APPARATUS FOR FORMING BRUSHES AND THE LIKE

FIG. 1

FIG. 7
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 arise 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of best adaptability to the cleaning tasks of the brushes, serious difficulties are encountered when the brushes are withdrawn from such mold assemblies because the slender bristles adhere to the faces of the die plates and are frequently damaged by excessive tension during withdrawal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a molding apparatus for brushes and the like which is constructed and assembled in such a way that the bristles may be withdrawn from the mold cavities without any damage thereto and regardless of whether the bristles taper from the roots to the tips thereof or are of constant thickness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 in 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 slayed 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 defined 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 configured 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;

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 with the 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 side face of each die plate is smooth and is adjacent to the mold cavities 11 of the die plate 10 next to it. 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, and so that an 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 unstrained condition (FIG. 1). In the illustrated embodiment, the die plates are assumed to have normally flat or plano ungrooved side faces 10a and tapering grooved side faces 10b. It will be noted that the gaps 12 communicate with the respective mold cavities 11 when the die plates are 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 13a mating with nuts 14. Each die plate 10 has a pair of downwardly projecting 10c which are provided with apertures 10d 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 10e (see the line 10f) and that the apertures 10d 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 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 part of no part of this invention.

The molding apparatus of FIGS. 1 and 2 further comprises a specially configured 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 10 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, motor or other mechanical actuating 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 10c 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 10d of the respective projections 10c 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 thereby eliminate the gaps 12 so that the mold cavities 11 are completely sealed from the atmosphere and communica 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 die plates define 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 falls 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 are shown in FIG. 4 each of them is compelled to move into full face-to-face abutment with each other then 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 311a are more likely to become fully separated from the adjacent side faces 310a, 310b of the respective die plates 310 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 310a and/or the face 310b. The tie bolts 313 are again applied below the line 310f at which the taper of the die plates 310 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 or may not be adjacent to their tips. The taper of the die plates 210 is assumed to terminate at the line 210f, 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 211a 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 connecting tie rods 213 is permitted to assume its normal open position in which the pairs of adjacent side faces 210a, 210b define between themselves elongated clearances or gaps 212 terminating at the line 210f, 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 211a and the mold space 215 is calculated in such a way that it exceeds the maximum width of the enlarged portion 211a. 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 211a 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. 3 and 4. The relative position 22' 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 210e. Each bristle tapers to 0.2 inch near its free end (so that, at the closed end 211b 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 211a) may be about 0.4 inch near the neck of the bristle, while the bulbous terminal may exceed 0.4 inch because, as shown in FIG. 5, the gaps 212 may extend beyond the open ends of the mold cavities 211.

Bulbous terminals are desirable to prevent excessive bending or premature breakage of the bristle tips, to stimulate the scalp if a brush is intended 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 310e and the line 310f. 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 adjacent to the mold cavities 311b normally remain spaced from each other whereby the cooperating pairs of side faces 310a, 310b define between themselves clearances or gaps 312 extending upwards to the line 310f, i.e., beyond the closed ends 311b 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 310e 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 310a, 310b 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 318a of the side wall 318 is preferably in full abutment with the side face 310a 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 about 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 310a, 310b, 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 central plate 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 410b formed with a series of elongated mold cavities 411. The side faces 410a of the die plates 410A are adjacent to side faces 410b of two die plates 410 and, in the normal closed position of the mold assembly, the side faces 410a are in full-length abutment with the adjacent side faces 410b. With the outer end of the die plate 410A in contact with 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 410e 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 is provided 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 418a 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 418b reciprocable in directions indicated by double arrows 418c. During an injection molding operation, the plungers 418b engage and disengage in a position shown to and maintain the cooperating pairs of side faces 410a, 410b 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 310b are moved away from the outermost die plate 410 so as to provide room for expansion of the mold assembly 410, 410a, 410b, 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 410a and/or 410b to become at least partially separated from the respective bristles. The spaces 418d defined by the inner surfaces 418c of the side walls 418 with the outermost die plate 410 (in retracted position of the plungers 418b) is sufficient to permit such separation of the die plates. The gaps developing between the cooperating pairs of side faces 410a, 410b upon deformation of the mold assembly 410 and its opening are minimized by the aid of 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 322a 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 differs 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 410a, 410b 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 10a, 10b 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 is 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 cavities having 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 its open position are minimized by the aid of 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 322a 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 differs 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 410a, 410b 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 10a, 10b 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 is 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 cavities having 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.
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 die plates when 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 re-assume 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 the first end portions are free to re-assume 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 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 closed ends of said mold cavities, said assembly being normally assumed 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 mold cavities when the mold assembly is permitted to re-assume 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, each 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, each 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 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.
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 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 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 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 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 elastically 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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MICHAEL V. BRINDISI, Primary Examiner.
MORRIS LIEBMAN, Examiner.