(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 224 205 A2**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: 86116117.2

(22) Date of filing: 18.11.86

(51) Int. Cl.4: B27N 1/00 , B27N 3/08

(30) Priority: 19.11.85 JP 259372/85
09.12.85 JP 276610/85
09.12.85 JP 276611/85

(43) Date of publication of application:
03.06.87 Bulletin 87/23

(84) Designated Contracting States:
DE FR GB SE

(71) Applicant: TOYOTA JIDOSHA KABUSHIKI KAISHA
1, Toyota-cho Toyota-shi
Aichi-ken 471(JP)

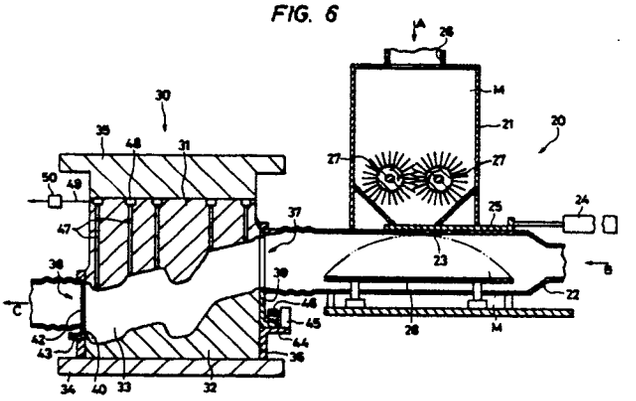
(72) Inventor: Imao, Eiichi
1-108, Umesato Midori-ku
Nagoya-shi Aichi-ken(JP)
Inventor: Ikeda, Sadao
34-3, Shiokura Hanazono-cho
Toyota-shi Aichi-ken(JP)
Inventor: Taguchi, Yoshio
2-17-22, Chitose Atsuta-ku
Nagoya-shi Aichi-ken(JP)

(74) Representative: Grams, Klaus Dieter, Dipl.-Ing. et al
Patentanwaltsbüro Tiedtke-Bühling-Kinne-Grupe-Pellmann-Grams-Struif Bavariaring 4
D-8000 München 2(DE)

(54) Method for the manufacture of a molden wooden product.

(57) A wooden product molded in a desired shape is produced by a method which comprises admixing wooden fibers resulting from digestion and disintegration of wood chips with a binding agent such as a synthetic resin, a water repellent, a mold release agent or other additive, directly supplying the consequently formed ligneous molding material to a molding die of the desired shape without being first converted into a mat, and effecting hot compression molding of the ligenous molding material in the die.

FIG. 6



EP 0 224 205 A2

METHOD FOR THE MANUFACTURE OF A MOLDED WOODEN PRODUCT

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a method for the manufacture of a molded wooden product by the hot compression molding of a ligneous molding material comprising wooden fibers and a binder in a die.

Description of the Prior Art:

The molded wooden products of the kind to which the present invention pertains are lighter than plywood, highly resistant to heat, water and moisture, and strong for their thickness and, because of these desirable qualities, have found extensive utility as so-called hardboard in applications including interior materials used in buildings, articles of furniture, interior materials in used automobiles, and cabinets for television and stereo sets.

Heretofore, molded wooden products have been generally manufactured by the following procedure.

First, wood chips are digested with steam at 160° to 180°C in a digester tank of a splitting machine to render their fibers readily disintegratable. Then, the digested wood chips are disintegrated into loose fibers by abrading with a splitting disc. The loose wooden fibers are dried in a current of hot air. The dry wooden fibers are thoroughly mixed with long fibers such as, for example, hemp fibers or polypropylene fibers for enhancement of deep-drawability, are mixed further with a binder made of phenolic resin to improve their molding property, and additionally with a water repellent such as a resin or paraffin. Subsequently, the wooden fibers resulting from the above mixing procedure (hereinafter referred to as "ligneous molding material") are formed into a stack of a prescribed thickness and subjected to moderate hot compression molding as with a roll press to form portable molding mats of approximately 10 to 40 mm in thickness.

The molding mat is cut in a size slightly larger than the size of the prospective molded wooden product which is desired to be produced. As illustrated in Fig. 1, the cut molding mat M1 is laid on a lower segment 2 of a compression molding die 1. Then, lower segment 2 and an upper segment 3 heated by hot plates 6 to a temperature in the range of 180° to 220°C are pressed toward each other by lowering the upper segment 3. As gas is evolved from mat M1, the die is opened to release the gas into the ambient atmosphere. After sufficient release of the gas, the upper and lower segments are joined again. After the preliminary compression and the release of gas performed in the manner described above are alternated and repeated several times, the upper segment 3 and the segment 2 are brought into tight mutual contact for complete closure of the die as illustrated in Fig. 2. At this time, the cavity of the die is evacuated of evolving gas by means of gas vents 5 and suction pipe 7. In Fig. 2, reference numeral 4 indicates scrap. Reference numeral 8 indicates a valve. When the die is opened, a molded wooden product M2 of a desired shape is obtained.

When the manufacture of the molded wooden product is effected by the conventional method descibed above, it necessitates the step, for preparing a molding mat, of using a ligneous molding material and a further separate step for cutting this mat in a desired shape and inevitably renders the process of manufacture complicated and deficient in operational efficiency. Further, since the mat is cut in a size slightly larger than the size of the finished product, the scrap portion cut from the mat is wasted, inevitably entailing the problem that the production yield is lowered and the cost of production is increased. When it is desired to obtain a molded wooden product having a deeply drawn portion from a single mat, it becomes necessary to use in the mat a large proportion (up to about 17%) of expensive hemp fibers in addition to the wooden fibers. Furthermore, the use of hemp fibers entails the requirement for incorporation of additional synthetic resin into the mat. In this respect also, the conventional method suffers from the problem of high production costs.

