

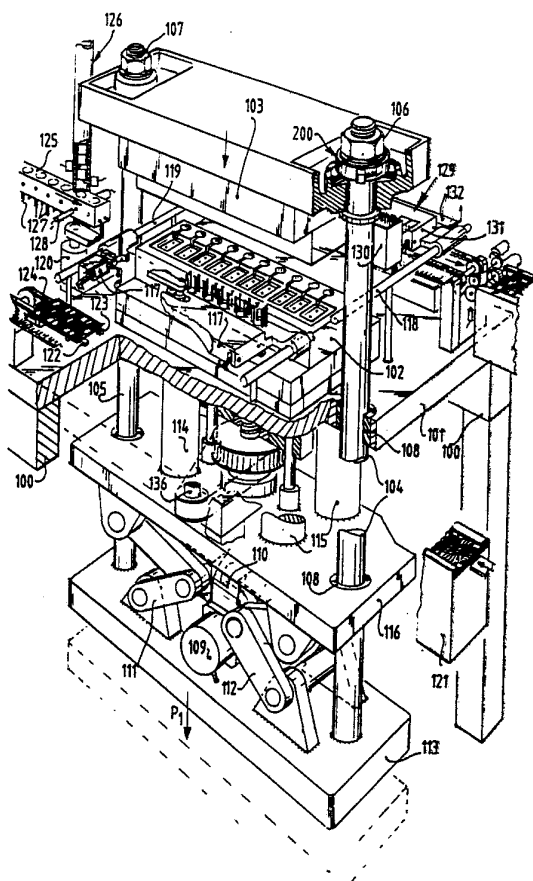


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(54) Title: SINGLE-STRIP MOULDING APPARATUS**(57) Abstract**

Electronic components, chips, are moulded in a single-strip moulding apparatus. The products to be moulded are placed in a mould consisting of two halves, one of the halves whereof displays recesses for receiving a component, which half is connected via a channel with a cavity for receiving a quantity of moulding material. After use the mould must be cleaned and the moulded product carried away. This is carried out by a cleaning-discharge unit combined into a unit.



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SINGLE-STRIP MOULDING APPARATUS

For the moulding of electronic components, chips, moulding apparatus are used wherein a so-called leadframe is placed into a mould wherein the mould displays recesses for receiving the parts for moulding, and in addition cavities are arranged in the mould wherein measured quantities of moulding material are placed and wherein by supplying heat and exerting pressure in these cavities the moulding material becomes liquid, moves via channels intended for that purpose to the parts for moulding and, curing there, encapsulates the leadframe. The leadframe is subsequently removed from the moulding apparatus and subjected to further processing.

The object of the invention is to provide a single-strip moulding apparatus which combines a simple construction with a relatively high production rate.

This is achieved according to the invention by providing a single-strip moulding apparatus comprising a mould die formed by two mould halves movable relative to one another and closable onto one another, means for placing a leadframe into one of the mould halves, means for carrying moulding material into cavities of the mould, means for exerting pressure in these cavities, means for heating the mould halves, means for cleaning the mould halves and means for removing a moulded product from the mould, wherein the means for cleaning and removing the formed product are unified into a cleaning-discharge unit.

By combining different processes such as cleaning, which has to take place after each moulding cycle, with the removal of the moulded product an optimal production rate is achieved.

According to a preferred embodiment the cleaning-discharge unit performs a reciprocating movement and during

the outward movement the one mould half is cleaned and during the return movement the moulded product is removed and the other mould half cleaned in one operating stroke.

5 An optimal production rate is achieved by setting into operation the means for placing a subsequent leadframe in a mould immediately following the return movement of the cleaning-discharge unit.

