Aug. 21, 1945. E. E. SLICK 2,383,349

GLASSWARE WORKING APPARATUS

Original Filed Feb. 17, 1936 5 Sheets-Sheet 1

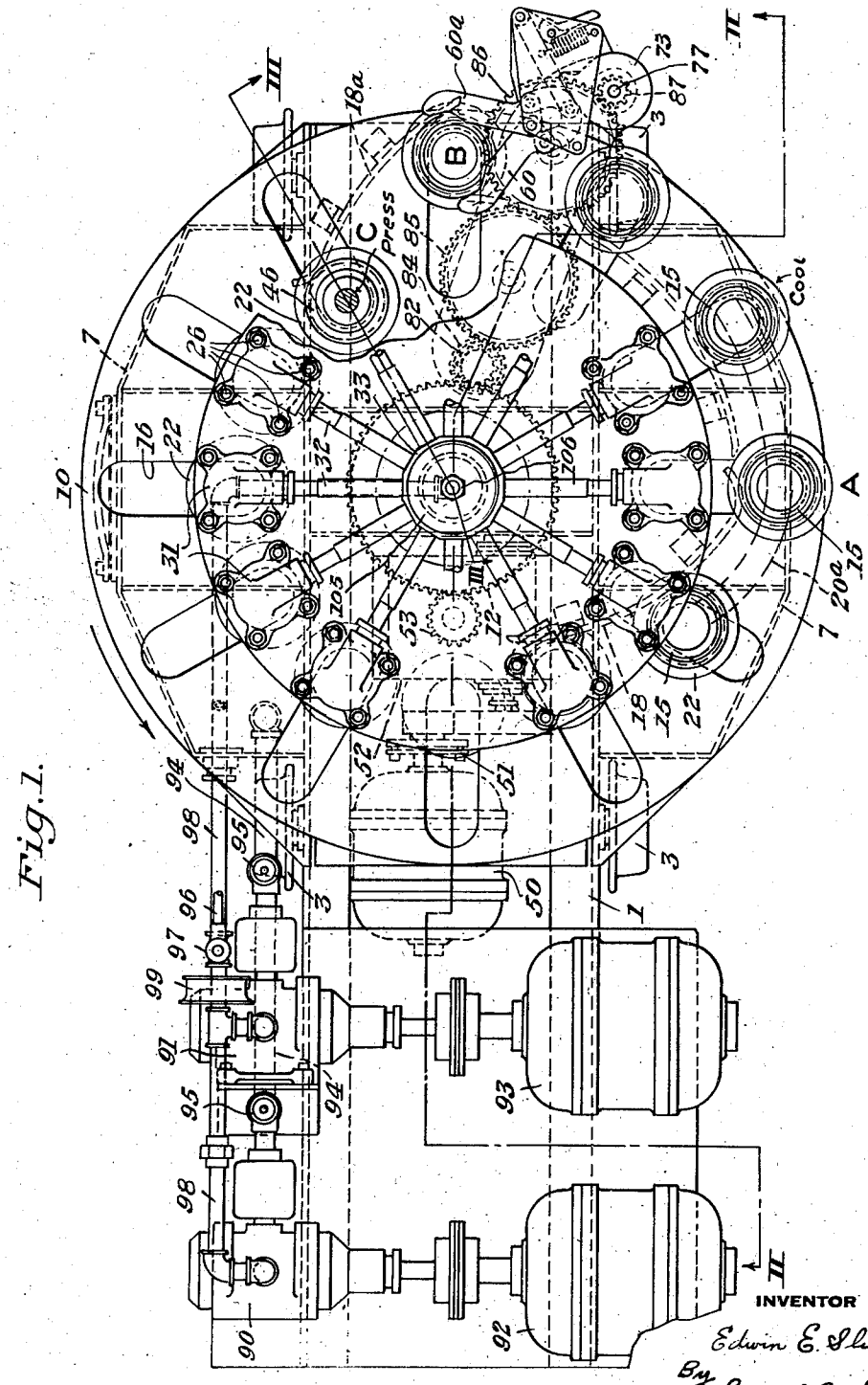


Fig. 1.