For the purpose of improving the deep-drawing property of a ligneous molding material which contains wooden fibers in a large proportion, the idea of softening the mat with steam and pre-molding the softened mat in the shape desired to be imparted to the finished product has been conceived and tried. This method, however, poses the problem that the number of operational steps is inevitably increased and the cost of equipment is proportionalately increased.

As a means of manufacturing a molded wooden product, there is also known a wet molding method which comprises mixing wooden fibers by the digestion method described above with synthetic resin and cellulose paper, dispersing the resulting mixture in water, filtering the dispersion under pressure and squeezing the filtration residue

under pressure (for so-called sheet formation), and hot compression molding the resulting sheet in a die. This method, however, necessitates installation of special devices for the pressure filtration and pressure squeezing, and inevitably entails the problem that the cost of the product is high.

SUMMARY OF THE INVENTION

It is an object of this invention is to provide a method for the manufacture of a molded wooden product, which method attains improved productivity and yield and, at the same time, permits production of molded wooden products of high quality.

Additional objects and advantages of the invention will be set forth in part in the description which follows, and in part will be apparent from the description, or may be learned by practice of the invention. The objects and advantages of the invention may be realized and attained by means of the instrumentalities and combinations particularly pointed out in the appended claims.

To achieve the objects and in accordance with the purpose of the invention as embodied and broadly described herein, the method of the present invention is characterized by directly feeding into the cavity of a molding die a ligneous molding material comprising wooden fibers, a binding agent and other optional components, and hot compression molding the material in the die.

The wooden fibers to be used in the present invention are obtained by disintegrating wood chips, for example. This invention does not particularly limit the wooden fibers according to the kind of wood to be used or by the method of disintegration thereof. Examples of wood suitable as the source of the wood chips include Japanese cypress (Chamaecyparis obtusa), Japanese red pine (Pinus densiflora), Japan cedar (Cryptomeria Japonica), lauan (genera Parashorea), and beech (Fagus crenatal). As means of disintegration, a method which comprises digesting wood chips and then disintegrating the digested wood chips mechanically is suitable.

The binding agent to be incorporated among the wooden fibers is only required to be capable of supplementing the molding or bonding property of wooden fibers themselves. For example, a thermoplastic resin such as a coumarone resin or a thermosetting resin such as a phenolic resin or a urea resin can be used as the binding agent. In addition to the binding agent, the ligneous molding material can have incorporated therein a water repellentt for improvement of waterproofness, or a mold release agent.

The method of this invention is characterized by directly supplying a ligneous molding material incorporating therein a binding agent as described above into the cavity of a molding die without previously molding the ligneous molding material into a preparatory shape such as the shape of a mat. This method need only be capable of supplying the ligneous molding material incorporating the binding agent therein directly into the cavity of the die. This material supply can be effected, for example, by causing the ligneous molding material to be carried on a current of air into the cavity of the molding die or allowing the ligneous molding material to fall spontaneously by gravity into the cavity. The timing of an addition such as of a binding agent to the wooden fibers is not specifically critical. This addition may be effected with a mixing machine installed at a position separated from the molding die. On the other hand, the addition can be made near the molding die just before the wooden fibers reach the molding die. Particularly when the addition is made immediately before the arrival of the wooden fibers at the molding die, the possibility of the wooden fibers being partially solidified is eliminated and the ligneous molding material can be placed uniformly into the cavity of the die.

In accordance with the method of this invention, the ligneous molding material is simultaneously bound integrally and molded by hot compressing. The molding conditions may be suitably selected depending on the kinds of raw materials such as the wooden fibers and the binding agent used, the shape of the product being molded, and the strength requirements of the molded product. Generally the molding temperature is in the range of 100° to 200°C, the molding pressure is in the range of 20 to 80 kg/cm², and the molding time is in the range of 20 seconds to 10 minutes.

It is permissible for the ligneous molding material incorporating the binding agent and other additives to be preheated and then subjected to the hot compression treatment. This preheating step is advantageous because the molding cycle can be shortened without it being necessary to elevate the molding temperature. As a means of preheating the wooden fibers, a method which effects the preheating by placing the wooden fibers in a container kept hot with a heater, a method which resorts to forced introduction of a current of hot air or steam into the wooden fibers, and a method which relies on the exposure of the wooden fibers to microwave or infrared rays can be used. This preheating treatment can be effected before the wooden fibers are supplied to the molding die or can be carried out within the molding die after the wooden fibers have been supplied into it. In the alternative, the wooden fibers can be simultaneously preheated and sup-

plied to the molding die by forcibly forwarding the wooden fibers into the molding die with the gas which has been used in heating the wooden fibers. The preheating temperature is desirably not higher than the molding temperature and falls in the range of 50° to 150°C. Since the preheating treatment raises the possibility of causing the wooden fibers to be bound with the binding agent, the preheated ligneous molding material is preferably immediately subjected to the compression molding.

Since this invention contemplates a method which comprises compounding a ligneous molding material by directly feeding the molding material into a molding die, and subjecting it to hot compression molding as described above, this method neither requires nor contemplates a step of converting the ligneous molding material into a mat or a step of cutting the mat in a prescribed shape and, therefore, attains simplication of the production process and an improved yield.

Optionally, the ligneous molding material of this invention can achieve an improved compression molding property by forming an increased wall thickness of the portion of the aggregrate of components intended for deep-drawing, or likewise by giving the aggregate of components a shape suitable for deep-drawing. From the ligneous molding materials having this improved compression molding property, molded wooden products free from such flaws as large cavities and cracks and of excellent quality can be obtained.

By the above-described improvement of the compression molding property, the amount of binding agent added to the wooden fibers can be decreased, the necessity of incorporation of expensive hemp fibers can be reduced or obviated, and the cost of production can be notably lowered.