10 The means for exerting pressure preferably consist of at least one plunger which is driven by means of an electromotor, a screwed rod and a nut arranged on a screwed rod. Driving has taken place to date in the usual manner with hydraulic means, which however entails various drawbacks. Hydraulic driving requires cooling and is not otherwise well compatible with the clean surroundings in which the process must take place. There has further been the drawback that 15 there was no direct proportional relation between the exerted hydraulic pressure and/or the controlled volume flow of the hydraulic oil and the displacement speed of the plunger. The pressure-raising process was difficult to control. Using 20 the electromechanical driving a direct relation is achieved between the action of the electromotor and the displacement speed of the plunger and/or the force to be exerted by the plunger on the moulding material by converting the rotation movement of the electromotor into a linear movement of the plunger rod using the nut and the screwed rod. An electromotor 25 moreover does not pollute the surrounding area which befits the cleanliness required of the area wherein the process takes place. In addition the energy consumption of a hydraulic plunger drive is much greater than that of an 30 electromechanical plunger drive. With hydraulic plunger driving cooling is therefore needed for the oil heated by friction losses. The noise level of an electromechanical driving is also considerably lower.

35 The mould halves are also preferably closed relative to one another by an angle lever system connected to one of the mould halves and driven by an electromotor and a screwed rod. The required closing force to be exerted on the mould

halves is transmitted in a suitable manner by the angle lever system since this exerts great force especially at the end of the stroke.

As first alternative embodiment the mould halves can
5 be moved relative to one another using a control mechanism consisting of a pneumatic cylinder which effects the largest part of the stroke and a piston-cylinder unit having multiple pistons placed on the piston rod for providing by pneumatic means the final necessary closing force.

10 As second alternative embodiment the mould halves can be moved relative to one another using a control mechanism consisting of at least one pneumatic cylinder which effects the largest part of the stroke and a closed piston-diaphragm cylinder unit filled with liquid for converting
15 pneumatic pressure into hydraulic pressure for providing the final necessary closing force.

With the apparatus according to the invention the mould halves are disposed horizontally, the mould halves perform a vertical movement relative to one another, the
20 lower mould half is fixedly disposed, the upper half is movable and the means for cleaning, for placing the leadframe in the mould half and for removing product out of the mould perform a horizontal movement and the means unified into a cleaning-discharge unit for cleaning and removal of the product
25 from the one side and the means for placing the leadframe from the other side perform a reciprocating movement extending into the mould die. This provides the advantage that during the discharge movement of the finished product to the one side following on therefrom the input means can
30 place a subsequent leadframe in the mould die.

The means for placing a leadframe are formed by a first carriage movable over guide rails while the cleaning-discharge unit is placed on a second carriage which is movable over the same guide rails.

35 The plunger increasing the pressure in a cavity is preferably under bias. It is hereby possible to raise the pressure to the required level despite the fact that the

same quantity of moulding material will not always be present in the relevant cavity. The position of the plunger is therefore adapted by the bias to the volume of moulding material in the relevant cavity. As alternative method a
5 channel is arranged in one of the two mould halves which mutually connects the cavities into which the measured quantities of moulding material are fed, with the object of equalising mutual volume-differences in these fed quantities of moulding material.

10 The invention will be further elucidated with reference to the drawings.

In the drawings:

figures 1-3 show schematically one complete cycle of the moulding apparatus according to the invention;

15 figure 4 shows a perspective view of the moulding apparatus according to the invention;

figure 5 shows on a larger scale a detail of the lowermost part of the moulding apparatus according to figure 4;

20 figure 6 shows a sectional view of the mould of the moulding apparatus from figures 4 and 5;

figure 7 shows a first alternative embodiment of the closing mechanism of the mould of the moulding apparatus according to the invention; and

25 figure 8 shows a second alternative embodiment of the closing mechanism of the mould of the moulding apparatus according to the invention.

In figure 1 the mould, which consists of a fixedly positioned lower half and a vertically movable upper half,
30 is open. It is assumed that the moulding has been completed during the previous cycle and that the moulded product 3 is still in the mould, that is, in the lower half 1. The cleaning-discharge unit 4 consists of a discharge carriage 5 and a brushing device 6 with brushes at the top 7 and brushes at
35 the bottom 8. After opening of the mould (figure 1) the cleaning-discharge carriage 4 performs a movement to the left and thereby cleans the upper half of the mould (figure

2). The input carriage 9 likewise moves to the left to pick up a subsequent leadframe 10 from a store (not drawn) by means of a feed belt 16.

