Sept. 5, 1950 C. E. MAYNARD ET AL 2,521,387

MACHINE FOR MAKING ARTICLES, SUCH AS DISPLAY COVERS FROM THIN PLASTIC SHEET MATERIAL

Filed Dec. 13, 1946 6 Sheets-Sheet 1

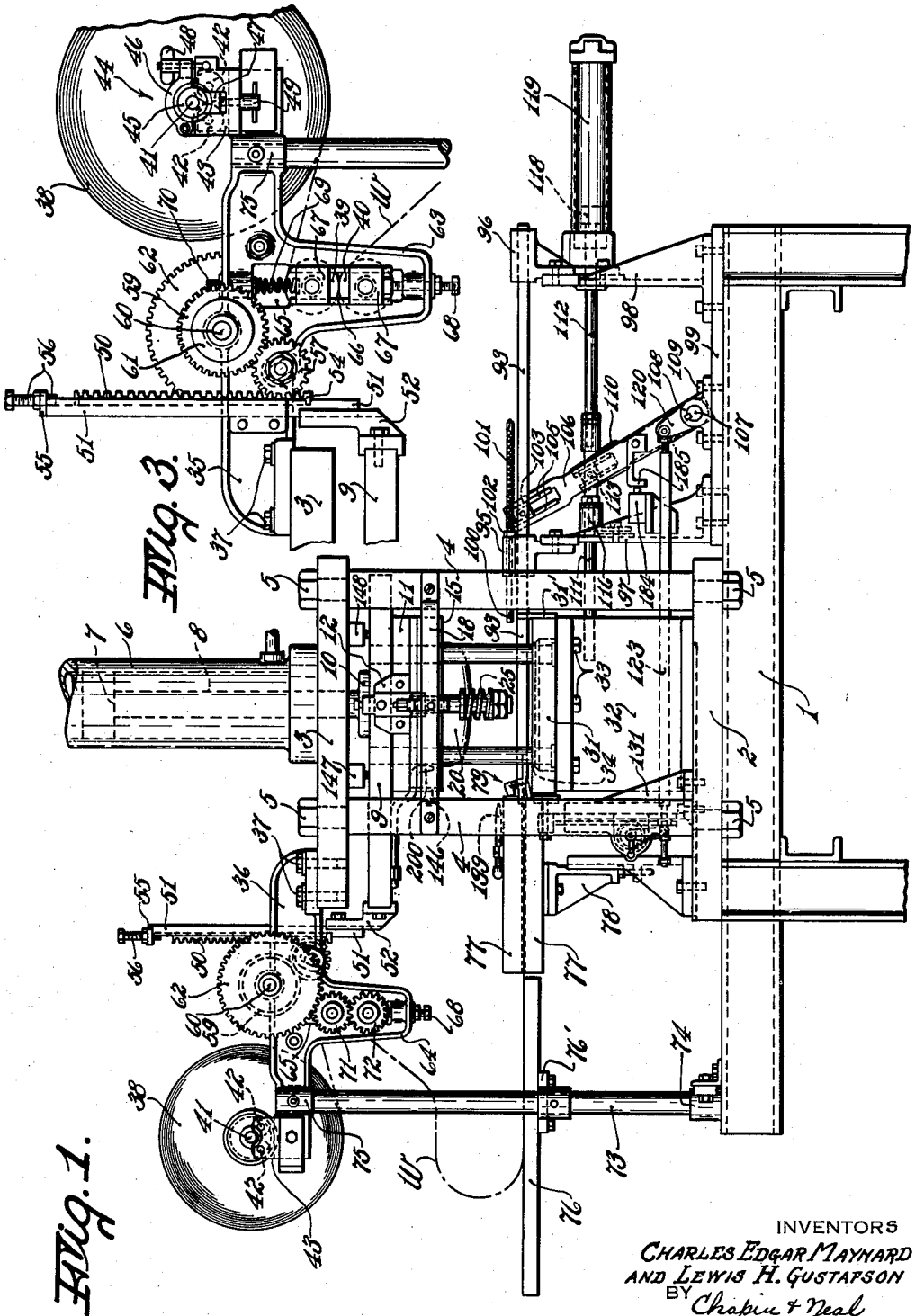


Fig. 3.

Fig. 1.

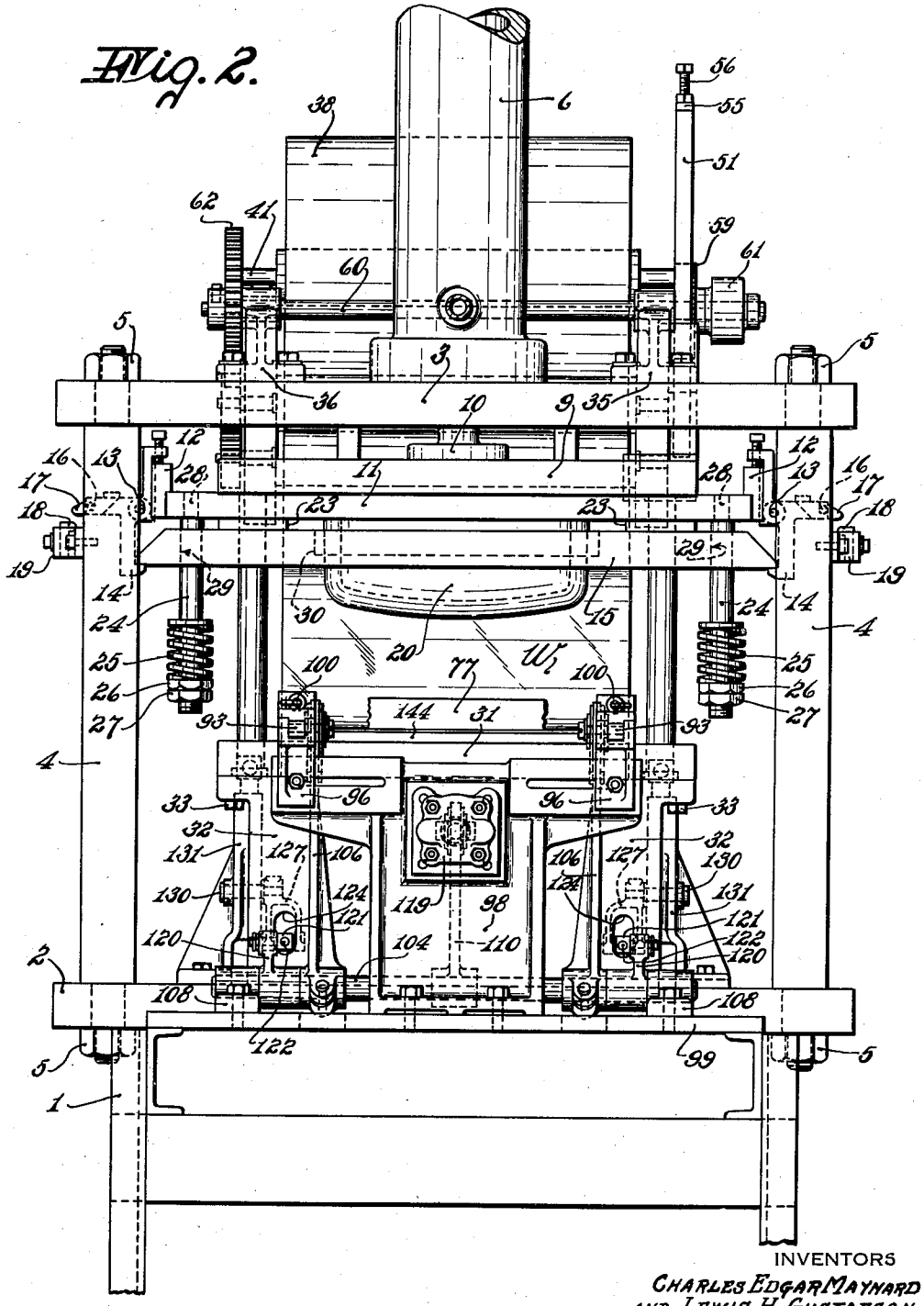
INVENTORS
CHARLES EDGAR MAYNARD
AND LEWIS H. GUSTAFSON
BY Chapin & Neal
ATTORNEYS

Sept. 5, 1950 C. E. MAYNARD ET AL 2,521,387

MACHINE FOR MAKING ARTICLES, SUCH AS DISPLAY COVERS FROM THIN PLASTIC SHEET MATERIAL

Filed Dec. 13, 1946 6 Sheets-Sheet 2

Fig. 2.