The accompanying drawings which are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and, together with the description, serve to explain the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 and Fig. 2 are cross-sectional views of a molding die used in the production of a molded wooden product by a conventional method.

Fig. 3 is a process diagram of an operation for the production of a molden wooden product.

Fig. 4 is a perspective view of a splitting machine indicated in Fig. 3.

Fig. 5 is a perspective view of a mixing machine indicated in Fig. 3.

Fig. 6 is a cross-sectional view of an apparatus for the production of a ligneous molding material in accordance the present invention.

Fig. 7 is a front view of an opening or door used in a molding die which is part of the production apparatus illustrated in Fig. 6.

Fig. 8 is a cross-sectional view illustrating in the closed state, the molding die as part of the production apparatus illustrated in Fig. 6.

Fig. 9 and Fig. 10 are cross-sectiional views of modified versions of the production apparatus shown in Fig. 6.

DETAILED DESCRIPTION OF THE INVENTION

An embodiment of the present invention will now be described with reference to the accompanying drawings.

The process through which the ligneous molding material is prepared will first be described with reference to Fig. 3 through Fig. 5.

As illustrated in Fig. 3, a storage tank 11 is provided for keeping wood chips W1 in storage. Wood chips W1 released from the storage tank 11 are washed in a chip washing machine 12 and then fowarded to a splitting machine 13, wherein they are digested with steam and disintegrated into loose fibers. At this time, a water repellent is supplied by a pump 14 to splitting machine 13. The wooden fibers W2 are then conveyed to a hot-air tube 15a of a drying machine 15, and carried on a current of hot air emanating from a blower or drier 15b to a cyclone 15c, whereby they are dried. The dried wooden fibers W2 are then conveyed to a hopper 16a of a mixing machine 16 and then forwarded the main body 16b of mixing machine 16, wherein they are mixed with a binding agent, a mold release agent or other additive. The ligneous molding material consequently obtained is forwarded to the next step.

The above-described splitting machine 13 is provided, as illustrated in Fig. 4, with a hopper 13a for temporary storage of the wood chips W1 forwarded from chip washing machine 12 shown in Fig. 3, a first screw feeder 13b disposed beneath hopper 13a and adapted to forward or feed wood chips W1 in a metered quantity, a digester tank 13c for digesting the wood chips W1 supplied from first screw feeder 13b, a second screw feeder 13d disposed below digester tank 13c and adapted to forward digested wood chips W1 in a metered quantity, and a splitting disc 13e for mechanically disintegrating wood chips W1 supplied from second screw feeder 13d.

Digester tank 13c is adapted to receive steam S supplied to the top of the tank from a source not shown. Wood chips W1 placed in digester tank 13c are stirred by a stirring rod 13f and, at the same time, treated with the steam S to provide them in a disintegratable state. The digested wood chips W1

are conveyed by the second screw feeder 13d to the splitting disc 13e, are mechanically abraded and split, and thereafter conveyed via a pneumatic tube 13g to drying machine 15 (Fig. 1).

The main body 16b of mixing machine 16, as illustrated in Fig. 5, comprises agitation or stirring blades 16d rotatably mounted in a tubular casing 16c. Casing 16c is further provided adjacent one end thereof with an inlet 16d for admitting wooden fibers W2 through hopper 16a (Fig. 3) and a spray nozzle 16e used for the supply of a binding agent such as a phenolic resin and a water repellent such as paraffin and is further provided adjacent the other end thereof with an outlet 16f for discharge of the resultant mixture (ligneous molding material).

In the apparatus described above, wooden fibers W2 which have been admitted through inlet 16d into one end portion of casing 16c are brought together with the binding agent, water repellent, or other additive fed through spray nozzle 16e, thoroughly mixed by agitation blades 16d rotated by drive means not shown, transferred sequentially toward outlet 16f, and discharged therethrough.

The process through which a molded wooden product is produced from the above-described ligneous molding material will now be described with reference to Fig. 6 through Fig. 8.

In Fig. 6 through Fig. 8, reference numeral 20 indicates a packing device which comprises a vertical feeding container 21 and a horizontal pneumatic container 22. Feeding container 21 and pneumatic container 22 communicate with each other through an opening 23 which is opened and closed with a shielding plate 25 driven by cylinder 24. Feeding container 21 is provided at the upper end thereof with a feeding port or inlet 26 for admitting the ligneous molding material M and is provided in the interior thereof with pair of rotary brushes 27 disposed above opening 23. Pneumatic container 22 has one end thereof connected to a blower, not shown, and the other end thereof connected to a molding die 30 which will be fully described hereinafter. Pneumatic container 22 further incorporates in the portion situated below opening 23 a weighing plate 28 connected to a load cell, not shown.

Molding die 30 comprises an upper segment 31 and a lower segment 32. The die is formed to be inclined by an angle large enough to permit compression of a deeply drawn part and avoid decreasing the draft angle. Upper segment 31 and lower segment 32 define a fixed space when the die is opened and they are fixed respectively to hot plates 34 and 35. A framework 36 is disposed to enclose space 33 which is defined by the upper and lower segments 31 and 32 of the die. Framework 36 is provided with a first opening 37 communicating with the above-described pneumatic container 22 and a second opening 38 communicating on the other side of the framework with the ambient atmosphere. Openings 37 and 38 have suitable lengths and upper and lower widths corresponding to those of the space in molding die 30.

Framework 36 is also provided with closures or doors 39 and 40 disposed to be laterally slidable so as to open and close openings 37 and 38. As seen in Fig. 7 which illustrates a representative door 40, doors 39 and 40 are each provided on one side thereof with an opening or window 41 substantially equal in size to the openings 37 and 38. In particular, door 40 associated with second opening 38 is provided in window 41 thereof with a metallic gauze 42 shown in Fig. 6. Doors 39 and 40 are each provided on the lower end thereof with a rack 43. Motor 45 is secured to a bracket 44 projecting from framework 36. Pinion 46 adapted to be meshed with rack 43 is attached to the output shaft of motor 45. Doors 39 and 40, therefore, are caused to slide laterally by the motion imparted by motor 45 and allowed to suitably select the position at which windows 41 are opposed to openings 37 and 38 and the position at which the openings are closed.

