent to the mold space **315** normally remain spaced from each other whereby the cooperating pairs of side faces **310***a*, **310***b* define between themselves clearances or gaps **312** extending upwardly to the line **310***f*, i.e. beyond the closed ends **311***b* of the mold cavities **311**. Each of these mold cavities has an open lower end which communicates with the mold space **315**, the latter bounded by the end faces **310***e* and by backing mold means including a base **319**. The side walls **318** of the backing mold means are constructed in such a way that the portions **322** thereof replace the deforming element **22** of FIG. 1. That side wall **318** which is shown in FIG. 6 may be moved in the direction indicated by the arrow **323** so as to deform the outermost die plate **310** in a direction to the right and to thereby consecutively deform the other die plates in order to eliminate the gaps **312** and to move the associated pairs of side faces **310***a*, **310***b* into abutment with each other whereby the mold cavities **311** are sealed from each other and communicate only with the mold space **315**. In such closed position of the mold assembly including the die plates **310** and the tie bolts **313**, the inner surface **318***a* of the side wall **318** is preferably in full abutment with the side face **310***a* of the outermost die plate **310**.

For example, the thickness of the bristles formed in the mold cavities **311** may be in the range of say one hundredth of an inch, and the contraction in one direction on curing is then about 2 percent. Thus, the curing will reduce the thickness of a bristle by two ten thousandths of an inch. This shrinkage, aided by elastic deformation or stretch of any points still held by friction will suffice to satisfactorily free for convenient removal bristles up to and even beyond one inch in length. If the stack of die plates **310** is say two inches wide and comprises thirty die plates in this width, and if it is desired to double the clearance of the bristles from the respective pairs of side faces **310***a*, **310***b*, then the adjacent die plates need not spread by more than two ten thousandths of an inch, and for thirty die plates at their lower ends (as viewed in FIG. 6) of less than six thousandths of an inch, i.e. the movement of the outermost die plates **310** from the fixed centre plane would be about three thousandths of an inch. This extreme case requires elastic deformation of die plates which is well within the elastic properties of the material of which the die plates consist.

The tie rods preferably consist of steel or bronze.

FIG. 7 illustrates a molding apparatus which is analogous to that shown in FIG. 6, excepting that the mold assembly includes two types of die plates **410** and **410A** and that each die plate is of uniform thickness throughout. The die plates **410A** are disposed between pairs of die plates **410** and each die plate **410** has a side face **410***b* formed with a series of elongated mold cavities **411**. The side faces **410***a* of the die plates **410A** are adjacent to side faces **410***b* of two die plates **410** and, in the normal closed position of the mold assembly, the side faces **410***a* are in full-length abutment with the adjacent side faces **410***b*. The tie bolts **413** connect the stack of die plates **410**, **410A** in the region of the upper ends of the mold cavities **411**, as viewed in FIG. 7, and the open lower ends of these mold cavities terminate at the end faces **410***e* which bound a portion of the mold space **415**. The remainder of the mold space **415** is bounded by backing mold means including a base **419** and side walls **418**. The mold cavity **415** communicates with a passage **416** provided in the base **419** through which a liquid dispersion of mold material is injected into this mold space and into the mold cavities **411**.

The inner surfaces **418***a* of the side walls **418** are spaced from the outer side faces of the outermost die plates **410** and each of these side walls is provided

with a horizontal cutout for a plunger 418*b* reciprocable in directions indicated by double arrows 418*c*. During an injection molding operation, the plungers 418*b* engage the outermost die plates 410 and maintain the cooperating pairs of side faces 410*a*, 410*b* in abutment with each other to prevent flashing. When the injection molding operation is completed and when the mold material filling the mold space 315 and the mold cavities 311 is permitted to set, the plungers 318*b* are moved away from the outermost die plates 410 so as to provide room for expansion of the mold assembly 410, 410A, 413, i.e. to permit the lower end portions of the die plates 410, 410A to become separated from each other. Such separation of the die plates is brought about by a deforming element in the form of a slightly curved plunger 422 which is reciprocable in directions indicated by the arrow 423 and which may be moved against the central portion of the stack of die plates so as to deform the tie bolts 413 and to permit the side faces 410*a* and/or 410*b* to become at least partly separated from the respective bristles. The spaces 418*d* defined by the inner surfaces 418*a* of the side walls 418 with the outermost die plates 410 (in retracted position of the plungers 418*b*) is sufficient to permit such separation of the die plates. The gaps developing between the cooperating pairs of side faces 410*a*, 410*b* upon deformation of the mold assembly to its open position are minimal but, aided by the shrinkage of the bristles formed in the mold cavities 411, these gaps are of sufficient width to bring about separation of the bristles from the respective side faces and to permit convenient withdrawal of the brush from the molding apparatus. The deforming element 422 may be reciprocated by a hydraulic motor or the like and, if desired, it may be moved at high speed toward and into abutment with the die plates so that the separation of lower end portions of the die plates is practically instantaneous. The distance 322*a* between the highest and lowest points of the front face on the deforming element 322 may be as small as 0.01".