INVENTORS
CHARLES EDGAR MAYNARD
AND LEWIS H. GUSTAFSON
BY
Chapin & Neal
ATTORNEYS

Sept. 5, 1950 C. E. MAYNARD ET AL 2,521,387

MACHINE FOR MAKING ARTICLES, SUCH AS DISPLAY COVERS FROM THIN PLASTIC SHEET MATERIAL

Filed Dec. 13, 1946 6 Sheets-Sheet 3

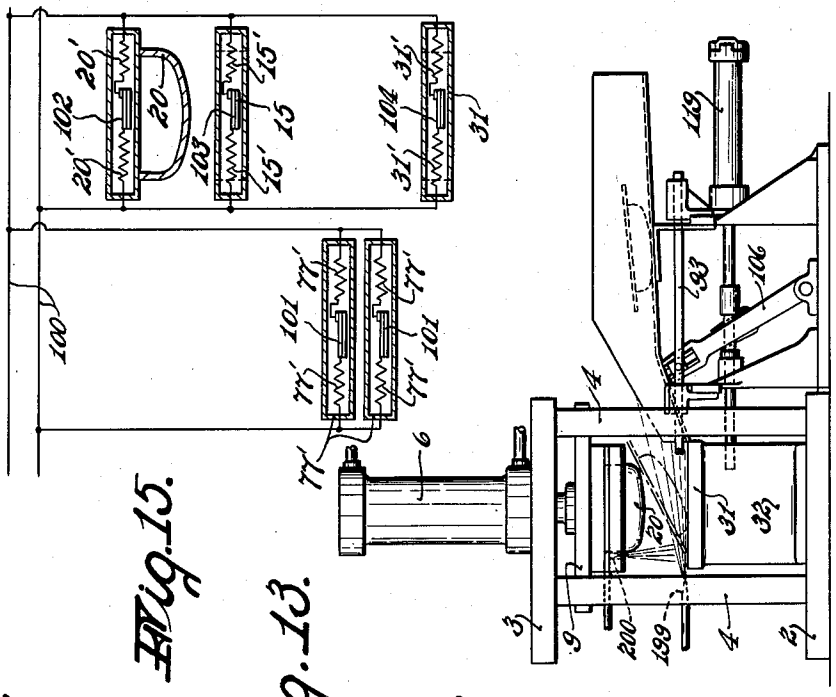


Fig. 15.

Fig. 13.

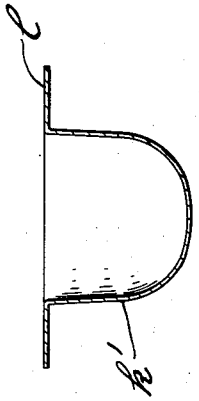


Fig. 12A

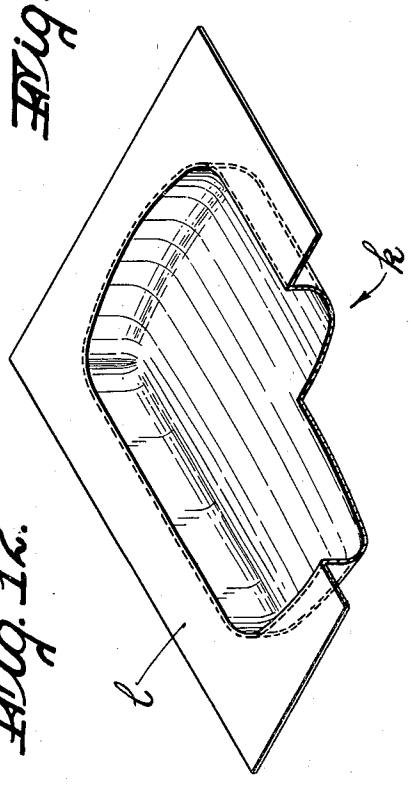


Fig. 12.

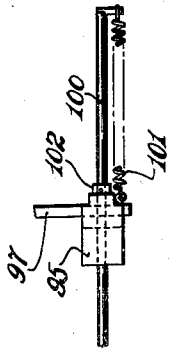


Fig. 4.

INVENTORS
CHARLES EDGAR MAYNARD
AND LEWIS H. GUSTAFSON
BY Chapin & Neal
ATTORNEYS

Sept. 5, 1950 C. E. MAYNARD ET AL 2,521,387

MACHINE FOR MAKING ARTICLES, SUCH AS DISPLAY COVERS FROM THIN PLASTIC SHEET MATERIAL

Filed Dec. 13, 1946 6 Sheets-Sheet 4

Fig. 6.

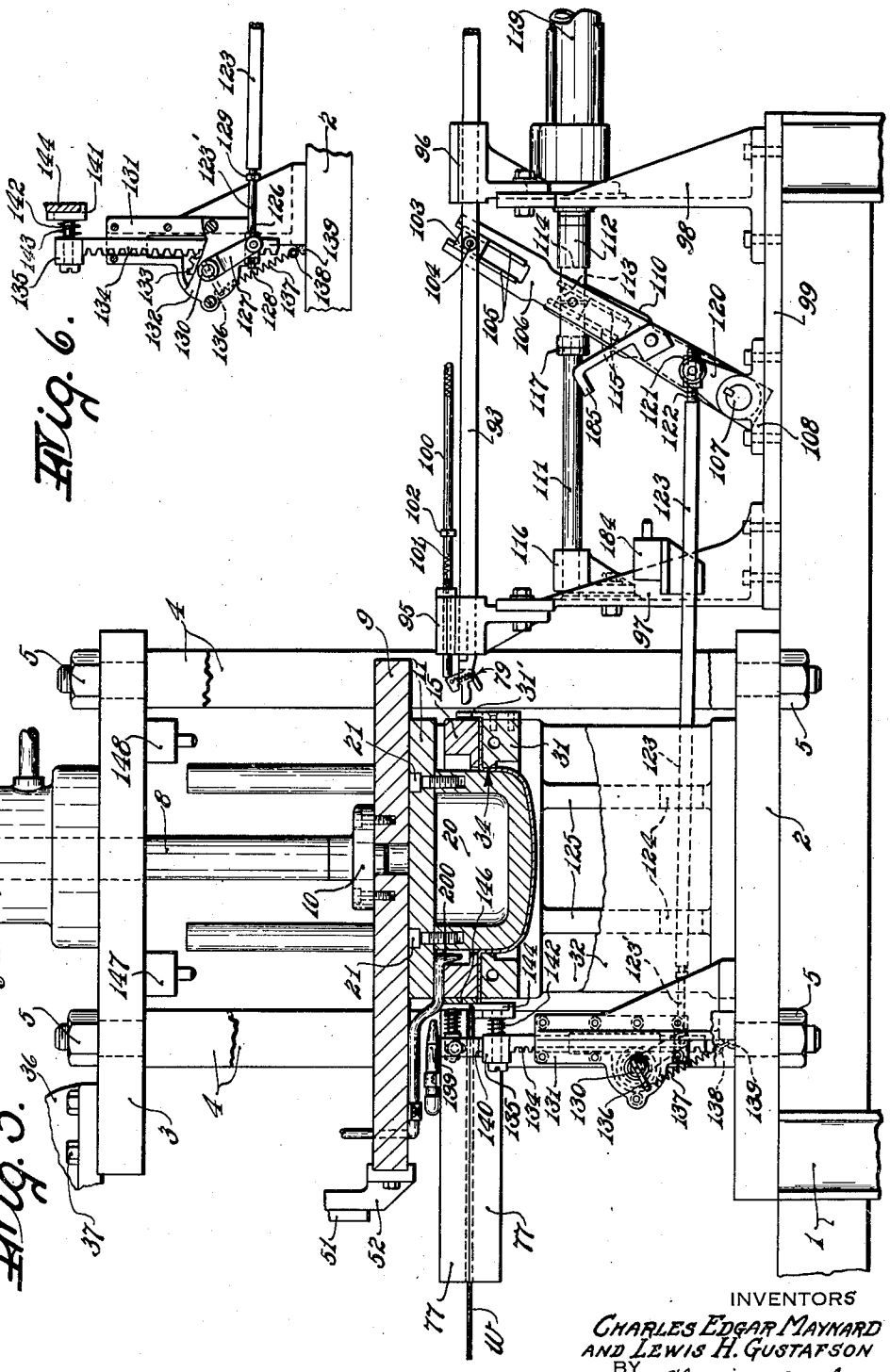


Fig. 5.

INVENTORS
CHARLES EDGAR MAYNARD
AND LEWIS H. GUSTAFSON
BY Chapin & Neal
ATTORNEYS

Sept. 5, 1950 C. E. MAYNARD ET AL 2,521,387

MACHINE FOR MAKING ARTICLES, SUCH AS DISPLAY COVERS FROM THIN PLASTIC SHEET MATERIAL

Filed Dec. 13, 1946 6 Sheets-Sheet 5

Fig. 7.