Upper segment 31 is provided with a gas vent 47, a port 48, a pipe 49 communicating with vacuumizing means, not shown, and a valve 50 inserted in pipe 49.

Owing to the arrangement described above, ligneous molding material M which has been injected through feeding inlet 26 into feeding container 21 as indicated by the arrow A in Fig. 6 is abraded by rotary brushes 27 to have its fibers disintegrated and, at the same time, allowed to fall down through opening 23 and accumulate on weighing plate 28 within pneumatic container 22. As the fibers accumulate to a fixed total amount, cylinder 24 is actuated to close opening 23 with plate 25. At this moment a blower, not shown, begins to blow air in the direction of the arrow B, so that the ligneous molding material M on weighing plate 28 will be carried forward into space 33 of die 30 by the air current.

Ligneous molding material M thus delivered into die 30 is prevented by metallic gauze 42 from containing its advance and caused to accumulate in space 33. In the meantime, the air passes through metallic gauze 42 and escapes into the ambient atmosphere. When space 33 is filled to capacity with ligneous molding material M, motor 46 is energized, causing doors 39 and 40 to slide and close first and second openings 37 and 38.

Upper segment 31 and lower segment 32 are kpet heated to a prescribed temperature (in the range of 180° to 220°C) by hot plates 34 and 35. When die 30 is filled with ligneous molding material M, upper segment 31 is lowered. As a result,

ligneous molding material M is compressed between upper segment 31 and lower segment 32 and is gradually densified with intertwining of the wooden fibers. Eventually, a molded wooden product of a prescribed shape is obtained as illustrated in Fig. 8.

During this time, valve 50 is opened and gas which is developed is drawn out through gas vent 47. Removal of the gas is continued while the die is being opened. As the die is opened, the molded wooden product is lifted by remaining attached to upper segment 31. Thereafter, this molden wooden product can be easily removed from the die by discontinuing the vacuum drawn on the internal gas.

Even when the molded wooden product possesses a deeply drawn portion P1 (Fig. 8), it does not sustain any flaw such as a crack or loss of wall thickness but enjoys highly satisfactory quality. When the molded wooden product is obtained in a wall thickness of 2.5 mm, for example, it exhibits a bending strength in the range of 200 to 350 kg/cm^2. Thus, the molden wooden products obtained by this invention have very high economic utility.

Since the present embodiment of this invention has the die formed as inclined, the degree of compression and the angle of draft of the deeply drawn part are so large that the molded wooden product can be produced without sustaining any tear or crack in the deeply drawn part and can be easily released from the die.

In the present embodiment, the binding agent and other components are added to the wooden fibers inside the mixing machine. Since the wooden fibers are apt to undergo partial solidification in the presence of the binding agent, it is preferred to supply the resulting mixture to the die interior as soon as possible.

Fig. 9 depicts a modified version of a packing device which fulfils the requirements of the invention. In Fig. 9, parts which are the same as shown in Fig. 6 are denoted by the same reference numerals, and explanation of these parts is not repeated. This embodiment is characterized by providing agitation or stirring blades 51 rotatably disposed inside feeding container 21 and further providing feeding container 21 in the upper part thereof with feeding inlets 52 for admitting wooden fibers W2 (Fig. 3) and feeding inlet 53 for admitting the binding agent and other components.

Owing to the use of packing device 20 adapted as described above, the dry wooden fibers W2 injected through feeding inlets 52 and the binding agent, water repellent, and other components injected through feeding inlet 53 are mixed inside feeding container 21. The ligneous molding material M consequently prepared is supplied to weighing plate 28 inside pneumatic container 22. When ligneous molding material M is immediately supplied to molding die 30 (Fig. 6) such as carried on the air current, since not much time has elapsed after the addition of the binding agent and other components, no time is allowed for the wooden fibers to undergo partial solidification. Thus, the ligneous molding material can be supplied to the interior of the die with uniform packing density and the molded wooden product consequently obtained enjoys improved compression molding properties.

The preceding embodiment has been described as effecting the heating of the ligneous molding material M exclusively by means of hot plates 34 and 35 of molding die 30. A device adapted to preheat the ligneous molding material M is effective in shortening the molding cycle.

Fig. 10 depicts a modification of the packing device which meets this requirement. In Fig. 10, parts which are the same as shown in Fig. 6 are denoted by the same reference numerals, and explanation of these parts is not repeated. This embodiment is characterized by enclosing feeding container 21 within an insulating container 61 and interposing a heater 62 between insulating container 61 and feeding container 21. Owing to this arrangement, since the ligneous molding material M can be injected into feeding container 21 the entirety of which is kept heated to a prescribed temperature by heater 62, it also can be heated automatically to the prescribed temperature, with the result that the regular heating performed inside molding die 30 (Fig. 6) will be completed within a shortened span of time and the time for the molding cycle proportionately shortened.

It will be apparent to those skilled in the art that various modifications and variations can be made in the method of the present invention for the manufacture of a molden wooden product without departing from the scope or spirit of the invention. Thus, it is intended that the present invention cover with modifications and variations thereof provided they come within the scope of the appended claims and their equivalents.

Claims

1. A method for the manufacture of a molden wooden product which comprises directly supplying to a molding die a mixture of wooden fibers with a binding agent, and peforming hot compressing molding of said mixture in said molding die.

