United States Patent

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[54] **FLAT BED TYPE CASTING MACHINE IMPROVEMENTS**
6 Claims, 6 Drawing Figs.

[52] **U.S. Cl.** **18/17,** 100/271
[51] **Int. Cl.** **B29h 5/00**
[50] **Field of Search** ..... 18/43, 44, 17 (E), 17 (M), 16 (M), 16 (H), 16 (F); 100/233, 271; 38/41

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ABSTRACT: A casting machine for casting thin plastic articles having a flat lower platen and a moveable upper platen closing with the lower platen with a clamshell motion and having fluid motor means associated with the upper platen whereby the rate of closure of the upper platen may be progressively varied. A floating clamping frame associated with the lower platen for securing a matrix to the lower platen.

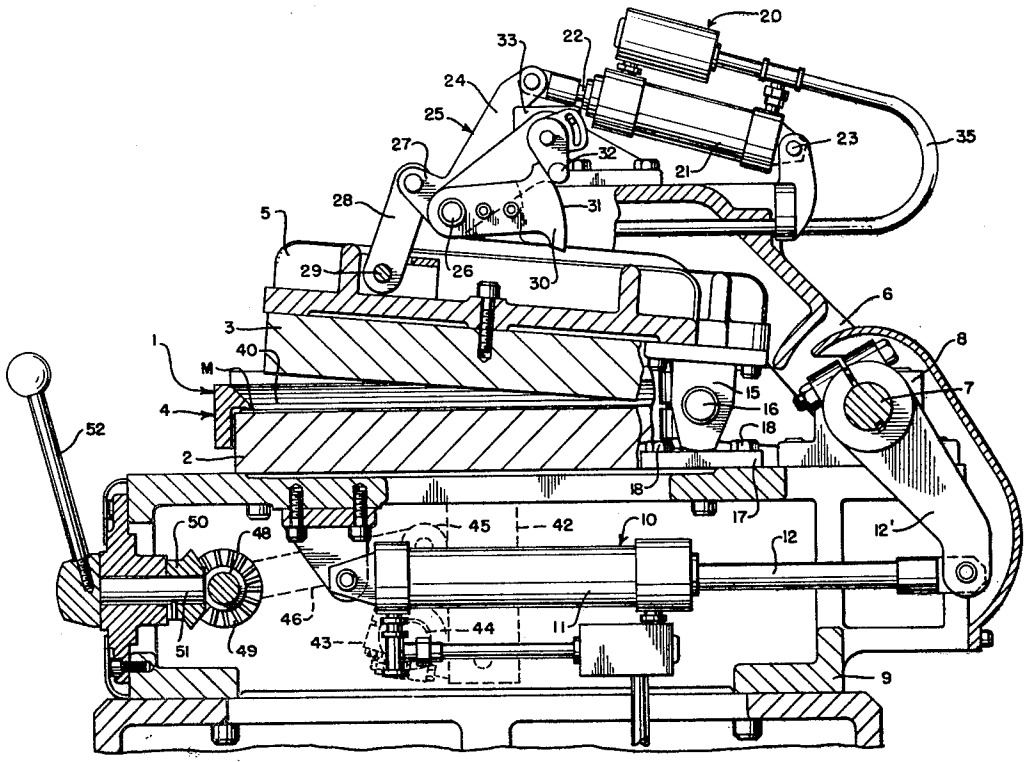
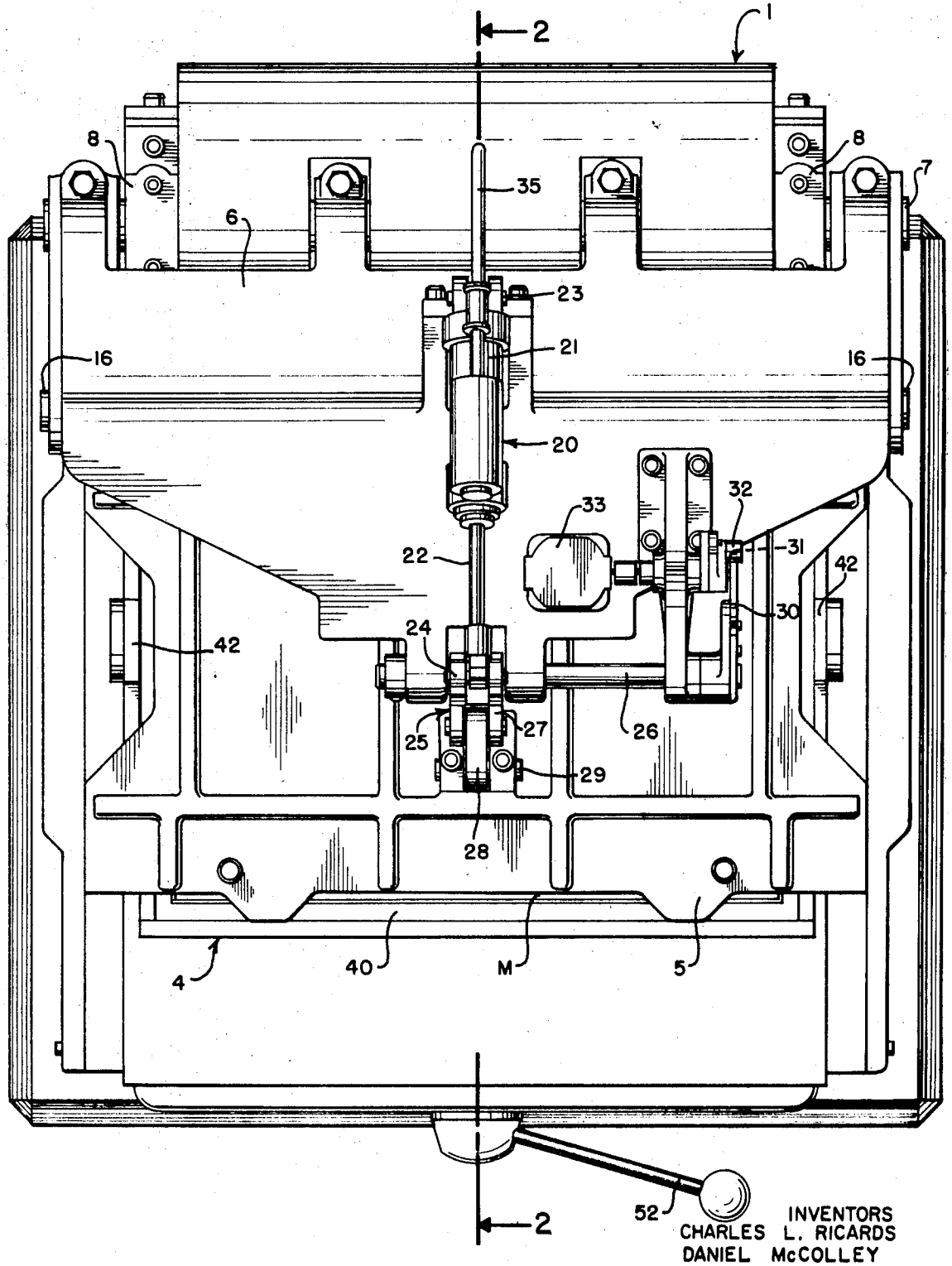