Once the brush is removed from the apparatus, the deforming action of the element 422 is terminated and the resiliently deformable tie bolts 413 automatically return the stack of die plates to their closed position. It will be noted that the molding apparatus of FIG. 7 differentiates from the apparatus shown in FIGS. 1, 4, 5 and 6 in that the mold assembly including the die plates 410, 410A normally assumes its closed position in which the cooperating pairs of side faces 410*a*, 410*b* remain in abutment with each other whereas the apparatus shown, for example, in FIG. 1 utilizes a mold assembly which normally assumes an open position, i.e. the cooperating pairs of side faces 10*a*, 10*b* normally remain at least partially spaced from each other to form the clearance 12.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic and specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. In an apparatus for injection molding of brushes, in combination, a mold assembly including a plurality of adjacent die plates having opposite side faces, first end portions, and second end portions, one end portion of each die plate having an end face extending between the respective side faces and the side faces of adjacent die plates forming pairs of side faces defining between themselves elongated mold cavities in which bristles are formed and cured upon introduction of mold material, said elongated mold cavities extending from said end faces toward the other end portions of said die plates and each thereof having a first end and a spaced second end, and means for connecting said die plates in the region of one end of each of said mold cavities, said elongated mold assembly being adapted to assume a closed position in which said pairs of side faces are in abutment with each other and in which said elongated mold cavities are closed substantially from said first ends thereof to said second ends and an open position in which said pairs of side faces are at least partly spaced from each other in a direction transverse to the elongation of said elongated mold cavities, said mold assembly normally assuming one of said positions and being deformable into the other of said positions; backing mold means adjacent to but spaced from said end faces; said backing mold means and said end faces defining between themselves a mold space for reception of mold material forming the base of the brush and said mold space communicating with said mold cavities; and means for deforming said mold assembly into said other position whenever required, the bristles being formed and cured in said mold cavities when the mold assembly assumes said closed position and the bristles being at least partly separated from the respective pairs of side faces when the mold assembly assumes said open position.

2. In an apparatus for injection molding of brushes, in combination, a mold assembly including a plurality of adjacent flexible die plates having opposite side faces, first end portions and second end portions, one end portion of each die plate having an end face extending between the respective side faces and the side faces of the adjacent die plates forming pairs of side faces defining between themselves elongated mold cavities in which bristles are formed and cured upon introduction of mold material, said mold cavities extending from said end faces toward the other end portions of said die plates and each thereof having a first end terminating at the respective end face and a second end spaced from said first end, and means for connecting said die plates in the region of one end of each of said mold cavities, said die plates being adapted to assume a closed position in which said pairs of side faces are in abutment with each other and an open position in which the first end portions of said die plates are spaced from each other, said die plates normally assuming said open position and being flexibly deformable in a direction transverse to said elongated mold cavities into said closed position; backing mold means adjacent to but spaced from said end faces, said backing mold means and said end faces defining between themselves a mold space for reception of mold material forming the base of the brush and said mold space communicating with the first ends of said mold cavities; and means for compressing in said transverse direction the first end portions of said plates so as to flex said die plates into said closed position and to seal said mold cavities from each other during introduction and curing of mold material, the bristles formed in said mold cavities being at least partly separated from the respective pairs of side faces when the die plates are permitted to reassume said open position.