2. The method according to claim 1 wherein the binding agent is a synthetic resin.

3. The method according to claim 2 wherein the synthetic resin is a coumarone resin, a phenolic resin or a urea resin.

4. The method according to claim 1 wherein the mixture contains a water repellent or a mold release agent.

5. The method according to claim 1 wherein the molding is carried out at a temperature of 100° to 220°C and at a pressure of 20 to 80 kg/cm² for from 20 seconds to 10 minutes.

6. The method according to claim 1 wherein said mixture is supplied to said molding die immediately after forming the mixture of said binding agent and said wooden fibers.

7. The method according to claim 6 wherein the binding agent is a synthetic resin.

8. The method according to claim 7 wherein the synthetic resin is a coumarone resin, a phenolic resin or a urea resin.

9. The method according to claim 6 wherein the mixture contains a water repellent or a mold release agent.

10. The method according to claim 6 wherein the molding is carried out at a temperature of 100° to 200°C and at a pressure of 20 to 80 kg/cm² for from 20 seconds to 10 minutes.

11. The method according to claim 1 wherein said mixture is supplied to said molding die is effected after said mixture incorporating therein said binding agent is preheated.

12. The method according to claim 11 wherein the binding agent is a synthetic resin.

13. The method according to claim 12 wherein the synthetic resin is a coumarone resin, a phenolic resin or a urea resin.

14. The method according to claim 11 wherein the mixture contains a water repellent or a mold release agent.

15. The method according to claim 11 wherein the molding is carried out at a temperature of 100° to 200°C at a pressure of 20 to 80 kg/cm² for from 20 seconds to 10 minutes.

16. The method according to claim 11 wherein said mixture is preheated to a temperature not higher than the temperature of said hot compression molding.