FIG. 1



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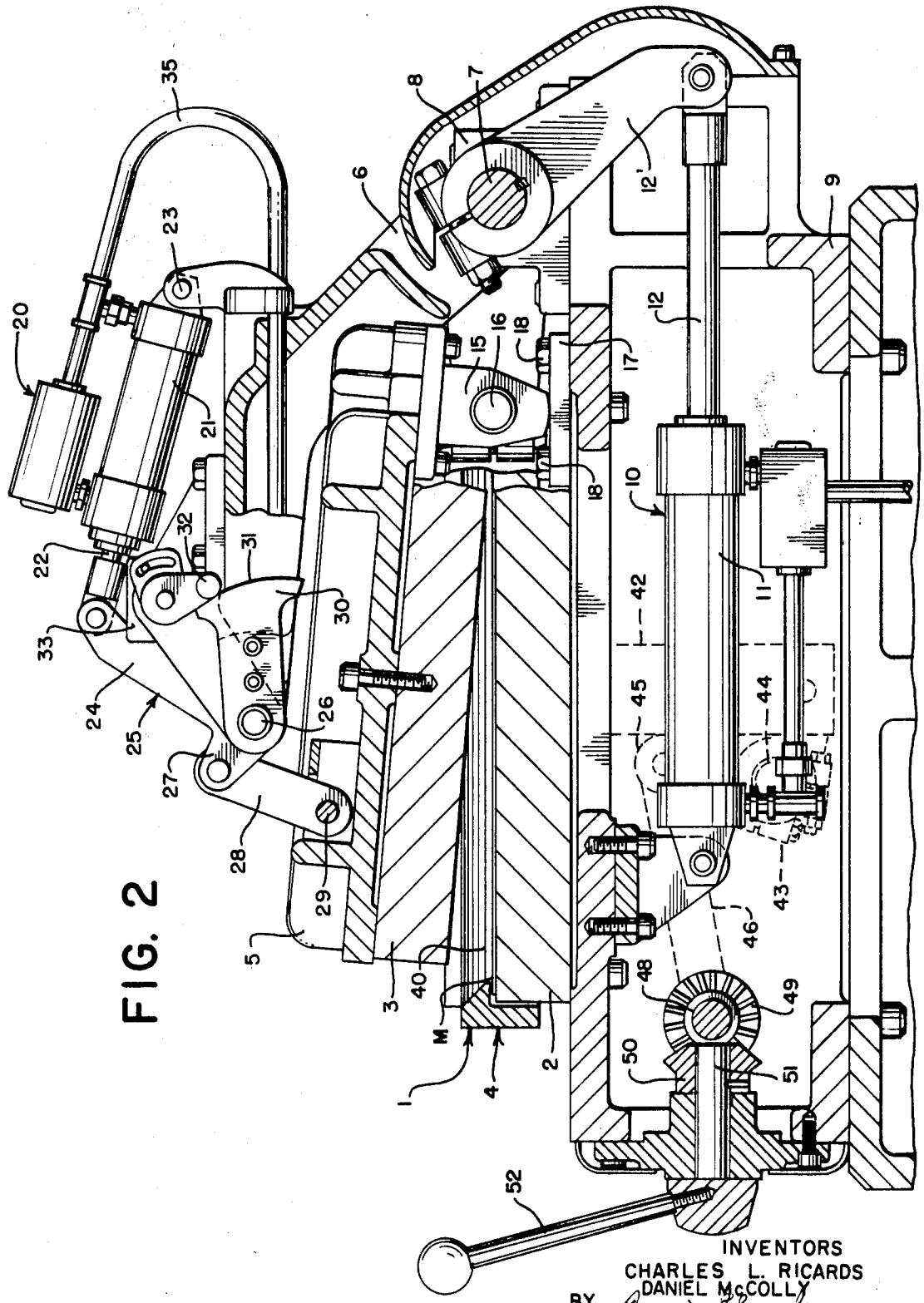