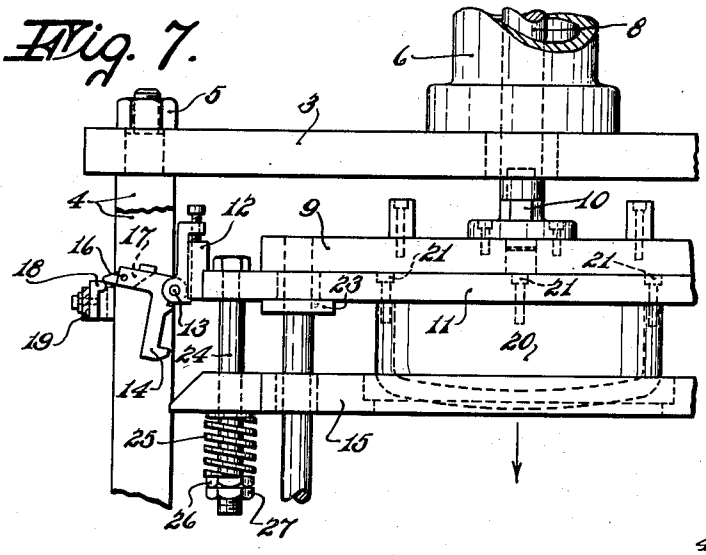


Fig. 8.

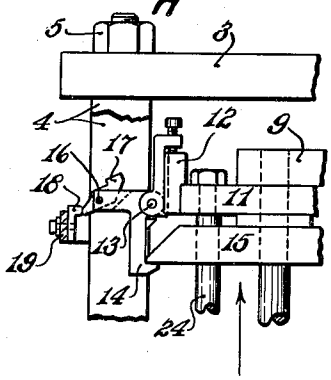


Fig. 9.

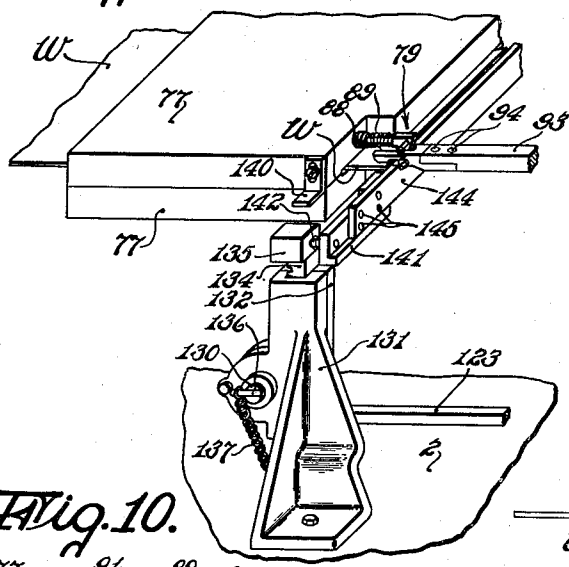


Fig. 10.

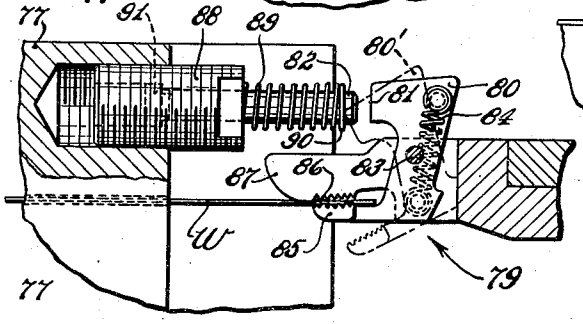
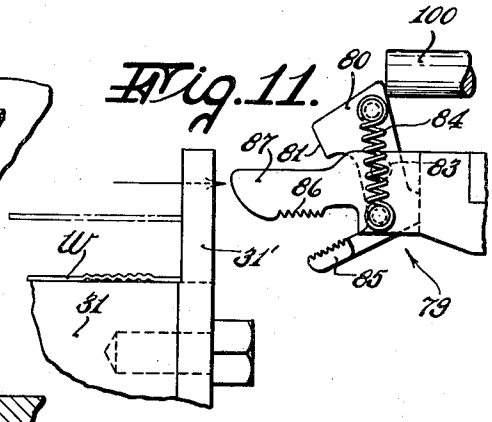


Fig. 11.



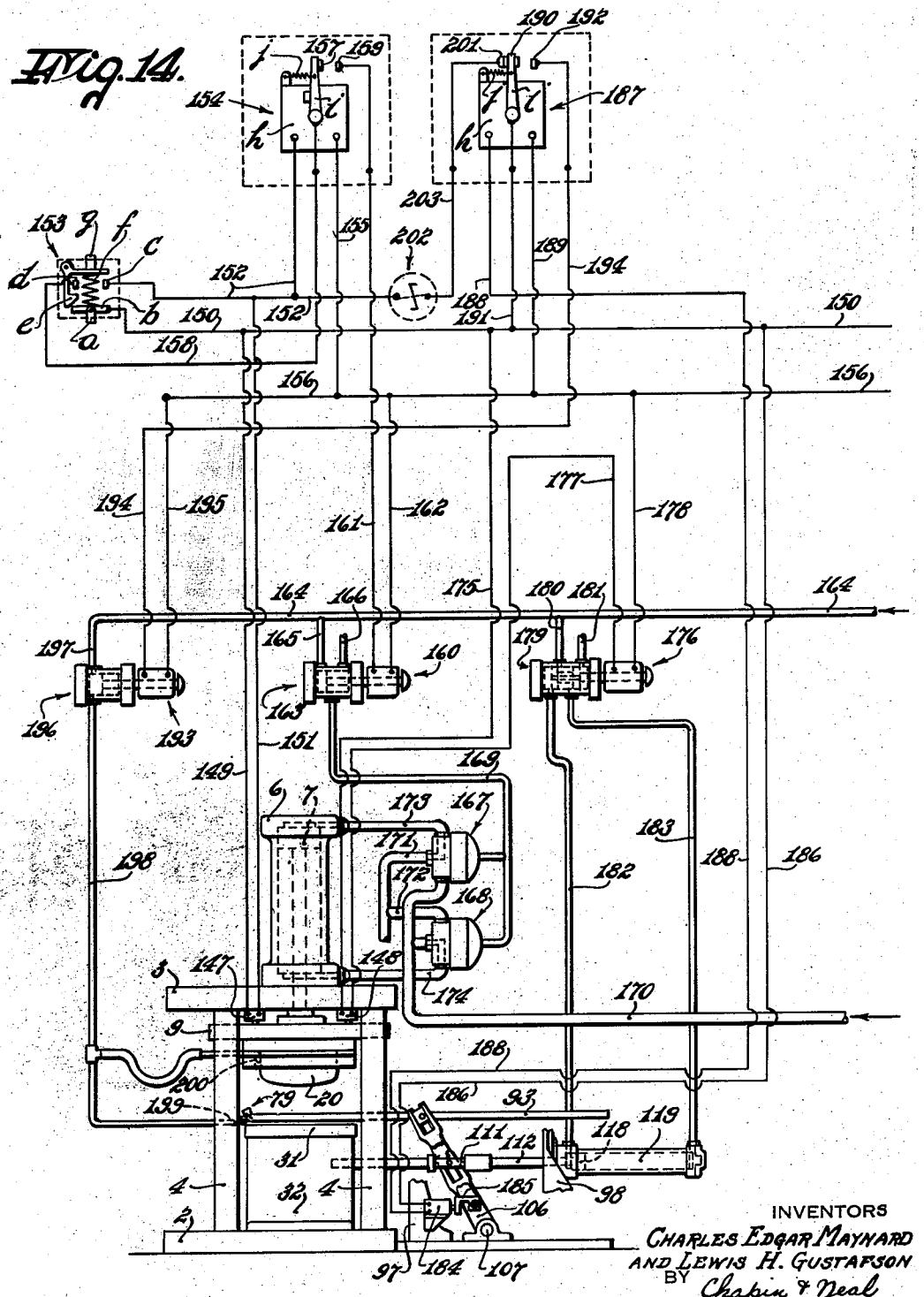
INVENTORS
CHARLES EDGAR MAYNARD
AND LEWIS H. GUSTAFSON
BY Chapin & Neal
ATTORNEYS

Sept. 5, 1950 C. E. MAYNARD ET AL 2,521,387

MACHINE FOR MAKING ARTICLES, SUCH AS DISPLAY COVERS FROM THIN PLASTIC SHEET MATERIAL

Filed Dec. 13, 1946 6 Sheets-Sheet 6

Fig. 14.



INVENTORS
CHARLES EDGAR MAYNARD
AND LEWIS H. GUSTAFSON
BY Chapin & Neal
ATTORNEYS

Patented Sept. 5, 1950 2,521,387

UNITED STATES PATENT OFFICE

2,521,387

MACHINE FOR MAKING ARTICLES, SUCH AS DISPLAY COVERS FROM THIN PLASTIC SHEET MATERIAL

Charles Edgar Maynard, Florence, and Lewis H. Gustafson, Northampton, Mass., assignors, by mesne assignments, to Design Center, Inc., Flushing, N. Y., a corporation of New York

Application December 13, 1946, Serial No. 716,014

6 Claims. (Cl. 18—19)

1

This invention relates to improvements in machines to make hoods or similar articles of ornamental plastic material. The hoods are made in commercial practice under this invention from transparent material and are used in making up display packages for retail selling of other things. For example, a display package consists of a bottom tray, a hair brush on the tray, and a transparent hood to cover the hair brush. The practice is to sell the brush with its display package as one unit. In this use the hood is in the form of a hollow plastic shell with a bottom opening adapted to receive and the hood cavity deep enough to contain the hair brush, and the tray closes the bottom opening. The hood as made under this invention has the significant features of being a thin one piece seamless shell of entirely self-sustaining form, of having a curved tapered surface, of being of highly ornamental plastic material which may be and preferably is highly transparent.