17. The method according to claim 16 wherein said mixture is preehated to a temperature of from 50° to 150°C.

FIG. 1

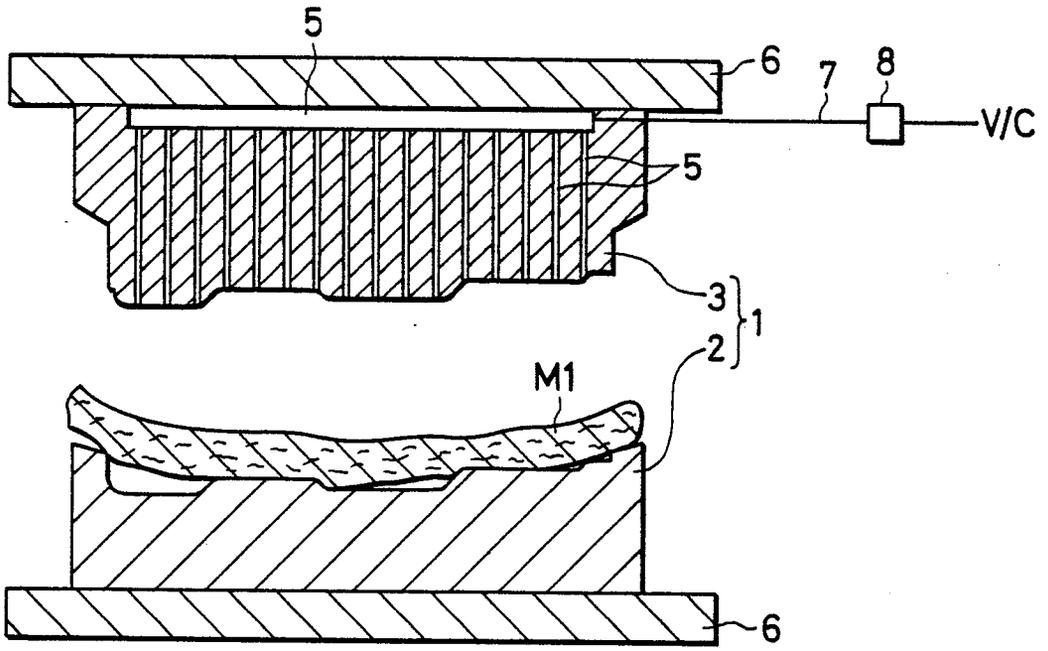


FIG. 2

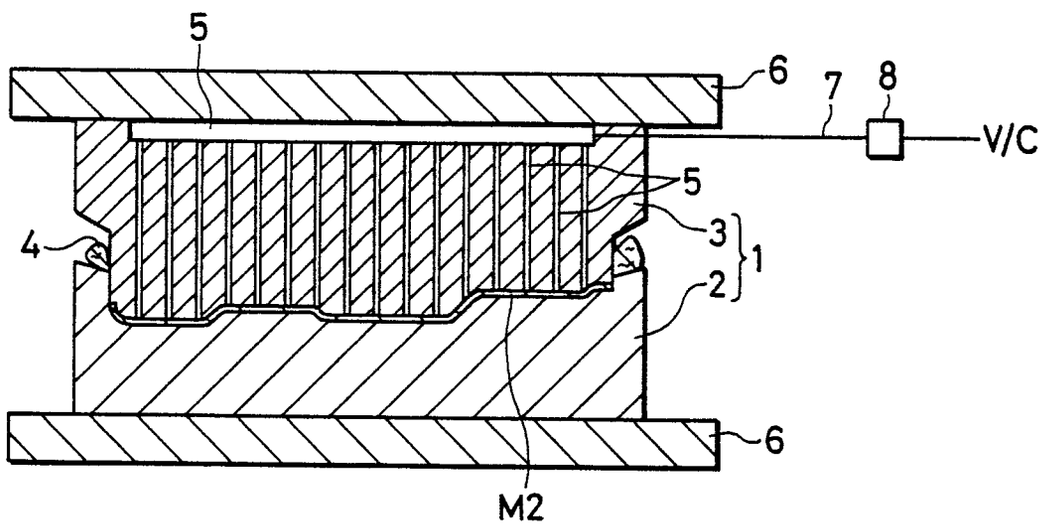


FIG. 3

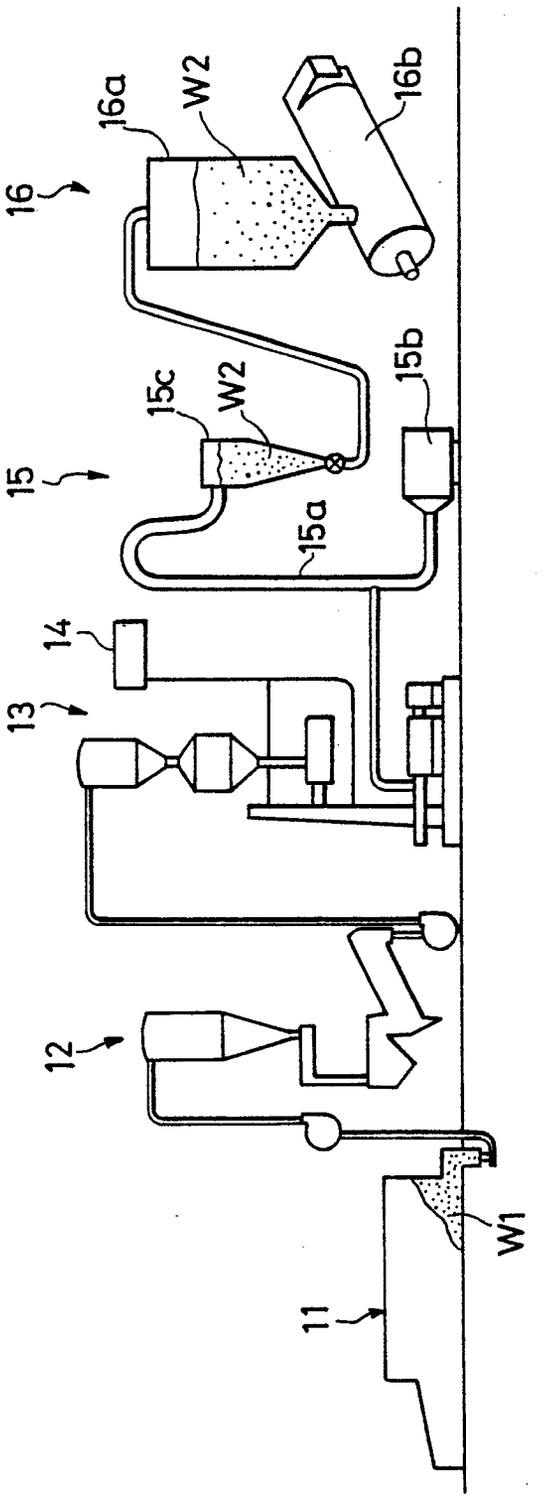


FIG. 4