FIG. 2

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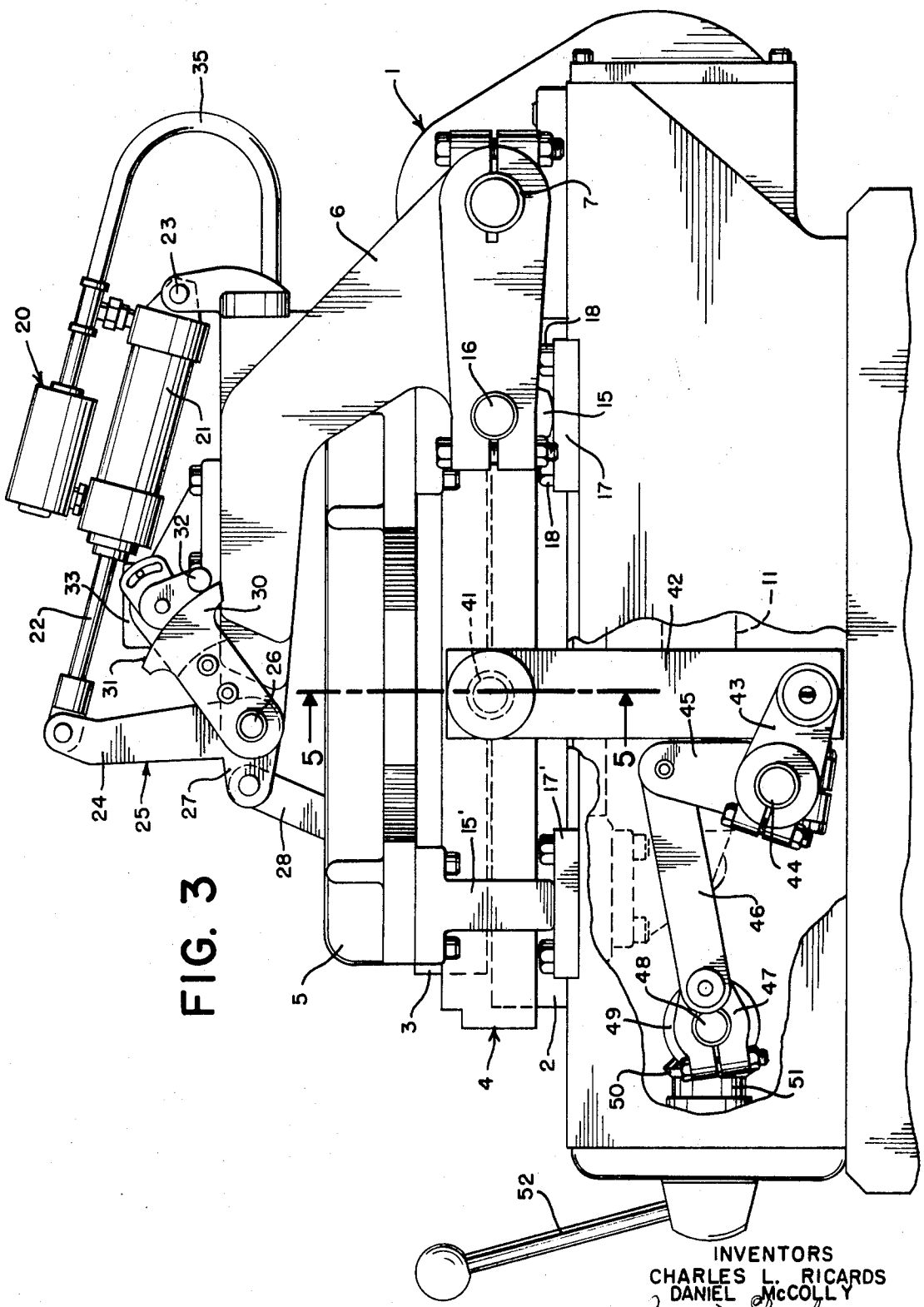
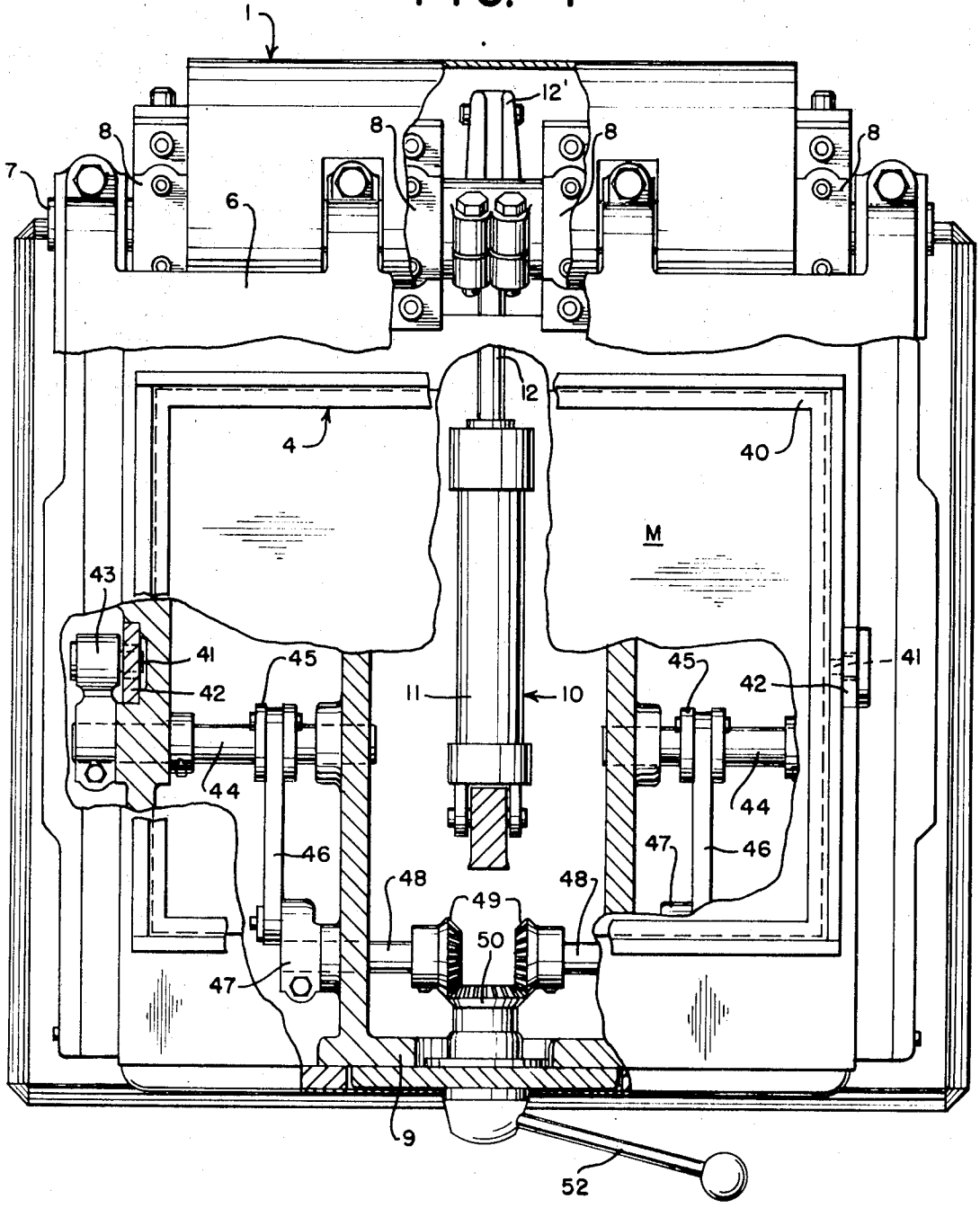