According to figure 2 the cleaning-discharge unit 4 then performs the return stroke wherein the discharge carriage 5 picks up the finished moulded frame 3 using schematically designated hook-shaped means 11, 12 and cleans the lower half of the mould.

Following on from the active stroke shown in figure 2 the input carriage 9 places the next leadframe into the mould. During the position in figure 1 the input carriage is thereby filled in cavities arranged for this purpose from a so-called pellet carriage 13 with pellet-shaped portions of moulding material which in the position as in figure 3 are placed into the cavities 14 intended for this purpose in the lower half 1 of the mould. The upper half 2 of the mould subsequently moves in the downward direction indicated with an arrow and closes (not drawn) onto the lower mould half, whereupon the moulding process begins. In the position drawn in figure 3 remnants of the moulding pellets are removed from the leadframe 3 with schematically designated means 15, after which the leadframe is discharged via a belt 17.

A further more detailed description will now be given with reference to figures 4 and 5.

Mounted on the frame 100 of the machine is a fixedly positioned table 101. The table 101 bears a fixed lower mould half 102. The upper mould half 103 is movable relative to the lower half 102 using pull rods 104, 105 which are connected to the upper half 103 by the respective nut connections, 106, 107. The pull rods 104, 105 are movable relative to the fixed table 101 via bearings, for example 108.

The driving of the upper half of the mould 103 takes place from an electromotor 109. Driven by means of the worm box 110 are the angle lever systems 111, 112. The angle lever systems are coupled on the one side to a movable underplate 113 and on the other side to a plate 116 fixedly

connected to the table 101 by means of columns 114, 115. When the electromotor rotates the underplate 113 is moved vertically, for example in the direction of the arrow P1, which movement is transmitted via the pull rods 104, 105 onto the upper mould half 103. At the end of the stroke the arms of the angle lever system 111, 112 lie practically in one line so that a very great closing force is achieved.

The input carriage 117 is movable over the guide rails 118, 119. The driving of the input carriage 117 takes place from the electromotor 120.

Leadframes are supplied from a supply cassette and are carried up over the belts 122, 123 as far as a stop 124. During the position of the input carriage outside the mould the input carriage is filled from a so-called pellet-filling carriage 125 with pellet-shaped moulding material which is taken from a supply reservoir 126. For a reliable take-over of pellet-shaped moulding material by the input carriage 117 from the pellet transporting carriage 125 use is made in both carriages of pin-shaped guiding means 127. The mutual movements are controlled using a sensor 128.

The cleaning-discharge unit 129 is likewise movable over the rails 118, 119 between the position outside the mould die and the position inside the mould die. The unit 129 consists of a cleaning-brushing device 130 and a discharge member 131. The cleaning device 130 brushes both mould halves after use and simultaneously sucks up brushed-off remnants. Co-acting with the unit is a break-off plate 132 which subjects the finished product to an after-processing.

As can be seen in figure 5, the cavities 133 in the lower half 102 of the mould are each provided with a plunger 134 which (see also figure 6) is biased by a spring washer 135 such that the position of the plunger is adapted to the quantity of moulding material in the relevant cavities 133. The plungers are driven from an electromotor which drives a screwed rod 137 via the speed control 136. A nut 138 is placed on the screwed rod so that the rotating movement is

converted into a vertically directed movement of the frame 139. Fixedly coupled to the frame are the drive rods 140, 141 for the plunger bracket 142 which in turn drives the plungers. As can be seen from the section VI-VI in figure 5 shown on a larger scale in figure 6, the pellet-shaped moulding material 143 is compressed during the ascending movement and transported via the channel 144 to the cavity 145 in the lower half of the mould where the chip 146 is arranged. As can be further seen in figure 6 a heating coil 147 is arranged for heating the lower half of the mould. The lower half of the mould is insulated by means of insulating material 148. Also visible in figure 6 is the protective cover 149.

In order to improve removal of the finished product a push-out pin 150 under bias of a spring 151 is arranged near the cavity 145.

The embodiment according to figure 7 shows another embodiment for displacement of the upper half of the mould and the generating of the required great closing force.