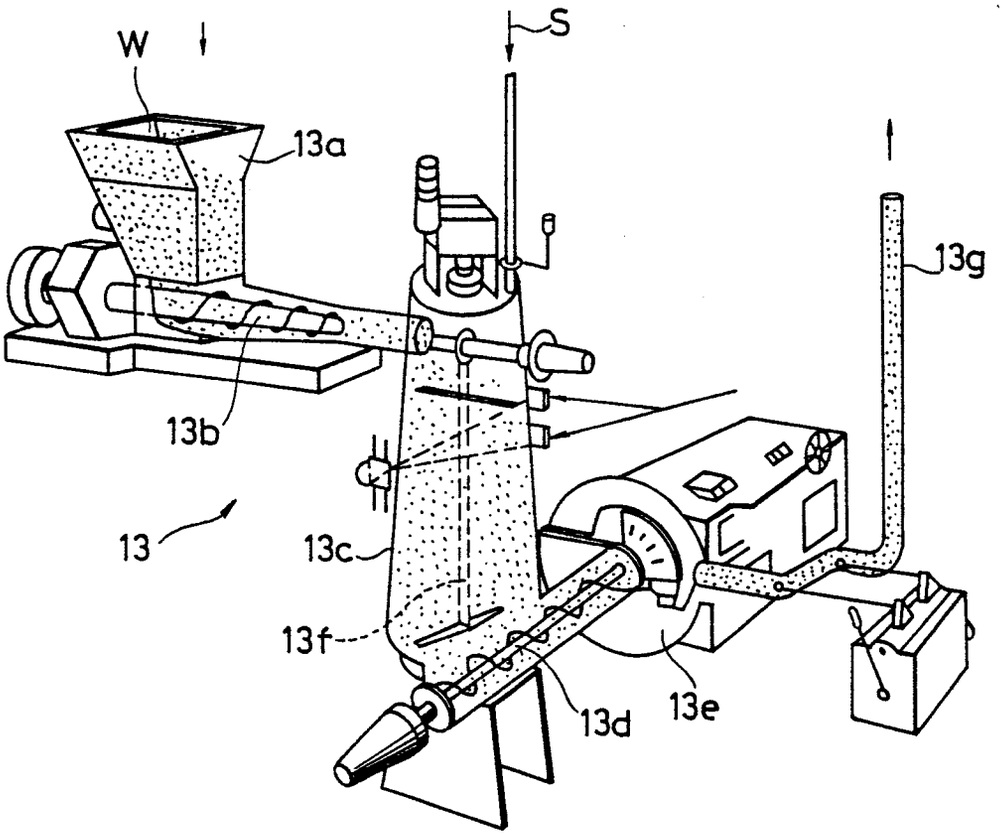


FIG. 5

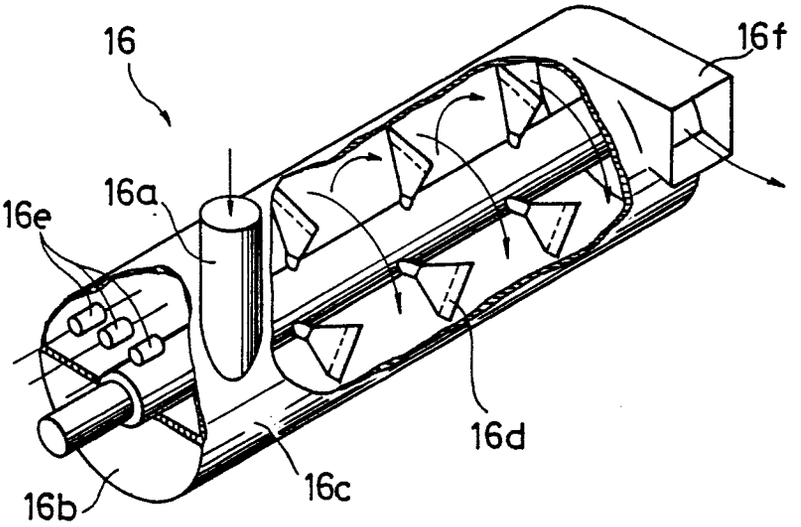


FIG. 6

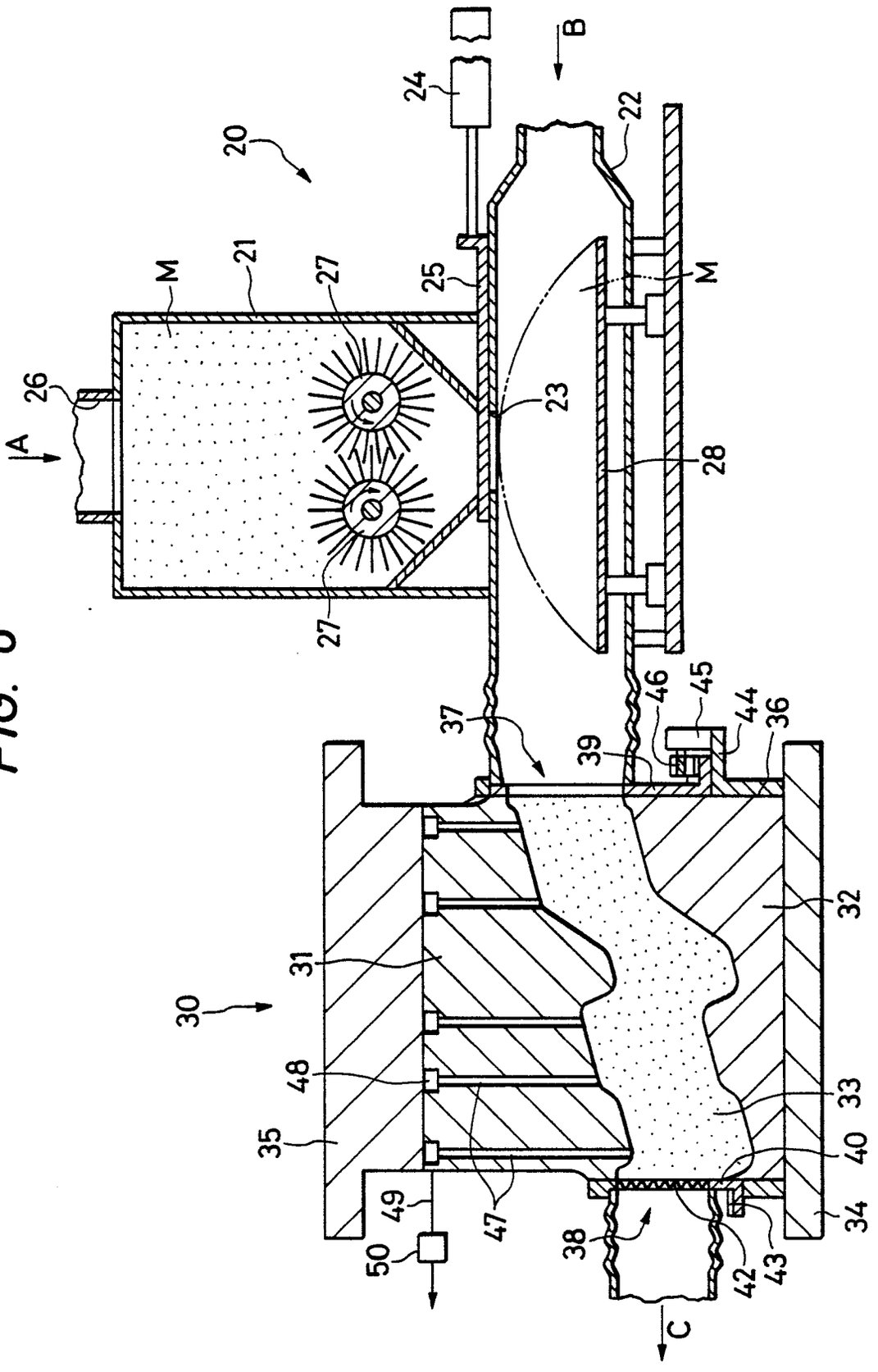

20
21
22
23
24
25
26
27
28
30
31
32
33
34
35
36
37
38
39
40
42
43
44
45
46
47
48
49
50
A
B
C
M

FIG. 7