FIG. 3

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FIG. 4



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FIG. 5

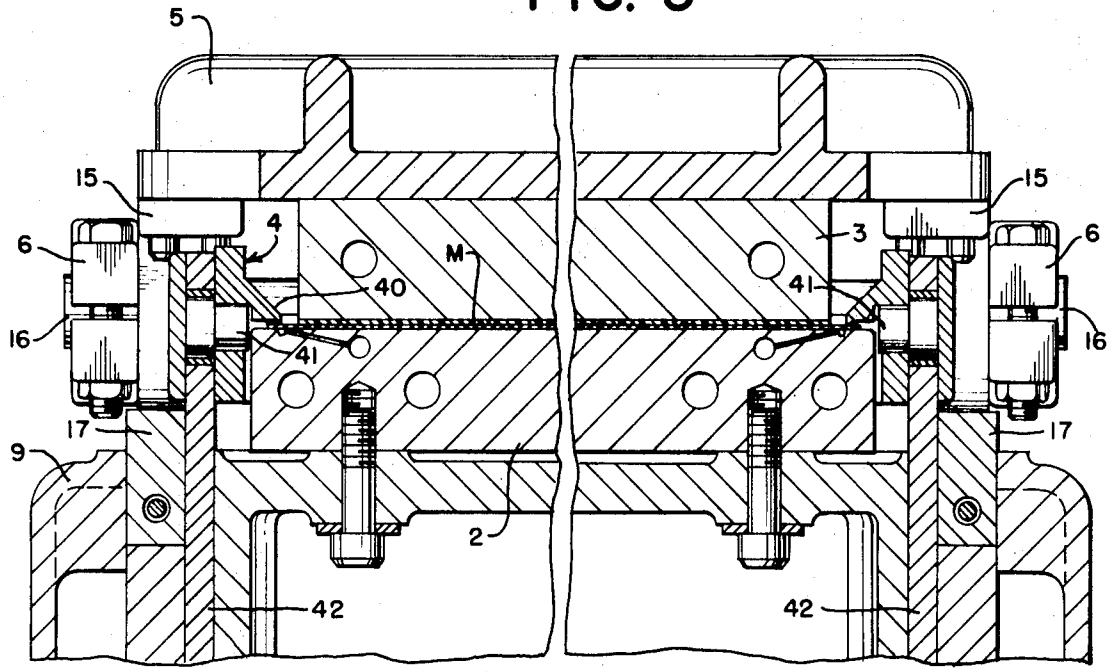
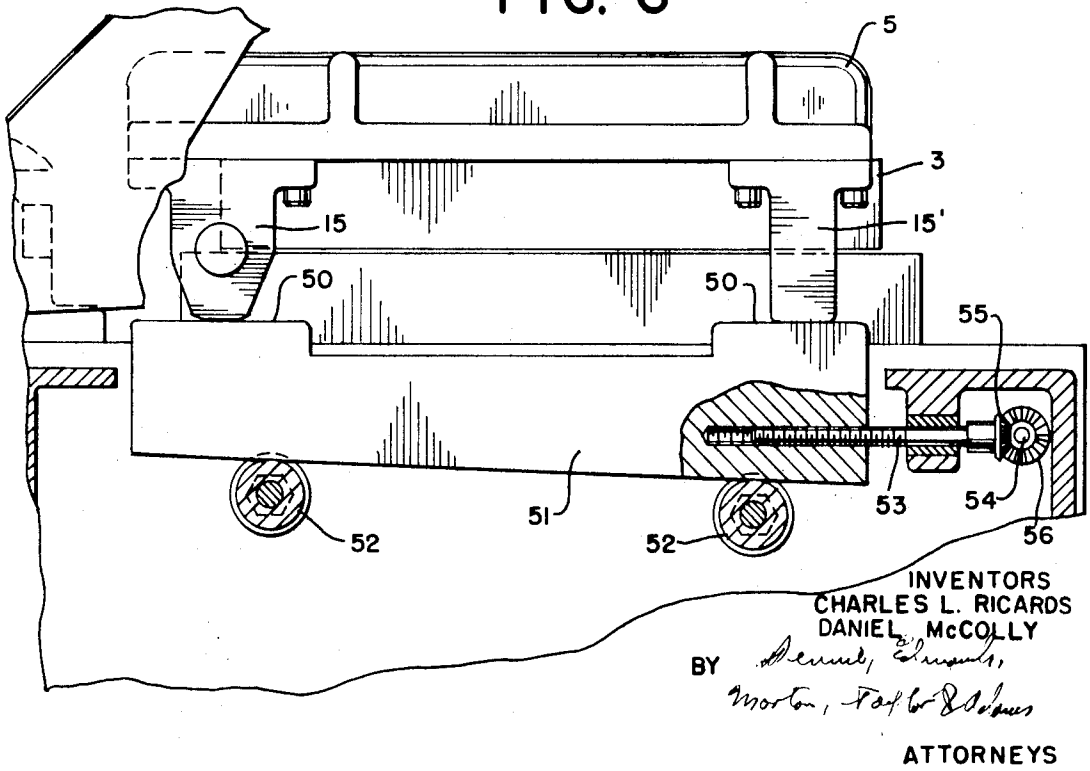


FIG. 6



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FLAT BED TYPE CASTING MACHINE IMPROVEMENTS

BACKGROUND OF THE INVENTION

This invention relates to a plate casting machine and more particularly to a machine for casting thin plastic printing plates from a thermosetting liquid resin having exothermic characteristics upon curing. The invention also relates to a clamping frame by which a matrix is clamped to a lower platen upon which the liquid resin is flowed and wherein the clamping frame is mounted for floating movement with respect to the matrix to accommodate matrices having varying thicknesses and uneven surface conditions.

Plate casting machines have been proposed for casting flat printing plates which have a lower platen and a moveable upper platen which is secured at one end to a hinge in turn mounted on an arm which is pivotable about a hinge line such that the upper platen closes with the lower platen with a clamshell motion. This use of a double hinge arrangement assures that the upper platen will completely close with respect to a lower platen notwithstanding the thickness of the printing plate being cast or whether the lower platen is slightly tilted. Liquid resin is flowed onto a matrix in turn clamped to the lower platen at the side of the matrix adjacent the hinge lines or closed end of the clamshell after which the upper platen is closed.