It is well known in the plastics industry, as its hand book and commercial literature shows, that with the ingredients of a plastic mix, a fine ornamental quality of plastic material can be made up in sheet form. The high quality desired from the material for ornamental purposes can be attained much easier and at much lower cost in sheet than in molded form. For this reason it is desirable in making ornamental plastic hoods to make them from sheet plastic material provided the quality of the sheet can be retained in shaping it to the desired hood form. This is also desirable if the hoods can be made from sheet plastic material at a cost way below the cost of molding them.

So far as we were informed prior to this invention it was not practical to draw ornamental sheet plastic material to a depth beyond about one half of the diameter or width of the finished piece. The article would not draw to a good appearance under prior practice. The commercial piece we first wanted to draw, rather than mold, was about two and a half inches wide by nine and a quarter inches long and two and one half inches deep. That is, the depth was about equal to the width. This put the dimensions very substantially outside the accepted limits of the art in drawing thin sheet plastic material as of the time we began to work to conceive our improvements. The thickness of the sheet plastic material we wanted to draw as a transparent hood to cover the hair brush in the "package" mentioned above was about ten thousandths of an inch. The sheets were available from several

2

large plastic manufacturers and with exceptionally fine transparent and ornamental quality in the flat form. On enquiry about the feasibility of drawing these sheets to the form we wanted we were advised that it could not be drawn according to the art knowledge as of that time.

This is the background of the problem met by our invention herein disclosed. In working out this problem however it will be seen that we have improved the art of drawing hoods generally within the range of drawing depths heretofore considered practical but more particularly and more important we have extended the depth range far beyond what was before considered feasible in drawing the sheet plastic material while retaining in the deep hood form the fine appearance of the sheet form of ornamental plastic material.

The invention will be considered first with regard to drawing the sheet material to hood form of useful depths, that is for articles of hood form generally, and then for articles of hood form drawn deeper than before considered practical. The invention is in the machine disclosed.

The disclosure of the machine will also disclose the method and the invention will be pointed out in the claims.

Referring to the drawings:

Fig. 1 is a side view of the machine;

Fig. 2 is a view looking from the right end of Fig. 1;

Fig. 3 is a view looking from the opposite side of Fig. 1 of parts on that side to distinguish from parts seen in the upper left hand portion of the view in Fig. 1;

Fig. 4 is a fragmentary plan detail of parts indicated in Fig. 1;

Fig. 5 is a view of the machine with some parts broken away and some in section to indicate the relative position of tools during the hood shaping step;

Fig. 6 is a detail view indicating part of the mechanism for cutting off a portion of the sheet plastic material for the shaping tools of Fig. 5;

Fig. 7 is a detail illustrating the action of a clamping plate and its holding mechanism with relation to other tools;

Fig. 8 is a detail of the mechanism of Fig. 7 with parts in different positions;

Fig. 9 is a fragmentary oblique drawing of the heater plates, feed jaw means and a lower knife mechanism;

Fig. 10 is an enlarged fragmentary section of feed jaws in position to grasp the web;

Fig. 11 shows the parts in Fig. 10 in different position;

Fig. 12 is a view of the hood shaped from the flat sheet material, but before trimming;

Fig. 12A is a view of a hood much longer than it is wide and of a drawn depth about equal to its width, to indicate a transparent hood made from sheet plastic material of about ten thousandths inch thickness;

Fig. 13 is a somewhat diagrammatic view of the machine indicating the operation of applying air blasts to free the hood from its shaping tool and blow it to one side to a receiving bin before starting another cycle of operations;

Fig. 14 is a diagrammatic view to disclose, with its discussion, a way for arranging power operable control means for the sequence of operations in each machine cycle and for full automatic operation of the machine; and

Fig. 15 is a diagram to indicate a heating plan for parts of the machine.

The idea for the main part of the machine will first be described, with particular reference to Figs. 1, 2 and 5. It consists of mechanism for reciprocating a male forcing die toward, into and then away from the aperture of a draw plate. Heated sheets of plastic material are periodically clamped in timed relation with the reciprocation of the die to the surface of the draw plate surrounding its aperture. The portion of the sheet inside the area of the portion directly clamped, is drawn to shape in conformity with that portion of the male die which is adapted to pass into and protrude through the draw plate aperture during reciprocation. The shaped hood is designated by the letter *k* and is shown in Fig. 12. Its marginal portion, that which has been clamped to the draw plate, is indicated at *l*.

In Figs. 1, 2 and 5, a stand 1 bears a frame consisting of a base plate 2 and a top plate 3 supported from the base plate 2 by supporting posts 4 and fixed thereto by nuts 5. A cylinder 6 mounted on the top plate 3 slidably carries a piston 7 to which is fixed a piston rod 8. The rod 8 may slide freely in a bore in the top plate 3 when so urged by the action of fluid pressure on the piston 7, and is attached to a cylinder plate 9 by means of an adapter 10. A die plate 11 is fixed to plate 9 and carries two brackets 12 to which are pivoted at 13 latching members 14. The latches 14 support a clamping plate 15 during a part of the work stroke, and through other mechanism now to be described and illustrated in Figs. 2, 7 and 8 function to release the clamping plate 15 to clamping position during the remainder of the work stroke. Pivotally mounted on the latches 14 at 16 are pawls 17 which cooperate with tripping elements 18 to rotate the latches 14 around pivots 13 to release clamping plate 15 when the plates 9 and 11 are being driven by the piston 7 in the direction indicated in Fig. 7, and which swing around pivots 16 to clear the tripping members 18 without disturbing latches 14 when plates 9 and 11 are moving as in Fig. 8. The tripping members 18 are fixed to straps 19 which are fastened to the frame supporting posts 4, as by screws.

A die 20 depends from the plate 11, fixed thereto, as by screws 21, Fig. 5, and is formed to the shape of the hood cavity to be produced, being deeper for the hood of Fig. 12A than for the hood of Fig. 12. The clamping plate 15 lies below the plate 11, spaced therefrom by spacers 23, and is held to the plate 11 by the latching members 14. The clamping plate 15 slides on, and is guided by, spring holding rods 24 when released by the latching members 14, and drops onto cushioning springs 25, which are supported on the rods 24 by nuts 26. Lock nuts 27 prevent the nuts 26 from jarring free of the threaded portion of the rods 24. The rods 24 are fixed to the plate 11 at 28 and extend through bores 29 in the plate 15, Fig. 2. The clamping plate 15 has an opening 30 machined therein to permit the die 20 to extend from the plate 11 through the plate 15 when said plate is held in its uppermost position by the latching members 14.

Beneath the plunger assembly, and positioned in cooperating relationship therewith, a draw plate 31 is borne by supports 32 which are fixed to the base plate 2. The draw plate 31 is fixed to the supports 32 as by bolts 33 and has a machined aperture 34 to receive the die 20 and a heated sheet of plastic material which is drawn to an overlying position on the draw plate 31 by feeding means to be described later.

Extending rearwardly from the top plate 3 and as viewed from the left of Fig. 1, left and right brackets 35 and 36 of web feed mechanism are attached to plate 3 by screws 37 and support a reel of flexible sheet plastic material 38, and feed rolls 39 and 40 (Fig. 3). The reel 38 is borne by shaft 41 which is rotatably mounted on rollers 42 of an anti-friction reel mounting 43. A suitable braking device may be used to frictionally restrain the reel 38 against overfeeding after the feed rolls 39 and 40 have come to rest. Such a device could have many forms, for example, that indicated by number 44 in Fig. 3 in which a collar 45 pinned to the shaft 41 is held between a hinged brake shoe 46 and a slidable shoe 47. Pressure is exerted on the collar 45 by the hinged shoe 46 through a wing nut 48 and by the slidable shoe 47 through a thumb screw 49.

The feed rolls 39 and 40, Fig. 3, are driven, through suitable gearing to be described later, by a rack 50 slidable in a slotted rack guide 51 mounted on bracket 52 which is fixed to, and therefore reciprocates with, the cylinder plate 9. The rack slot in guide 51 extends from a lower stop 54 to a cap 55 secured to the rack guide 51. A screw 56 threaded through the cap 55 provides an adjustable upper stop for the rack 50. As plate 9 descends (from the position shown in Fig. 1) carrying with it the rack guide 51 the rack 50 is held stationary by an idler gear 57 with which it is in mesh until the upper stop screw 56 contacts the upper end of rack 50 and drives it downwardly during the remainder of the stroke of the cylinder plate 9. Variations in the amount of sheet unrolled may be obtained by using racks of different lengths.