Pneumatic cylinders 152 and 153 displace the upper half of the mould via the movable underplate 113, as in the case of the first discussed embodiment. At the end of the stroke the slide 153 is pushed under the piston rod 154 so that a closed piston-plunger 155 is created. Via the channel compressed air is subsequently admitted from a source 156 (not drawn) which is distributed via the sub-channels, for example 157, over pistons, for example 158, arranged on the piston rod 154. As a result of the large suction surface obtained by the combination of the pistons 158 arranged parallel on the rod 154 a very great closing force is achieved with a small stroke. This is transmitted to the plate 113 and therefore to the upper half of the mould 103. It is further noted that the closing of the slide takes place by means of the plunger 160.

Figure 8 shows an alternative embodiment of the closing mechanism of the mould of the moulding apparatus according to the invention.

A discussion of those parts which correspond with the embodiment according to figure 7 is omitted.

5 The closing force of the mould halves is provided in this case by a piston-diaphragm cylinder unit filled with liquid. The plunger 161 is moved by the pressure of the liquid exerted on the piston 162, which is derived from the control cylinder 163. This is in contact with the cylinder space of the plunger 161 via the line 156.

Preferably a device 200 for measuring the closing force of one of the halves of the moulds is with respect to the other mould half is provided in the linkage for transferring the force from the electromotor to the movable mould half. Upon receiving a predetermined value of the closing force, a control signal is generated that is applied to stop the driving electromotor.

CLAIMS

1. Single-strip moulding apparatus comprising a mould formed by two mould halves movable relative to one another and closable onto one another, means for placing a leadframe into one of the mould halves, means for carrying
5 moulding material into cavities of the mould, means for exerting pressure in these cavities, means for heating the mould halves, means for cleaning the mould halves and means for removing a moulded product from the mould, wherein the means for cleaning and for removing the formed product are
10 unified into a cleaning-discharge unit.

2. Apparatus as claimed in claim 1, **characterized in that** the cleaning-discharge unit performs a reciprocating movement and during the backward movement the one mould half is cleaned and in the forward movement the moulded product
15 is removed and the other mould half is cleaned in one operating stroke.

3. Apparatus as claimed in claim 1, **characterized in that** the cleaning-discharge unit performs a reciprocating movement and transports the moulded product and cleans both
20 mould halves during the return movement.

4. Apparatus as claimed in claims 1-3, **characterized in that** immediately following the return movement of the unit the means for placing a leadframe into the mould become
operative.

25 5. Apparatus as claimed in claims 1-4, **characterized in that** the means for exerting pressure consist of a plunger which is driven by means of an electromotor, a screwed rod and a nut arranged on the screwed rod.

30 6. Apparatus as claimed in claim 1, **characterized in that** the mould halves are closed relative to one another by an angle lever system connected to one of the mould halves and driven by an electromotor over a screwed rod.

7. Apparatus as claimed in claim 1, **characterized in**

that the mould halves are moved relative to one another using a control mechanism consisting of at least one pneumatic cylinder and a closed piston-diaphragm cylinder unit filled with liquid for providing the closing force.

5 8. Apparatus as claimed in claims 1-7, **characterized**
in that the mould halves are disposed horizontally, the
mould halves perform a vertical movement relative to one
another, the lower mould half is fixedly disposed and the
upper is movable and the means for cleaning, for placing the
10 leadframe into the mould half and removing a product from
the mould perform a horizontal movement and that the means
unified into a cleaning-discharge unit for cleaning and for
removing of the product from the one side and the means for
placing the leadframe from the other side of the mould
15 perform a reciprocating movement into the mould.

 9. Apparatus as claimed in claims 1-8, **characterized**
in that the means for placing a leadframe are formed by a
first carriage movable over guide rails and that the cleaning-discharge unit is placed on a second carriage movable
20 over these guide rails.