3. In an apparatus for injection molding of brushes, in combination, a mold assembly including a plurality of adjacent flexible die plates having opposite side faces, normally spaced first end portions and second end portions, one end portion of each die plate having an end face extending between the respective side faces and the side faces of the adjacent die plates forming pairs of side faces defining between themselves elongated mold cavities in which bristles are formed and cured upon introduction of mold material, said elongated mold cavities extending from said end faces toward the other end portions of said plates; backing mold means adjacent to but spaced from said end faces, said backing mold means and said end faces defining between themselves a mold space for reception of mold material forming the base of the brush and said mold space communicating with said mold cavities; and means for compressing in a direction transverse

to said side face the first end portions of said plates so as to flex said plates in said transverse direction and to tightly press said first end portions against each other and to seal said mold cavities from each other during introduction and subsequent curing of mold material, the bristles formed in said mold cavities being at least partially separated from the respective pairs of side faces when the first end portions of said die plates are permitted to reassume their normal spaced positions.

4. In an apparatus for injection molding of brushes, in combination, a mold assembly including a stack of adjacent flexible die plates having opposite side faces, normally spaced first end portions, and second end portions, said second end portions having end faces extending between the side faces of the respective die plates and the side faces of the adjacent die plates forming pairs of side faces defining between themselves elongated mold cavities in which bristles are formed and cured upon introduction of mold material, said elongated mold cavities extending from said end faces toward the first end portions of said die plates and each of said mold cavities having at least one enlarged portion, the thickness of each of said die plates increasing in a direction from the first toward the second end portions thereof and the enlarged portions of said mold cavities being provided in such zones of said plates whose thickness is less than the maximum thickness of the plates; backing mold means adjacent to but spaced from said end faces, said backing mold means and said end faces defining between themselves a mold space for reception of mold material forming the base of the brush and said mold space communicating with said mold cavities; and means for compressing the first end portions of said die plates in a direction transverse to said side faces so as to flex said die plates and to tightly press said first end portions against each other in said transverse direction and to seal said mold cavities from each other during introduction and subsequent curing of mold material, the bristles formed in said mold cavities being at least partially separated from the respective pairs of side faces when said first end portions are free to reassume their normal spaced positions.

5. A combination as set forth in claim 4, wherein said pairs of side faces define between themselves gaps extending from the first end portions toward the second end portions of said die plates when the first end portions of said die plates are spaced from each other, and wherein the combined width of said gaps and of the respective mold cavities intermediate said enlarged portions and said mold space at least equals the maximum width of said enlarged portions so that the portions of bristles formed and cured in said enlarged portions may be withdrawn from the respective mold cavities in a direction toward said mold space.

6. A combination as set forth in claim 5, wherein said enlarged portions resemble bulbs.

7. In an apparatus for injection molding elongated members, particularly for molding bristles, in combination, a mold assembly including at least two adjacent die plates defining between themselves a plurality of elongated mold cavities and each of said mold cavities having an open end and a closed end, and tie bolt means for connecting said die plates in the region of the closed ends of said mold cavities, said assembly being adapted to assume a closed position in which said die plates are in contact with each other and in which each of said mold cavities is closed substantially from its closed end to its open end and an open position in which said die plates are at least partly spaced from each other at least in the region of the open ends of said mold cavities in a direction transverse to the elongation of said mold cavities, said mold assembly normally assuming said closed position and at least said tie bolt means being elastically deformable to permit the mold assembly to assume said open position; and means for elastically deforming said tie bolt means whenever desired so that the elongated members molded in said mold cavities in closed position of said mold assembly are automatically at least partially separated from said die plates when the mold assembly is permitted to reassume said open position.

8. In an apparatus for injection molding of brushes, in combination, a mold assembly including a plurality of adjacent flexible die plates having opposite side faces, first end portions, and second end portions, one end portion of each die plate having an end face extending between the respective side faces and the side faces of adjacent die plates forming pairs of side faces defining between themselves elongated mold cavities in which bristles are formed and cured upon introduction of mold material, said mold cavities extending from said end faces toward the other end portions of said die plates and each thereof having a first end and a spaced second end, the thickness of each of said mold plates decreasing in a direction from the one toward the other end portion thereof and each of said die plates having a section of constant thickness in the region of one end of the respective mold cavity, and means for connecting said sections of the die plates, said die plates being adapted to assume a closed position in which said pairs of side faces are in abutment with each other and in which each of said mold cavities is substantially closed between said first and said second end thereof and an open position in which said pairs of side faces are at least partly spaced from each other in a direction transverse to said die plates in the region of the other end portions of said die plates, said die plates normally assuming said open position and being flexible in said transverse direction into said closed position; backing mold means adjacent to but spaced from said end faces, said backing mold means and said end faces defining between themselves a mold space for reception of mold material forming the base of the brush and said mold space communicating with said mold cavities; and means for deforming said die plates into said closed position whenever required, the bristles being formed and cured in said mold cavities when the die plates assume said closed position and the bristles being at least partly separated from the respective pairs of side faces when the die plates assume said open position.