The idler gear 57 is journaled in the left hand bracket 35 and cooperates with a gear 59 to drive a shaft 60 through a unidirectional clutch 61. The shaft 60 is suitably journaled in left hand bracket 35 at one end and right hand bracket 36 at the other end, and projects beyond its right hand bearing to fixedly receive a gear 62. The brackets 35 and 36 have depending projections 63 and 64 which have slots at 65 that contain slides 66 to receive slidable bearing members 67 in which the feed rolls 39 and 40 are mounted. The feed rolls 39 and 40 are positioned by screws 68 and are held in contact by spring 69. Pressure between the rolls 39 and 40 may be varied by means of adjusting screws 70 which bear on springs 69. Rolls 39 and 40 are driven by the gear 62 fixed to shaft 60 through the intermediate

gears 71 and 72, Fig. 1. Brackets 35 and 36 are supported on rods 73 which extend from sockets 75 on the brackets downwardly to sockets 74 on stand 1.

Sheet plastic material, indicated by the letter *w*, is unrolled from the reel 38 by the action described above, passing over feed roll 39, Fig. 3, and back between rolls 39 and 40 to fold loosely over a platform 76. The platform 76 is supported by brackets 76' on the rods 73. The web *w* passes between upper and lower heater plates 77, which are preferably kept at a constant temperature by electrical heating means indicated at 77', Fig. 15, or by the circulation of temperature control fluid through cored or drilled passages, not shown. The heater plates 77 are adjustably mounted on supports 78.

The free end of the web *w* normally extends beyond the plates 77 sufficiently to provide a grabbing surface for a pair of laterally disposed feed jaws 79, one near the left hand edge of the free end of web *w*, the other near the right hand edge. The feed jaws 79 at properly timed intervals grasp the free end of the web *w* which protrudes beyond the inner edges of the heater plates 77 and draw the sheet material over the draw plate 31. Only one of the feed jaw devices used has been shown, since their structures are identical. Figs. 9, 10 and 11 show how the feed jaws 79 operate. As the feed jaws approach the free end of the web *w*, Fig. 10, the movable jaw 80 is in the dotted line position 80'. A flattened face 81 of the jaw 80 butts a spring mounted stop pin 82, and this action causes the jaw 80 to pivot around pin 83 to the full line position shown in Fig. 10. A toggle spring 84 serves to maintain the pivoted jaw in this position. A toothed portion 85 machined on the pivoted jaw 80 cooperates with a tooth portion 86 on a fixed jaw 87 to firmly clamp the edge of the web *w*. The stop pin 82 is slidable in a plug 88 threaded into the upper heating plate 77 and is constantly urged to its extreme extension by a spring 89 which is held between the outer face of plug 88 and a fixed washer 90 on the pin 82. A head portion 91 of the stop pin 82 butts a shouldered counterbore within the plug 88 to limit the extension of pin 82. Each of the pair of feed jaws 79 are fixed to the left and right hand feed bars 93 respectively, as by screws 94, as shown in Fig. 9, said feed bars extending through pairs of guiding brackets 95 and 96, Figs. 1 and 5. Brackets 95 and 96 are mounted on spaced bracket supports 97 and 98 fixed to an auxiliary platform 99. The brackets 95, in addition to supporting the bars 93 each carry a sliding stop pin 100 mounted to slide in a bore in the guide bracket and held therein by tension springs 101, Figs. 1, 4 and 5. A collar 102 pinned to rod 100 limits the forward extension of the rod 100 through the bore in bracket 95. Only the right hand bracket 95 with its stop pin 100 has been shown, but it should be clear that a similar bracket and pin assembly is located on the left to cooperate with the left hand feed jaws 79, in a manner to be later described. The feed bars 93 are reciprocated at timed intervals by an air cylinder and piston assembly through drive levers and a countershaft mechanism which will now be described.

The feed bars 93 have blocks 103 pivotally fixed to them by pivot pins 104, as shown in Figs. 1, 2 and 5, said blocks being held in slides 105 machined in the upper end of feed levers 106. The feed levers 106 are keyed to a cross shaft 107 which is mounted in bearings 108 fixed to the auxiliary platform 99 by screws 109, Fig. 1. The cross shaft 107 is driven by a drive lever 110 which extends through a slotted extension 111 of a piston rod 112, Fig. 5. A sliding block 113 is rotatably pinned within a slot 114 in the extension 111 and is guided by slides 115 machined in the drive lever 110. The extension 111 is supported by a guide bracket 116 which is fixed to bracket 97. A stop collar 117 limits the travel of the feed rod 112 by butting the guide bracket 116. A variety of feeds may be obtained by varying the thickness of the stop collar 117. The piston rod 112 is driven by a piston 118, Fig. 1, contained in an air cylinder 119 which is mounted on bracket 98.

Mechanism for extending a movable knife blade to a cutting position under the web *w* adjacent to the draw plate 31, as shown in Figs. 1, 5 and 6, is also driven from cross shaft 107. Keyed to, and driven by the shaft 107 are cranks 120 which carry blocks 121 rotatably fixed thereto, Figs. 1, 2 and 5. The blocks 121 are adapted to receive the threaded end 122 of a knife actuating rod 123 which extends below the die plate 31 through openings 124 in the supporting webs 125 of the die plate supports 32, as shown in Fig. 5. The rod 123, Figs. 5 and 6, has a turned down portion 123' adapted to slidably receive a sleeve 126 pinned to a forked lever 127. Stop collars 128 and 129 fixed to the rod portion 123' limit the sliding motion of the sleeve 126 on slide portion 123'. The forked lever 127 is fixed on a stub shaft 130 journaled on one side in a casing 131 and on the other in cap 132 of the casing 131. The shaft 130 carries a pinion 133 fixed thereto which cooperates with a rack portion 134 of a knife support 135. A pin 136 is fixed to the outer end of stub shaft 130 and serves as a hook on which to anchor one end of a tension spring 137. The other end of spring 137 is hocked to a screw eye 138 fixed to the base of the casing 131 at 139. The action of spring 137 on the shaft 130 and the pinion 133 is such that as the rod 123 is withdrawn from the position shown in Fig. 1 the pull of the spring 137 on the pin 136 rotates the shaft and pinion assembly counterclockwise. The forked lever 127 follows the stop 129 until the upper end of the knife support 135 strikes a stop 140 which is adjustably mounted on the upper heating plate 77. As the rod 123 is further retracted the portion 123' slides through the sleeve 126 until prevented from further travel by the stop 128. Thus the knife support 135 is positively held in its upper position until the action of the rod 123 returning to the position shown in Fig. 1 returns the knife support 135 to its lower position through the action of the lever 127, the pinion 133 and rack 134.

A knife holder 141 is threaded to a stud 142 loosely mounted in the knife support 135. A spring 143 provides flexibility for the knife mounting and serves to maintain it at its extended position. A knife blade 144 is mounted on the knife holder 141 as by screws 145, Fig. 9, to cooperate with an upper knife blade 146 fixed to the clamping plate 15, Fig. 5, to cut off that portion of web *w* overlying the draw plate 31 when the clamping plate 15 descends to hold the sheet of plastic material firmly to the draw plate.

Obviously, it would be possible to control the operation of the machine described by hand. That is, an operator could push the free end of the web *w* between the heater plates, manually operate a hydraulic valve for the reciprocation

of the drive piston and the forming die, and manually operate another valve to introduce air pressure to the feed cylinder which would advance the feed jaws and extend the lower knife blade. A faster and more efficient method of operation is provided, however, when electrical, pneumatic and hydraulic controls are introduced and properly connected to the various drive elements so that after the initial closing of an electrical switch the machine elements will perform their various functions in perfectly timed coordination—for one cycle, if desired, or with a continuous repetition of the cycle, until the supply reel of plastic sheet material has been exhausted.

Electrical control elements or devices of well known commercial forms are put in the combination of the machine of our invention. They include a start and stop button switch, timers or timing elements, solenoids and limit switches. All have been indicated only diagrammatically to illustrate their function in the control circuit for the automatic power operation of the machine shown.

The pneumatic control devices consist of valves alternately opened and closed by the solenoids when said solenoids are electrically activated by the timing elements or limit switches; and a pair of spring loaded diaphragm valves which alternately introduce and exhaust pressure fluid to the top and bottom ports of the die reciprocating cylinder.

The mechanism and its controls, which have been shown diagrammatically in Fig. 14, will now be described in detail. In the diagram the mechanism and controls have been shown in their rest or cycle starting position. When the male die assembly, see die 20, is in its uppermost position limit switches 147 and 148, which are fixed to the top plate 3 of the main frame, are held open by the cylinder plate 9. The limit switch 147 is connected by a lead 149 to one branch 150 of the supply line and by lead 151 to a line 152 which connects the open side of a switch 153 with one terminal of the timing element 154. In operation, when the "start" button *a* of the switch 153 is pressed and held, the contact *b* of the switch, which is connected to a supply line 150 touches contacts *c* and *d* energizing lines 152 and 158, respectively. When pressure to button *a* is released, contacts *b* and *d* are held together by latch *e* while contacts *b* and *c* are pushed apart by spring *f*, so that, while line 158 remains energized, line 152 does not. Latch *e* is pivoted to release contact *b* upon pressure on stop button *g*.