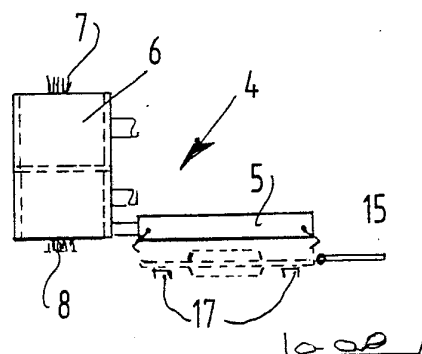
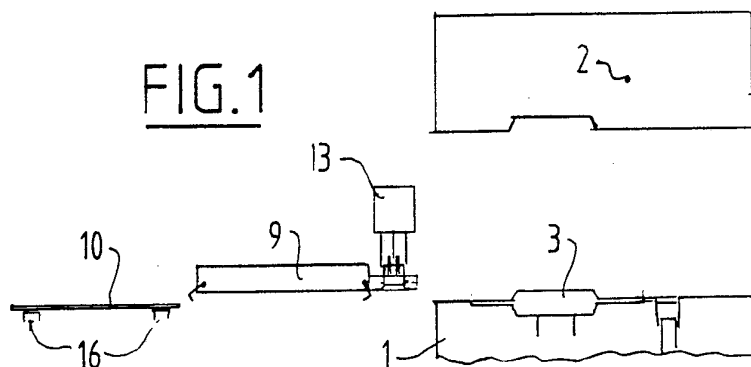
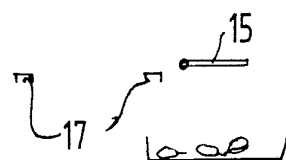
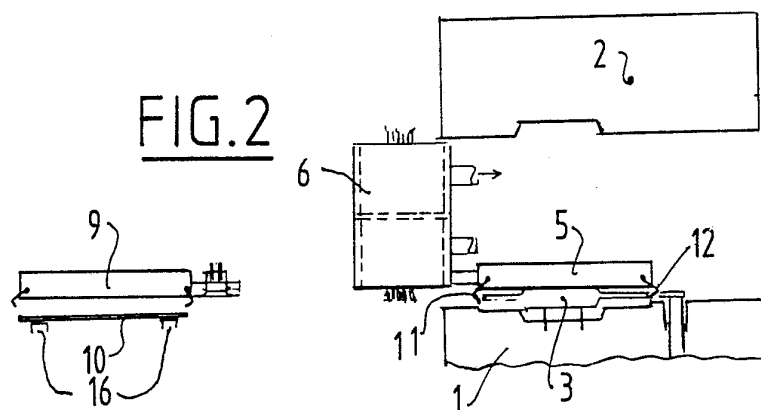
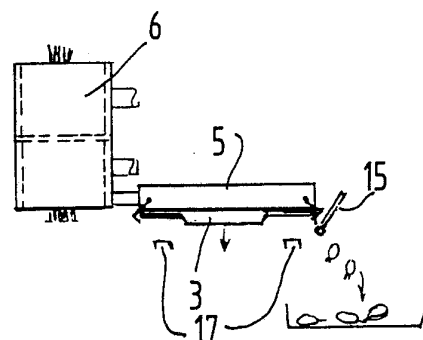
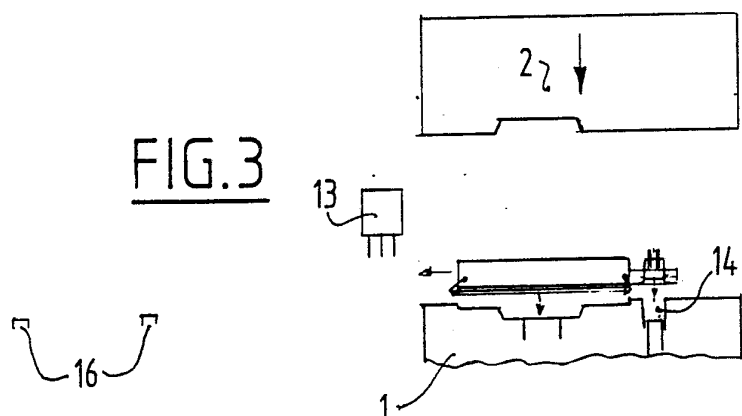
 10. Apparatus as claimed in claims 1-9, **characterized in that** each plunger increasing the pressure in a cavity is under bias.