9. In an injection brush molding apparatus, in combination, a mold assembly including a plurality of adjacent flexible die plates having opposite side faces, first end portions, and second end portions, one end portion of each die plate having an end face extending between the respective side faces and the side faces of adjacent die plates defining between themselves elongated mold cavities in which bristles are formed and cured upon introduction of mold material, said mold cavities extending from said end faces toward the other end portions of said die plates and each thereof having a first end and a spaced second end, and means for connecting said die plates in the region of one end of each of said mold cavities, said die plates being adapted to assume a closed position in which said pairs of side faces are in abutment with each other and in which each of said mold cavities is substantially closed between said first and said second end thereof and an open position in which said pairs of side faces are at least partly spaced from each other in a direction transverse to said die plates, said die plates normally assuming and remaining in one of said positions and being flexibly deformable into the other of said positions; backing mold means adjacent to but spaced from said end faces, said backing mold means and said end faces defining between themselves a mold space for reception of mold material forming the base of the brush and said mold space communicating with said mold cavities; and means for flexibly deforming said die plates in said transverse direction into said other position whenever required, the bristles being formed and cured in said mold cavities when the die plates assume said closed position and the bristles being at least partly

separated from the respective pairs of side faces when the die plates assume said open position.

10. In an injection brush molding apparatus, in combination, a mold assembly including a plurality of adjacent elastically deformable die plates having opposite side faces, first end portions and second end portions, one end portion of each die plate having an end face extending between the respective side faces and the side faces of the adjacent die plates forming pairs of side faces defining between themselves elongated mold cavities in which bristles are formed and cured upon introduction of mold material, said mold cavities extending from said end faces toward the other end portions of said die plates and each thereof having a first end terminating at the respective end face and a second end spaced from said first end, and elastically deformable means for connecting said die plates in the region of the second ends of said mold cavities, said mold assembly being adapted to assume a closed position in which said pairs of side faces are in abutment with each other and an open position in which the first end portions of said die plates are spaced from each other in a direction transverse to the elongation of said elongated mold cavities, said mold assembly normally assuming said closed position and being elastically deformable into said open position; backing mold means adjacent to but spaced from said end faces, said backing mold means and said end faces defining between themselves a mold space for reception of mold material forming the base of the brush and said mold space communicating with the first ends of said mold cavities; and means for elastically deforming said mold assembly into said open position, said mold cavities being sealed from each other in closed position of said mold assembly when mold material is being injected into the mold space and into the mold cavities and the bristles formed in said mold cavities being at least partly separated from the respective pairs of side faces when the mold assembly is elastically deformed into said open position.

11. In an injection brush molding apparatus, in combination, a mold asesmbly including a plurality of adjacent die plates having opposite side faces, first end portions, and second end portions, one end portion of each die plate having an end face extending between the

respective side faces and the side faces of adjacent die plates defining between themselves elongated at least slightly tapering mold cavities in which tapering bristles are formed and cured upon introduction of mold material, said mold cavities extending from said end faces toward the other end portions of said die plates and each thereof having a first end and a spaced second end, and means for connecting said die plates in the region of one end of each of said mold cavities, said die plates being adapted to assume a closed position in which said pairs of side faces are in abutment with each other and in which said elongated mold cavities are closed substantially from said first ends thereof to said second ends and an open position in which said pairs of side faces are at least partly spaced from each other in a direction transverse to the elongation of said elongated mold cavities, said mold assembly normally assuming one of said positions and being deformable into the other of said positions; backing mold means adjacent to but spaced from said end faces; said backing mold means and said end faces defining between themselves a mold space for reception of mold material forming the base of the brush and said mold space communicating with said mold cavities; and means for flexibly deforming said mold assembly into said other position whenever required, the bristles being formed and cured in said mold cavities when the mold assembly assume said closed position and the bristles being at least partly separated from the respective pairs of said faces when the mold assembly assume said open position.

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