Because the liquid resin used has exothermic characteristics upon curing, it becomes vitally important that the rate of closure of the upper platen with the lower platen be precisely regulated in order that the upper platen may serve as a heat sink for the resin during curing. However, the matrix upon which the liquid resin is flowed contains a number of indentions and protuberances corresponding to the printing portions of the plate to be produced which serve to impede the flow of resin over the surface of the matrix. If precautions are not taken, voids or air bubbles may be cast into the plate because of the inability of the liquid resin to completely fill these depressions. This failure to fill the depressions can be caused among other things by the resin gelling before it has a chance to completely wet the matrix or when an upper platen having a clamshell closing movement is used, in the flow of the main body of the resin being accelerated by the descending upper platen such that it is faster than a normal advancing wave of liquid resin seeking its own level. In this latter case, the flow of resin will be over the depressions rather than into them resulting in entrapped air bubbles. Printing plates containing air bubbles are objectionable in that the printing portions of the plate will be marred. This can be extremely important wherein the printed matter may take the form of a telephone book where accuracy of printing is a vital requirement.

A further problem entering into the casting of printing plates using flat bed casting equipment is that the rate of the advancing wave of liquid resin over the matrix from the area on which it is initially flowed progressively decreased due to partial curing of the resin. It therefore becomes apparent that the rate of closure of the upper platen with respect to the lower plate must vary to the same extent as the rate of advance of the liquid resin on the matrix, if the upper platen is not to accelerate the flow of the main body of resin over the matrix and at the same time engage the resin to provide a sufficient heat sink.

The pressure with which the upper platen contacts the liquid resin in the machines proposed heretofore depends entirely upon the weight of the platen. In some instances it may be desirable to vary the force with which the platen engages the liquid resin to vary the characteristics of the plate produced.

The prior casting machines utilize matrix clamping rings or frames which clamp the outer periphery of a matrix to the surface of the lower platen and which at the same time serve as a coffer dam by which the liquid resin is contained on the matrix. These frames are pivoted at one end adjacent the closed end of the clamshell arrangement of the upper and lower platens. Thus if for any reason the matrix used is thicker at one end than at the other, the frame will clamp the matrix with an uneven engagement.

It is therefore an object of my invention to provide a means whereby the rate of closure of the upper platen may be precisely regulated such that there will be no acceleration of the main body of liquid resin over that of the advancing wave of resin to thus prevent any entrapment of air bubbles at the bottom of the depressions of the matrix. It is a further object of the invention to provide a means whereby the rate of closure of the upper platen will be progressively decreased in order to compensate for the decreased rate of advancement of the wave of liquid resin due to partial curing. A still further object of the invention is to provide for a floating matrix clamping frame which will compensate for any change in thickness of the matrix between the ends of the matrix to insure uniform engagement of the frame with the edges of the matrix.

Broadly, a casting machine constructed according to my invention has a flat lower platen with a clamping frame associated therewith for clamping the matrix to the plate. The clamping frame is journaled in two journals positioned on the sides of the platen midway between the front and back ends. In this manner the matrix clamping frame is free to rotate about the journals to compensate for any change in thickness of the matrix between its ends.

A flat moveable upper platen is provided which is carried by an arm pivotable about a first hinge line extending parallel to an end of the lower platen. The upper platen is mounted on the arm at one end by a hinge which forms a second hinge line about which the platen pivots. Stops are provided to limit movement of the arm towards the upper platen closed position. Power means are included for moving the arm about the first hinge line. A hydraulic motor is mounted on the arm and is connected to the upper platen to pivot the platen about the second hinge line to final closing engagement with the lower platen. Cam operated valve means are provided for varying flow of hydraulic fluid in the hydraulic motor in order that the rate of closure of the upper platen may be progressively decreased to compensate for the decreased rate of advancement of liquid resin as it spreads over the matrix.

DESCRIPTION OF THE DRAWINGS

FIG. **1** is a plan view of a casting machine constructed according to the invention;

FIG. **2** is a side sectional view of FIG. **1** taken along lines **2–2** illustrating the upper platen in the partially open position;

FIG. **3** is a side view of FIG. **1** illustrating the upper platen in the fully closed position;

FIG. **4** is a part sectional plan view of the machine of FIG. **1**;

FIG. **5** is a sectional view of the machine of FIG. **3** taken along lines **3–3**; and

FIG. **6** is a sectional view of a further embodiment of the casting machine illustrating means for varying the distance between the upper and lower platens to vary thickness of the plates cast.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIGS. **1** and **2** there is illustrated a casting machine **1** having a lower platen **2** and an upper platen **3**. Both the upper and lower platens are made of heavy gauge steel in order to provide sufficient heat sink for the liquid resin as it cures and both are provided with passages therein such that a heated fluid may be circulated therethrough to maintain the platens at a desired base temperature. The lower platen has a matrix M clamped thereon by means of a mat clamping frame **4** as more fully explained hereafter.

The upper platen **3** is carried by platen frame **5** in turn carried by rotatable arm **6**. Rotatable arm **6** is mounted on a shaft **7** in turn rotatably mounted in bearing **8** situated on the frame **9** of the casting machine. Arm **6** and bearing **8** together form a first hinge having a first hinge line extending parallel to the

rear ends of the platens and about which the arm pivots. Power means 10 in the form of a fluid motor comprising a cylinder 11 and a piston, not shown, is connected by piston rod 12 to the arm 12' keyed to shaft 7 and provides a means for pivoting the arm about the hinge line in order to move the upper platen towards and away from a closed position.