 11. Apparatus as claimed in claims 1-10, **characterized in that** the plungers increasing the pressure in the
25 cavities are mutually connected by means of channels in one of the mould halves.

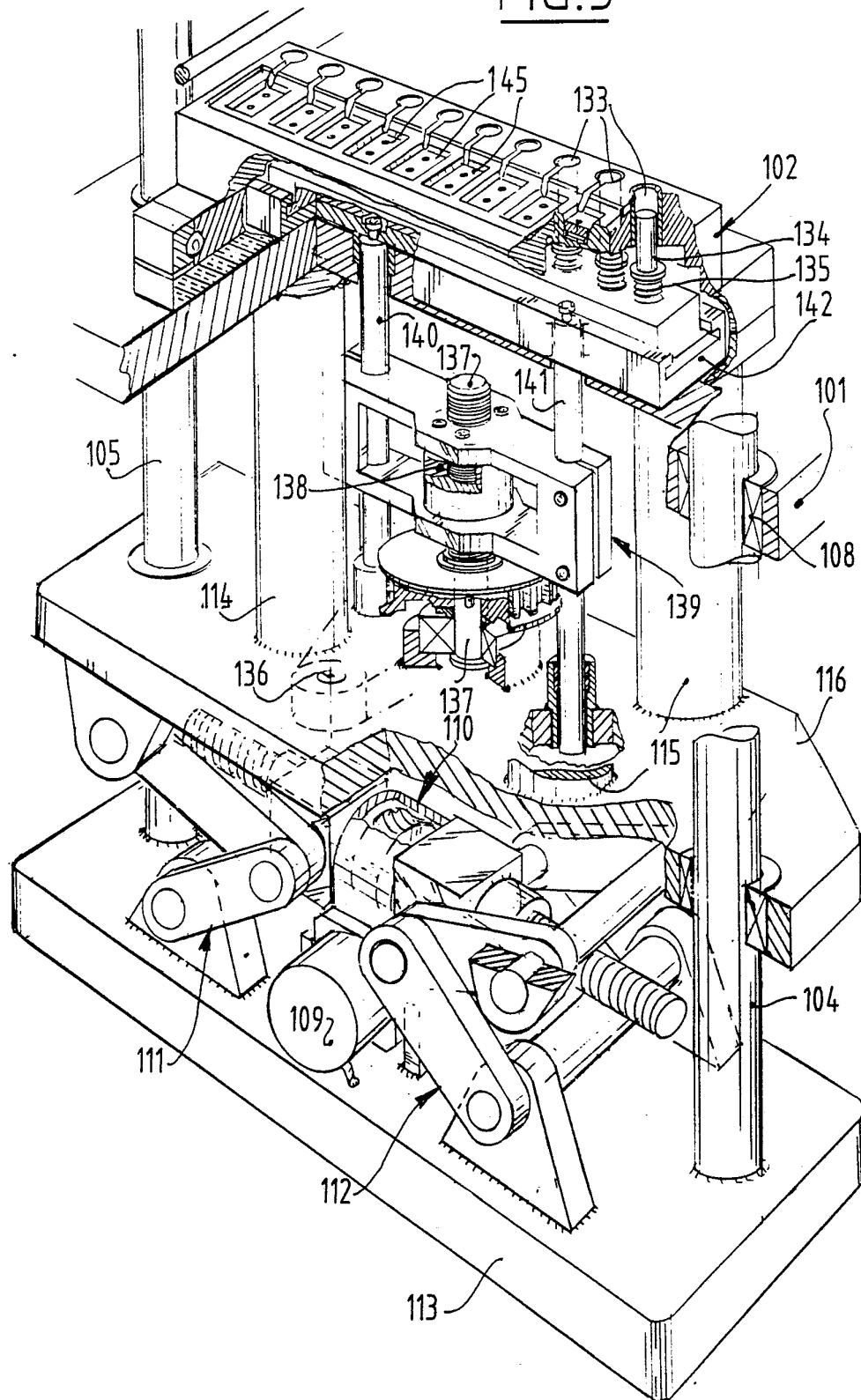
 12. Apparatus as claimed in claims 1-11, **characterized in that** means (200) are provided for measuring the closing force of the mould halves.