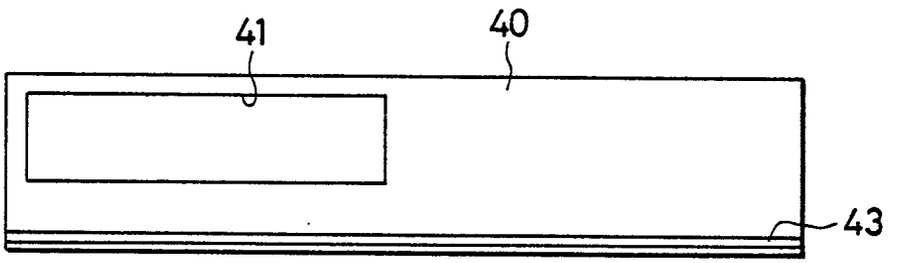


FIG. 8

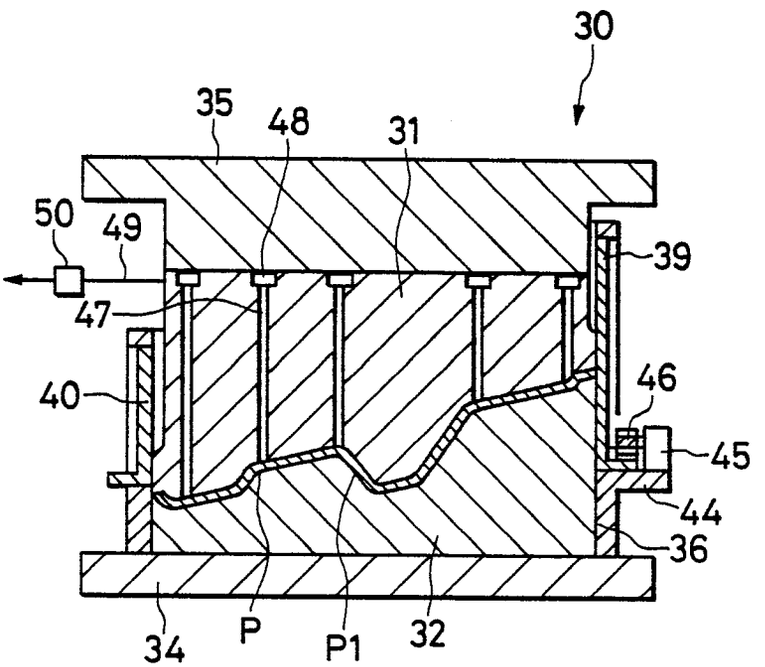


FIG. 9

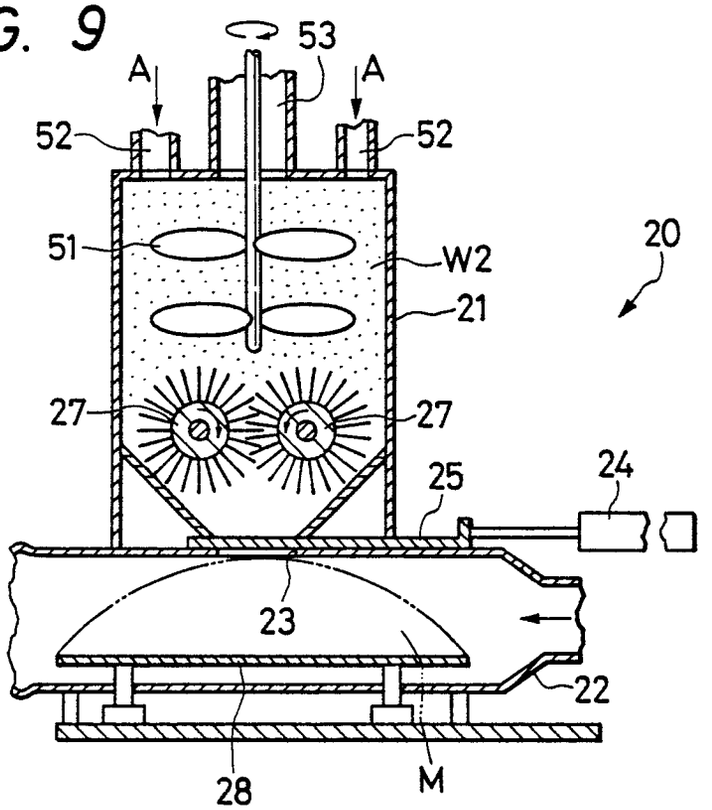
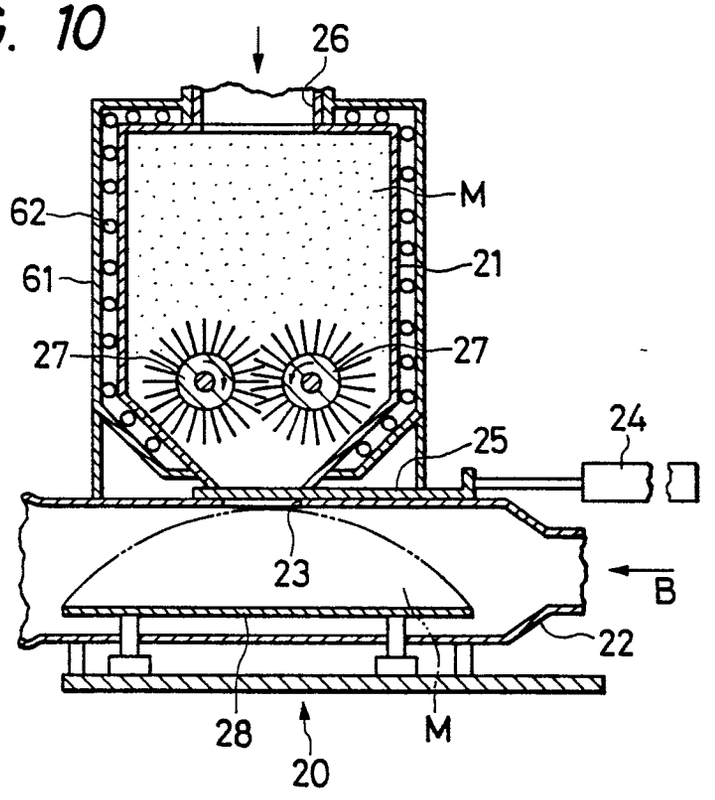

53
A
A
52
52
51
W2
20
21
27
27
25
24
23
22
28
M

FIG. 10


26
M
62
21
61
27
27
25
24
23
B
22
28
M
20