A timing element or device 154 has been indicated diagrammatically as consisting of an electrical device, such as a small motor, not shown, but in box *h*, adapted to move a contact arm *i* against a tension spring *j* when the motor is operated to bring contacts 157 and 159 together. Incorporated within the device 154, and not shown in the diagram, is timing means adapted for presetting to determine the time interval in which contacts 157 and 159 stay together. The spring *j* returns the arm to its original position at the end of the predetermined time interval. The parts indicated in device 154 remain in the position shown even though the circuit lines 152 and 155 remains closed, until this circuit to the device is opened and again closed. This sort of time switch device is well known per se. The reset mechanism contained within the device, and not shown in the diagram, acts to reset the timing device for recycling so that when the control circuit through 152 and 155 is closed a succeeding cycle is started.

When contact 157 of device 154 is against contact 159 the following circuit is established; contact 157 to the contact *d* of switch 153, contact 159 to solenoid 160, from the latter to line 156 by lead 162, and from contact *d* through contact *b* to line 150. This results in energizing solenoid 160.

The solenoid 160 operates an air valve 163 which is connected to air pressure supply line 164 by pipe line 165, and exhausts through pipe line 166. The valve 163 introduces or exhausts air under pressure, under the control of the solenoid 160, to a pair of air operated diaphragm valves 167 and 168 through pipe line 169. The diaphragm valves 167 and 168 are connected to an hydraulic pressure source through supply line 170 and exhaust through lines 171 and 172. Diaphragm valve 167 is connected to the upper end of cylinder 6 by pipe line 173, while valve 168 is connected to the lower end of cylinder 6 by pipe 174. The valves 167 and 168 are spring loaded and so arranged that when relieved of control air, as is the condition indicated in Fig. 14, valve 167 blocks off fluid pressure from line 170 and connects line 173 and the upper end of cylinder 6 to the exhaust line 171, while valve 168 opens the line 174 and the lower end of cylinder 6 to the pressure supply line 170. These diaphragm valves for this type of function are well known.

Limit switch 148 fixed to top plate 3, and held open by plate 9, as has been described before, is connected to branch 150 of the electrical supply line by a lead 175, and to a solenoid 176 by a lead 177. The electrical circuit to the solenoid 176 is completed by a lead 178 to branch 156 of the supply. The solenoid 176 controls an air valve 179 which is connected to air pressure supply line 164 by pipe line 180 and exhausts through pipe line 181. The valve 179 alternately connects the forward end of feed cylinder 119 to air pressure line 180 or to exhaust line 181 through a line 182, and introduces or exhausts pressure to the rear end of cylinder 119 through a line 183.

A third limit switch 184 supported by bracket 97 and held closed by a lug 185 carried by lever arm 186 on shaft 187 is connected to supply branch 150 by line 188 and to one terminal of a second timing element or device 187 by line 188. The second terminal of timing element 187 is connected to supply line branch 156 by line 189. A contact 190 controlled by timing element 187 is connected to supply line 150 by lead 191 and connects with a contact 192 for a predetermined interval of time when the circuit to the timer 187 is closed. The timing element or device 187 is similar to timing element or device 154 in its general operation with regard to time switch control function, for its circuits. A solenoid 193 is connected to contact 192 by a lead 194 and to supply line 156 by lead 195. The solenoid 193 controls an air valve 196 which is open to air under pressure through line 197. A pipe 198 connects valve 196 with an air nozzle 199 which directs an air jet in a line approximately parallel with the top of die plate 31, and to a nozzle 200 which directs a jet of air approximately parallel to the front side of die 20. The nozzle 200 is flexibly connected to line 198 to provide for the travel of the die assembly.

The timing device 187 has a third contact 201 which is connected to one terminal of a switch

202 by lead 203. A second terminal of the switch 202 is connected to lead 152. When switch 202 is open the machine will operate for one cycle and stop. When it is closed, as in the dotted line position in Fig. 14, line 152 will be connected to the supply line 150, by line 191, contact 190, contact 201, line 203 and the switch 202. Since the circuit to timing element device 154 is completed by line 152 the effect will be that when switch 202 is closed the timing element device 154 will become energized when the movable arm *i* of timing element device 187 returns to its rest position, as in Fig. 14.

So far this disclosure has concerned specific and somewhat complicated mechanism for making hoods or covers in the form of self-sustaining one piece hollow plastic shells from flexible sheet plastic material and without seams. It must be pointed out, however, that the invention does not reside in the machine alone. Conceivably, the method of the invention could be carried out, and to advantage, with a minimum of elementary hand operable tools. For instance, precut sheets of plastic material could be placed in a heater, or oven, lifted out at drawing temperature, clamped by a heated clamp plate to an apertured and heated draw plate, drawn to shape by a heated die mounted to be moved by hand or food press and the hood taken from the die when properly set. This method would be slow, of course, but the finished product would possess the same qualities as are possessed by the article produced by the automatic machine illustrated.

The operation of the machine will now be described with reference to all drawings and to Fig. 14 in particular. With the machine elements in the position illustrated in Figs. 1, 2 and 14, if the "start" button *a* of switch 153 is pressed, contact *b* touches contacts *c* and *d* in the switch connecting the power source, through line 150, to lines 152 and 158. Line 152 now connects timing motor *h* of the timing element 154 to one side 150 of the power supply, and since the motor of box *h* is permanently connected to the other side 156 of the power supply by line 155 the timing motor is now energized, and moves arm *i* so that contact 157 strikes contact 159 and a circuit is made through line 158, arm *i*, contacts 157 and 159 to line 161. The arm *i* will remain in this position for a preset interval of time and then return to the position of Fig. 14, as has been explained earlier. This energizes solenoid 160, valve 163 is shifted to its intake position and control air under pressure flows through line 169 to diaphragm valves 167 and 168 reversing these valves so that hydraulic pressure fluid from supply 170 now flows through valve 167 and pipe 173 to the upper end of cylinder 6, and the valve 168 connects the lower end of the cylinder 6 and pipe 174 to the exhaust line 172. The piston 7 starts downwardly carrying with it the die assembly. Almost immediately after the die assembly starts its downward travel (approximately ½ inch of travel), the actuating buttons of the limit switches 147 and 148 are released closing both switches. Limit switch 147 connects line 150 and line 152 so that it is no longer necessary to hold switch contacts *c* and *b* together and the start button *a* may be released. The other side of switch 153, that is, that to which line 158 is connected, is locked in contact and may only be released by pressing the stop button *g* of the switch.

When the die assembly starts downwardly the rack 50, Figs. 1, 2 and 3, drives the feed rolls 39 and 40 through the clutch 61 and gearing previously described, which action strips from the reel 38 a predetermined unit quantity of sheet plastic material. The rack 50 is slidable in the guide 51 an amount limited by the adjustable stop 56 and the distance the rack 50 may slide in guide 51 determines the amount of sheet material unrolled regardless of the length of the piston stroke. The unrolled sheet plastic material remains loosely folded over platform 76 and extends between the heater plates 77, Fig. 1.

Returning to Fig. 14, the limit switch 148 which with limit switch 147 is closed when the die assembly starts to descend energizes the solenoid 176 which reverses valve 179 and introduces air under pressure to the front end of feed cylinder 119 through pipes 180 and 182 and connects the rear end to exhaust through pipes 183 and 181. The piston 118 is driven to the opposite end of cylinder 119, as in Fig. 5, carrying with it the rod 112 and the slotted connection 111. The lever 110 rotates the shaft 107 and levers 106. This results in the retraction of the pair of feed jaws 79 by sliding blocks 103 and feed bars 93, Fig. 5, and since the free end of the sheet plastic material is protruding through the heater plates 77 and is firmly clamped by feed jaws 79, the sheet material is drawn through the heater plates over the draw plate 31. The free end of the web *w* is released when the pivoted jaw 80 of each of the feed jaws 79 (Figs. 10 and 11) strikes the stop rods 100, is pivoted to its release position and is held there by the toggle action of the spring 84. The stop rods 100 are slidably held in their normally extended position in the guides 95 by the springs 101 and collars 102, but are pushed part way through guides 95 by the feed jaws 79 when the feed jaws are in their retracted position, as in Fig. 5. The edge of the sheet plastic material hits stop fingers 31', Fig. 11, only one of which are shown, which prevents the sheet from adhering to the toothed jaws and being pulled beyond the draw plate 31.