A bracket 15 is mounted on each rear side of the frame 5 and provides a journal for a shaft 16 carried by the arm 6. The brackets 15 and shaft 16 together form a second hinge having a second hinge line about which the upper platen 3 may pivot. The brackets 15 are adapted to bear on rear stops 17 which are adjustable vertically with respect to the machine frame 9 and the lower platen 2 by bolts 18. As seen in FIG. 2, rotation of the arm 6 in the counterclockwise direction and towards the upper platen closing position will be limited by engagement of the brackets 15 with the stops 17. Brackets 15' similar to brackets 15 are mounted on the front end of the platen 3 for engaging adjustable stops 17' similar to stops 17 in order to limit downward movement of the front end of the upper platen. The rear stops 17 are so adjusted that they limit rotation of the arm 6 when the upper platen is at an angle of approximately 5° with the lower platen and where the rear engaging surface of the upper platen will just contact the upper surface of liquid resin that has been previously poured onto the rear end of the matrix adjacent the hinge line. It is apparent that the distance between the upper and lower platens when the upper platen is in the closed position and thus the thickness of any plate being cast may be conveniently regulated by adjusting stops 17 and 17'.

A hydraulic motor 20 is mounted on the arm 6 and comprises a cylinder 21 having a piston therein connected to piston rod 22. The blind end of the cylinder 21 is pivotally connected to the arm 6 by means of a pin 23 while the rod 22 is connected to an arm 24 of a bellcrank 25. Crank 25 is keyed to a rotatable shaft 26 carried on the end of the arm 6 and the arm 27 of the crank is connected to link 28 which is also connected to the upper platen frame 5 by pin 29.

Shaft 26 has an arm 30 keyed thereto having a cam surface 31 on its outer end. A cam follower 32 which is connected to the control mechanism of a valve 33 engages cam surface 31. The valve 33 is contained in a hydraulic circuit leading from the rod end of the cylinder 21 such that movement of the cam follower varies flow of hydraulic fluid from the rod end of the cylinder as the piston in the cylinder is moved from the blind end towards the rod end by force of hydraulic pressure in the blind end.

A conduit 35 leads to a conventional crossover valve not shown which controls the flow of hydraulic fluid into and out of the blind end of the cylinder either to direct flow from the cylinder to a sump or from a source of pressure into the cylinder. The hydraulic circuitry in which the motor 20 is included contains conventional solenoid operated valves and pump controls which are actuated by limit switches or timers. Thus limit switches not shown are provided for operating valves to admit pressure into the blind end of the cylinder 21 when the arm 6 has moved to its counterclockwise limit as determined by the brackets 15 engaging the stops 17. Conventional checks and bypass check valves are included in the circuitry such that hydraulic pressure may be exerted into the rod end of the cylinder 21 to raise the upper platen after a plate has been cast. Similarly, the hydraulic circuitry in which the power means 10 is included likewise includes conventional solenoid valves operated by limit switches to control movement of the arm 6.

The cam surface 31 is so proportioned that the valve 33 is progressively closed as the upper platen moves from the partially closed position shown in FIG. 2 to the fully closed position shown in FIG. 3. Closure of the valve 33 progressively reduces the outflow of hydraulic fluid from the rod end of the cylinder 21 thus reducing the velocity with which the rod 22 moves under the force of hydraulic pressure in the blind end of the cylinder.

As seen by reference to FIGS. 2 and 3, as rod 22 moves to the left, it will cause crank 25 to move in a counterclockwise direction thus depressing arm 28 and causing platen 3 to pivot counterclockwise about the shaft 16. When the platen reaches the fully closed position as shown in FIG. 3, a predetermined closure pressure may be maintained by the upper platen by maintaining a predetermined positive pressure on the blind side of the cylinder 21. If for any reason it is desired to vary the closure pressure of the upper platen, this may be conveniently done by varying the hydraulic pressure in the blind side of the cylinder.

It is apparent that the rate of final closure of the upper platen with respect to the lower platen may be conveniently varied by varying the cam surface 31. Thus the machine can be easily adjusted to accommodate different resins having different flow characteristics where the rate of advancing flow of the resin over a matrix may vary.

Referring to FIGS. 3, 4 and 5, the matrix clamping frame 4 comprises a rectangular frame which extends around the outer periphery of the lower platen and which has thereon a knife edge 40 for engaging into the upper surface of a matrix. As shown the frame comprises an integral casting which has stub shafts 41 positioned approximately midway along its sides extending between its front and back ends which are rotatably mounted in vertically moveable arms 42. Arms 42 in turn are connected by arms 43 to a rotatable shaft 44 extending across the machine. Shaft 44 has thereon arms 45 which are connected by links 46 to arms 47 mounted on the ends of a rotatable shaft 48 carried in the frame of the machine. The drive end of each of the shafts has a bevel gear 49 thereon meshing with a bevel gear 50 connected to a shaft 51 on which a handle 52 is mounted to provide a single clamp actuation means. It is seen by reference to FIGS. 3, 4 and 5 that the stub shafts 41 and thus the frame 4 may be conveniently raised and lowered by movement of the handle 52 such that a matrix may be replaced on the lower platen. Since the frame 4 is pivotable about the shafts 41 near its center, it in effect floats with respect to the matrix and thus is able to accommodate matrices which may be thicker at one end than the other.