 13. Apparatus as claimed in claim 12, **characterized in that** said means (200) are adapted to produce a control signal to stop the electromotor for driving said angle lever system connected to one of the mould halves when said closure force obtains a predetermined value.

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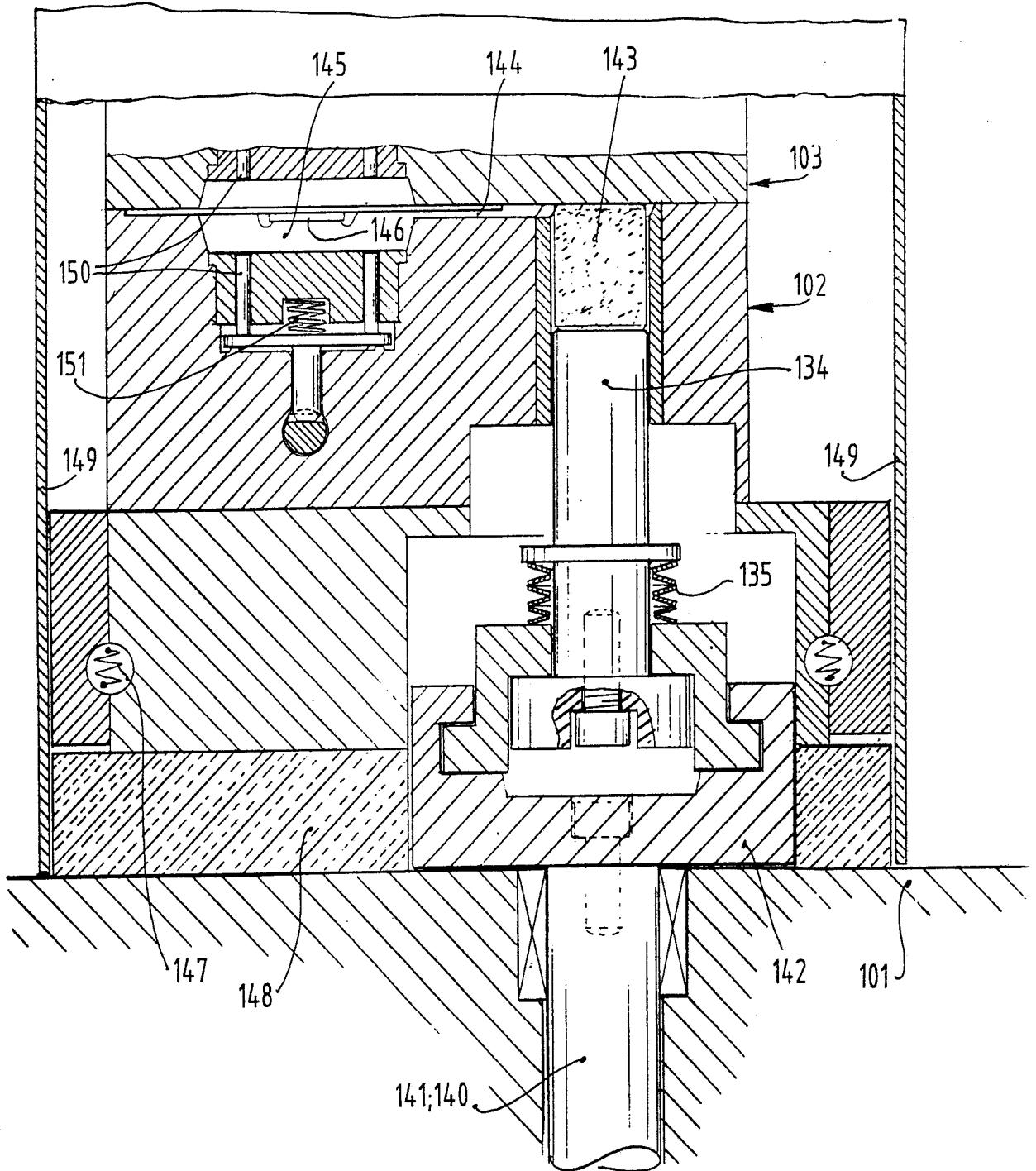
FIG.1FIG.2FIG.3