Rotation of the shaft 107 results also in rotation of the crank 120 which retracts the lower knife actuating rod 123 from the position shown in Fig. 1 to the position of Fig. 5. The forked lever 127, Fig. 6 rotates under the influence of spring 137 and drives the knife support 135, through the pinion 133 and rack 135, to its cutting position, as shown in Figs. 5 and 6. The collar 128 provides a lock against counter-rotation of the pinion when the cutting action takes place. That is, when the die assembly approaches the lower limit of its downward stroke the clamping plate 15, preceding the die slightly, descends to clamp the web to the draw plate 31, and the upper knife blade 146 carried by the clamping plate 15 cooperates with knife blade 144 to shear off that portion of the web positioned on top of the draw plate 31. The clamping plate 15 operates to clamp the web to the draw plate 31 before the forcing action of the die takes place, by being released by the latching members 14, Fig. 7. As the die assembly descends, the stop 18 pivots the latch around its pivot 13 to release the clamping plate and permit it to drop to the cushioning springs 25. When the die arrives at the bottom of its stroke the latches 14 cam over the beveled edge of the clamping plate 15 and once again support it. The pawl 17 permits the holding latch

14 to pass the stop 13 on the upward stroke without interference, as shown in Fig. 8.

The limit switch 184, see Figs. 1, 5 and 14, which is actuated by bracket 185 carried by lever 106, is opened when this lever is rotated by the shaft 107, as in Fig. 5. This deenergizes the timing element 187 which automatically resets and remains in readiness for its next signal from the switch 184.

With the sheet plastic material now cut off and clamped to the draw plate 31 by the clamping plate 15 the die assembly completes its downward stroke. The die enters the draw aperture pushing along with it the plastic material suspended over said aperture until part of the die assembly bottoms against the draw plate 1, and is held there by pressure against the piston 7, as in Fig. 5. The sheet material has now been stretched tightly from the edge of the draw plate opening over the male forming die. After a preset interval of time the timing element 154 (Fig. 14) breaks the circuit between contact 159 and 157, thus deenergizing solenoid 160. The air valve 163 returns to the position shown in Fig. 14 and the diaphragm valves reverse and the piston 7 starts upward and with it the die assembly. At the top of this upward stroke the cylinder plate 9 contacts the limit switches 147 and 148, opening the circuit to these switches. Opening switch 147 opens the circuit between power line 150 and 152, deenergizing timing element 154 which now resets automatically. Since the timing element 154 had already broken the circuit to solenoid 160 at the bottom of the die stroke there is now no change in the solenoid 160, the valve 163, or the diaphragm valves 167 and 168. The piston 7 travels to the top of its stroke and is held there by hydraulic pressure.

Opening limit switch 148 opens the circuit to the solenoid valve 176, the air valve 179 reverses, pressure is reversed in the feed cylinder 119 which causes the piston 118 to reverse its position in the cylinder and causes the feed jaws 79 to advance and grasp the web protruding from the heating plates 77, the position shown in Figs. 1, 7 and 10. This action also results in a withdrawal of the lower knife holder 135 to its lower position through the retraction of the rod 123. The feed jaws 79 and the knife holder 135 are held in this position by air pressure against the piston 118 in the cylinder 119 (Fig. 1).

When the above described action takes place the bracket 185 carried by lever 106 strikes the button of the limit switch 184 closing the circuit in this switch (Fig. 1). This action energizes timing element 187 (Fig. 14) which closes the circuit through contacts 190 and 192 for a preset interval of time. This energizes solenoid 193, reversing valve 196, and air under pressure flows through nozzles 199 and 200 in the form of a high velocity air blast, as is shown somewhat diagrammatically in Fig. 13. The air from nozzle 200 serves to blow the formed plastic hood from the die 20 downwardly toward the draw plate 31. At this point the jet from nozzle 199 serves to eject the article from the press up a discharge chute to a receptacle or conveying means.

The duration of this ejecting action is controlled by timing element 187 and need only be for a very short time—two seconds, approximately. When the preset time interval elapses the circuit is broken between contacts 190 and 192, solenoid 193 is deenergized and spring pressure returns the valve 196 to its closed position (Fig. 14). The circuit of the timing element 187 is still closed, but inoperative, since its circuit must be broken, through limit switch 184, before it will reset or automatically recycle to operate. Contact 190 meets contacts 201, but if the switch 202 is open, as might be the case when setting up the machine before starting on an automatic run, there is no flow of energy between the line 203 and 152, and the machine and its controls remain in the condition shown in Figs. 1 and 14. This might be termed the one cycle operation. In order to start a following cycle the "start" button of switch 153 must be pressed to energize line 152 and the timing element 154. However, in normal running operation the switch 202 would be closed, connecting line 152 with line 203 so that, as soon as the timing element 187 returns its contact arm i to rest position and its live contact 190 strikes contact 201, a circuit is immediately closed to timing element 154 energizing it and automatically starting the working cycle as has been explained above.

Referring to Fig. 15, there is a power circuit 100 from which heating current is turned on and off in circuit 77' each controlled by a thermostat 101 sensitive to the temperature of its heating plate or oven parts 77 to hold the oven temperature substantially constant. There is another heating circuit 20' turned on and off by a thermostat 102 sensitive to the temperature of male die part 20 to hold the temperature of this part substantially constant. There is another heating circuit 15' turned on and off by a thermostat 103 sensitive to the temperature of clamp plate 15 to hold this plate temperature substantially constant. There is another heating circuit 31' turned on and off by a thermostat 104 sensitive to the temperature of draw plate 31 to hold this plate temperature substantially constant. Under the heating plan indicated or an equivalent one the temperature of the sheet plastic material is made one that will draw best when it is drawn by the machine. For example the oven or heating plates 77 may give the sheet the right drawing temperature and the other machine parts thereafter contacting the sheet are heated just enough to avoid heat loss until the sheet is drawn. Or the heat can be more gradually added to the sheet it being important that the sheet being drawn is carefully guarded against a marring chill and be of the right drawing softness when it is drawn.

The plan of Fig. 15 is diagrammatic only. It is sometimes useful, particularly in working plastic material, to use fluids in cored passages of tool parts to control the temperature of the plastic for working it. There is the advantage that any tendency of overheating can be corrected by mixing hot and cold fluid to get the right tool temperature speedily. The electrical heating plan lends itself better to a simple diagram sufficient for the purpose of this disclosure.

There are some particularly important things to do in providing for practicing the invention and especially important when the depth of drawing begins to or substantially exceeds one half the width of the article being made, as is indicated in the article of Fig. 12A when the depth and width are about equal. Referring to Fig. 5, the two openings one in each of the two plates 15 and 31 through which the former or male die 20 passes, should be most carefully dimensioned with respect to the thickness of the sheet plastic material, i. e. the work piece, shown in the relation of the parts in Fig. 5. Of course

the male die part will be deeper when the article of Fig. 12A is made. The dimensions should be made in all dies and especially the deep die forms, to provide a very small clearance between the sheet plastic material and the opening in the female clamping plate 31. For example, in forming sheet material to make successive hoods, the thickness will vary a little. Suppose it is between .001 and .002 of an inch. Then the openings in plates 15 and 31 should be made as close as possible to be sure to provide for such variation but otherwise omit all clearance between the material and plate 31, as seen in Fig. 5. One fault in prior efforts to draw hoods of satisfactory finished appearance, especially the deep hoods of Fig. 12A, is in providing for too great clearance between the draw plate and die. Of course there are practical difficulties in getting extremely close dimensions. The important thing is to consider the requirements of providing for variations in sheet plastic thickness. It is available commercially with variations of a very few thousandths of an inch. When care is taken to provide the space corresponding to that seen in Fig. 5 as filled with material of the article being made, between part 20 and plate 31, to accommodate variations of a very few thousandths of an inch in the sheet material thickness and far as possible avoid additional clearance, the proper practice will be followed. As a practical matter the degree of clearance can be kept within a range of a very few thousandths of an inch and this appears to be a condition for the most successful work in any hood and one essential for making deep hoods. It is in contrast to very much larger clearances heretofore provided in the proposals and attempts to draw fine appearing hoods whose depth is anywhere near or beyond one half their width in relative dimensions.

Another important provision in operating the method by machine work to get an economical commercial operation is this. Referring to the drawings, the flat plastic sheet is initially heated in the oven. It then moves to lie on the draw plate. This plate is heated and kept at a substantially constant temperature. The sheet is engaged between the hold down or clamping plate 15 and draw plate 31. This plate 31 is also heated and kept at a substantially constant temperature. The sheet is then engaged by the forming die 20. This die is also heated and kept at a substantially constant temperature. Thus the sheet properly heated to that softness suitable for drawing is not chilled. It is neither overheated nor underheated but its drawing softness effectively provided for and guarded until the sheet is drawn to finished hood form. This is a critical thing because if the material is anywhere underheated in the area drawn there is a strain which frequently tears or wrinkles it. If the material is anywhere overheated in the area drawn there is a high liability and frequent occurrence for the sheet to be given "pock-marked" areas or blemishes in the finished article making it unsatisfactory for its intended use.