In some casting machines it is desirable that the lower platen be tilted such that its front end is lower than its rear end to assist in the flow of resin over the matrix. The floating feature of the matrix clamping frame will accommodate change in tilting of the lower platen since the axis about which the frame pivots is at the center of the lower platen and will move up and down with the platen.

The operation of the plate casting machine as illustrated in the drawings is facilitated by the arrangement of the hydraulic motor for making the final closuré of the upper platen as well as by the floating matrix clamping frame. In operation, a matrix is initially positioned onto the lower platen with the aid of stops on the platen. The matrix clamping frame is then lowered to clamp the matrix securely to the lower platen. Liquid resin is then flowed onto the rear end of the matrix and the power means 10 is actuated to bring the arm 6 and upper platen 3 to the partially closed position as shown in FIG. 2. At this point the rear engaging surface of the upper platen will contact the liquid resin and will be at a distance from the lower depressed portions of the matrix equal to the thickness of the plate being cast. Limit switches will then be actuated which will cause hydraulic fluid to flow into the blind end of the cylinder 21 thus moving platen 3 to the closed position. The rate of closure of the upper platen will be progressively decreased due to the closing action of the valve 33 such that the rate of closure will not exceed the natural advancing flow of resin on the matrix.

Referring to FIG. 6, there is illustrated a further embodiment of a casting machine having means by which the distance between the upper platen and the lower platen may be conveniently regulated in order to vary the thickness of the plates being cast. As shown, the upper platen 3 and its frame 5 are similar to that of the machine of FIGS. 1—5 and means similar to power means 10 and hydraulic motor 20 may e utilized for

raising and lowering the upper platen. The upper platen has brackets **15** and **15'** as in the prior embodiment which, however, in this instance bear upon stop surfaces **50** of incline slides **51** (only one of which is illustrated) positioned on either side of the lower platen **2**. Incline slides **51** in turn are supported by supporting rollers **52** contained in the frame of the machine. Each slide is connected by means of a screw **53** to a shaft **54** through means of bevel gears **55** and **56**. Shaft **54** in turn is connected to a handle, not shown, by which the shaft may be rotated. As shaft **54** is rotated, it will cause screws **53** to turn thus moving slides **51** forward and backward with respect to the machine. Since the bottom portion of the slide is inclined, the slide will raise and lower on the supporting rollers thus raising and lowering stop surfaces **50** which in turn will vary the distance between the upper platen **3** and the lower platen **2**. The advantage of the construction shown is that a single control may be utilized to regulate the four surfaces **50** (two on one slide bar and two on the opposite slide bar) whereby accurate setting of the upper platen may be obtained when it is in the closed position.

I claim:

1. In a plate casting machine for casting plastic printing plates made from a thermosetting resin having exothermic characteristics during curing where said machine has a flat lower platen, an arm pivotable about a first hinge line extending parallel to a side of said lower platen, a flat upper platen hinged at one end to said arm along a second hinge line to open and close with respect to said lower platen with a clamshell-like motion, a matrix clamping frame associated with said lower platen to clamp the outer periphery of a matrix and to contain liquid resin thereon, power means for pivoting said arm about said first hinge line, and stop means for limiting movement of said arm about said first hinge line towards an upper platen closing position; the improvement comprising having in addition hydraulic motor means positioned on said arm and connected to said upper platen which upon the application of hydraulic force will pivot said upper platen about said second hinge line to the closed position with respect to said lower platen and valve control means for varying the rate at which said hydraulic motor will pivot the upper platen about said second hinge line in order that the rate of engagement of the upper platen with liquid resin which has been flowed on one end of the matrix adjacent said first hinge line will not exceed the rate of advancing flow of said liquid resin over said matrix.

2. In a plate casting machine according to claim **1** wherein the improvement comprises in addition in that said hydraulic motor comprises a cylinder having a piston therein operatively connected to said upper platen by a piston rod and linkage arms whereby said hydraulic motor is actuated when the movement of said arm towards the upper platen closing position is limited by said stop means.

3. In a plate casting machine according to claim **2** wherein the improvement comprises having in addition a cam surface operatively connected to one of said linkage arms, and wherein said valve control means has a cam follower engaging said cam surface whereby said valve control means will vary the operation of said hydraulic motor to progressively decrease the rate at which the upper platen moves about said second hinge line as it approaches the closed position with respect to said lower platen.

4. In a plate casting machine according to claim **1** wherein the improvement comprises in addition having said matrix clamping frame journaled in two vertically adjustable journals positioned substantially midway along the sides of said lower platen extending away from said first hinge line whereby said frame may adjust to irregularities in the surface of the matrix.

5. In a plate casting machine according to claim **4** wherein the improvement comprises in addition that said matrix clamping frame is an integral casting.

6. In a plate casting machine according to claim **4** wherein the improvement comprises having in addition a single clamp actuation means for vertically raising and lowering said journals whereby said clamping frame may be moved between matrix locking and unlocking positions to facilitate matrix replacement.