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FIG.5

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FIG.6



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FIG. 7

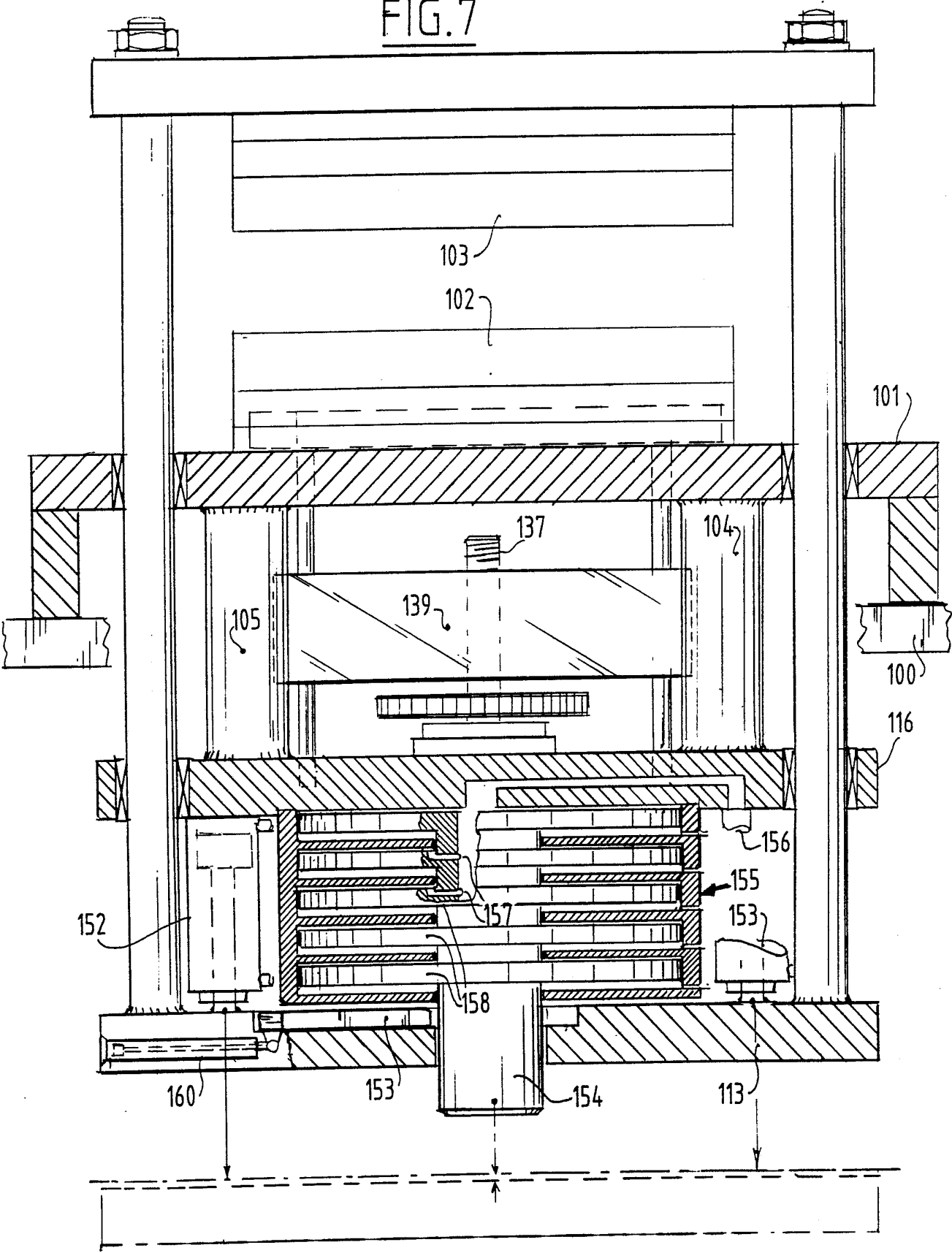


FIG.8 6/6