Another important provision is to maintain a definite and uniform pressure at the edge margin of the material, i. e. the margin of material engaged between plates 15 and 31, as the material is drawn through the draw plate opening. When the material starts to be formed over the male die, it must be slightly stretched and at the same time it must be allowed to slip from underneath the hold down or clamping plate just the right amount and this can be provided for only by properly guarded uniform pressure on the edge of the material. The useful way to accomplish this as herein disclosed is by the pressure due substantially to the weight alone of hold down or clamping plate 15 deposited on top of the material resting on draw plate 31. The weight gives uniform pressure and such weight is easily made just the right weight for its hold down function. It will not vary in the operation and wear of the machine and once determined for a particular article will remain constant as long as the machine lasts. The pressure will not vary in successive operations.

It is useful to have the male forming die heated for the reason before stated so as not to chill the material being drawn and mar its appearance. It is also desirable, however, to have this die part begin to cool the material as it is being drawn. That is, the temperature of the material can be above that of the die so that while the cooling effect or heat loss of the material is too little to interfere with the drawing, it is enough to start the material cooling toward the permanently setting temperature of the plastic material to the hood form. The material should be so set before it is removed from the forming die. The heating arrangement, i. e. a difference in the temperature of the material and the male die temperature is for the purpose of avoiding time loss in the period of dwell of the material at the forming station in the operation of the machine. The machine disclosed is an expensive one and it is useful to increase its production by any means to save time in the operation of forming and then setting the sheet plastic material just that amount necessary to remove the article from the male die.

From what has been stated one will understand the importance of a close temperature control in the operations of making the articles not only to guard their quality but to use the tools and the machine most efficiently. To disclose the plan with reference to a diagram, one indicated as suitable to electric heating means is shown in the drawings. Another suitable means not shown is by coring the tools for the passage of fluid to control the temperature. This way would have the advantage that the fluid could be quickly changed in temperature by mixing cool and hot fluid for passage through the tool metal to hold the temperature down on any tendency to overheat. The diagram of the drawings shown is only a diagram to indicate the plan for close temperature control of machine parts. It will be sufficient to disclose the nature and principles of temperature control for efficient operation and one which is highly desirable to quality of the articles to be made. The equivalency between electrical and hydraulic means for holding the right temperature of the machine tools will be apparent without diagramming the hydraulic means in the drawing.

The invention having now been disclosed, the claims are:

1. A machine to make hoods from sheet plastic material comprising in combination, a horizontally arranged draw plate having an opening with an edge corresponding to a base line of a hood, a roll support adapted to hold a roll of plastic sheet material, a web support for the material, power driven means adapted to intermittently draw portions of material off its roll and put it on the web support in loose web condition, an open ended oven in position for the web to pass through toward said draw plate, web feeding

means including power driving means to feed the forward end of the web intermittently to draw one part into the oven and another heated part from the oven across the draw plate to cover its opening, web cutting means to shear off the portion of web covering the draw plate opening clamping means to press the margin of the heated cut part around the draw plate opening, power tool reciprocating means mounted above the draw plate opening, a drawing tool, in the shape of a core corresponding to a hood cavity, such tool carried by said reciprocating means, the aforesaid elements being operable under power for repeated cycles of operation, to draw a heated sheet portion from the oven, cut it off from the continuous web clamp it over the draw plate opening, move the drawing tool against the plastic material and draw the latter to hood form while the material at the edges of the opening is held in flat pressed condition by the clamping means, and air blast means adapted to blow aside the cutoff drawn portion clear of the drawing tool after the latter has operated and the clamping means has been released.

2. A machine to make hoods from sheet plastic material comprising in combination, a horizontally arranged draw plate having an opening with an edge corresponding to a base line of a hood, a roll support adapted to hold a roll of plastic sheet material, a web support for the material, power driven means adapted to intermittently draw portions of material off its roll and put it on the web support in loose web condition, an open ended oven in position for the web to pass through toward said draw plate, web feeding means including power driving means to feed the forward end of the web intermittently to draw one part into the oven and another heated part from the oven across the draw plate to cover its opening, web cutting means to sever the heated part when said part is in position across the draw plate opening, clamping means to press the margin of the heated part around the draw plate opening, power tool reciprocating means mounted above the draw plate opening, a drawing tool, in the shape of a core corresponding to a hood cavity, such tool carried by said reciprocating means, the aforesaid elements being operable under power for repeated cycles of operation, to draw a heated sheet portion from the oven, sever it from the continuous web clamp this blank over the draw plate opening, move the drawing tool against the plastic material and draw the latter to hood form while the material at the edges of the opening is held flat by the clamping means to permit controlled slipping, air blast means to blow the cut off drawn portion to one side of the drawing tool after the latter operates and such cut off portion is unclamped, and power operated timing means for controlling the sequence in the power operation of said elements whereby the machine is adapted for fully automatic operation to make hoods one after another, except in relation to replacing exhausted spools of the sheet plastic material.

3. A machine for shaping articles from predetermined lengths of thermoplastic sheet material comprising, the combination of, a web supply support adapted to hold a web supply of plastic sheet material, a power driven web feed assembly adapted to feed predetermined lengths of the web from the web supply, a web support positioned beneath the level of the web supply and the feed assembly and presenting a horizontally disposed support for the web as it passes from the feed assembly, heating means forming a heating zone positioned adjacent said web support in horizontal alignment therewith whereby successive predetermined lengths of the web may be pulled horizontally from the web support to said heating zone for heating with the leading end of the web at the edge of the heating zone opposite said web support, a forming die assembly positioned adjacent the heating zone at the side thereof opposite said web support and adapted to receive the predetermined lengths of the web from the heating zone, said forming die assembly including a horizontally arranged plate having an opening with an edge corresponding to a base line on an article being formed, web-cutting means to shear off the portion of the web covering said opening, clamping means to press the margin of the heated cutoff part around said opening, and means to shape the web into said opening to form articles, power operated web-pulling mechanism comprising web clamping means to clamp the leading edge of the web and elongated means supporting said web clamping means, and mechanism to operate said web-pulling means through a cyclic operation whereby said web clamping means is caused to engage and clamp the leading end of the web at the edge of said heating zone and is then moved through the zone of said forming die assembly a distance equal to said predetermined length of the web, whereby a heated length of the web is drawn from the heating zone into the forming die assembly and another length of the web is drawn into the heating zone.

4. A machine for shaping articles from predetermined lengths of thermoplastic sheet material comprising, the combination of, a web supply support adapted to hold a web supply of plastic sheet material, a power driven web feed assembly adapted to feed predetermined lengths of the web from the web supply, a web support positioned beneath the level of the web supply and the feed assembly and presenting a horizontally disposed support for the web as it passes from the feed assembly, heating means forming a heating zone positioned adjacent said web support in horizontal alignment therewith whereby successive predetermined lengths of the web may be pulled horizontally from the web support to said heating zone for heating with the leading end of the web at the edge of the heating zone opposite said web support, a forming die assembly positioned adjacent the heating zone at the side thereof opposite said web support and adapted to receive the predetermined lengths of the web from the heating zone, power operated web-pulling mechanism comprising web clamping means to clamp the leading edge of the web and elongated means supporting said web clamping means, and mechanism to operate said web-pulling means through a cyclic operation whereby said web clamping means is caused to engage and clamp the leading end of the web at the edge of said heating zone and is then moved through the zone of said forming die assembly a distance equal to said predetermined length of the web whereby a heated length of the web is drawn from the heating zone into the forming die assembly and another length of the web is drawn into the heating zone.

5. A machine as described in claim 4 wherein said web-pulling mechanism comprises a plurality of individually operating units each of which includes one of said elongated means in the form of a bar and one of said web-clamping means in the form of a top jaw rigidly fixed to its bar and a

swingable bottom jaw spring-urged into engagement with its top jaw, and stationary abutment means which is adapted to engage and swing the lower jaws away from the upper jaws at the end of each web-pulling operation.

6. Apparatus as described in claim 5 wherein each of said lower jaws is provided with a spring which is adapted to retain the jaw in either of its extreme positions wherein it either clamps against its upper jaw or is positioned spaced therefrom, means positioned adjacent said heating zone to move each of the lower jaws into clamping relationship, and wherein said mechanism to operate the web-pulling means comprises a rocking lever construction pivoted at its lower end on a horizontal axis beneath said bars and mechanically interrelated at its upper end to said bars, and hydraulic means to swing said rocking lever construction.

CHARLES EDGAR MAYNARD.
LEWIS H. GUSTAFSON.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
483,957	Godfrey	Oct. 4, 1892
1,181,964	Bohlman	May 2, 1916
2,229,613	Strauch	Jan. 21, 1941
2,255,116	Helmstaedter	Sept. 9, 1941
2,270,186	Dulmage	Jan. 13, 1942
2,270,187	Dulmage	Jan. 13, 1942

Certificate of Correction

Patent No. 2,521,387 September 5, 1950

CHARLES EDGAR MAYNARD ET AL.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows:

Column 7, line 69, after the word "circuit" insert *through*; column 12, line 25, for "circuit" read *circuits*;

and that the said Letters Patent should be read as corrected above, so that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 2nd day of January, A. D. 1951.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.