INVENTOR
Edwin E. Slick
By Thomas G. Miller
Attorney

Aug. 21, 1945. E. E. SLICK 2,383,349

GLASSWARE WORKING APPARATUS

Original Filed Feb. 17, 1936 5 Sheets-Sheet 2

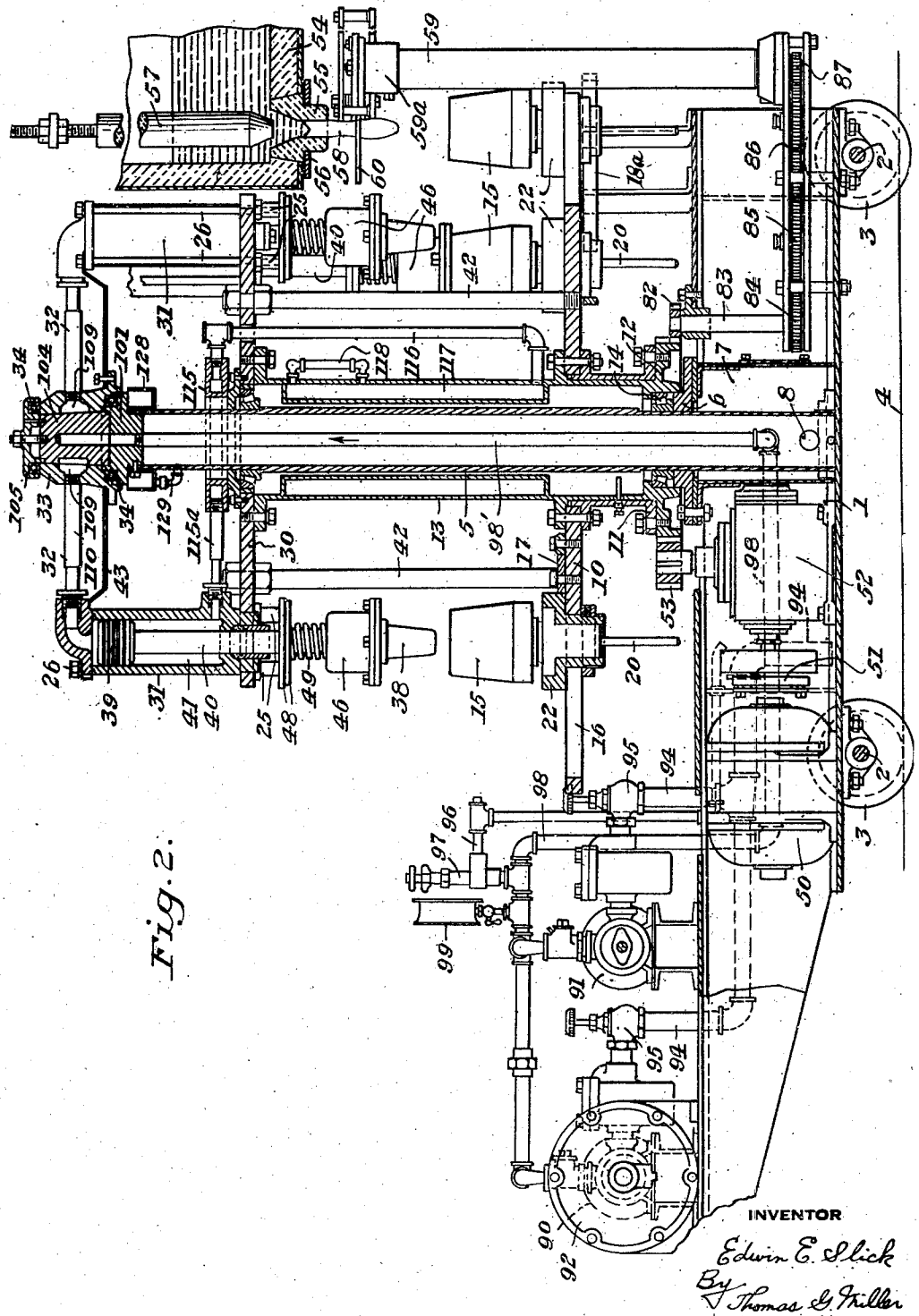


Fig. 2.

INVENTOR
Edwin E. Slick
By Thomas G. Miller
Attorney

Aug. 21, 1945. E. E. SLICK 2,383,349

GLASSWARE WORKING APPARATUS

Original Filed Feb. 17, 1936 5 Sheets-Sheet 3

Fig. 3.

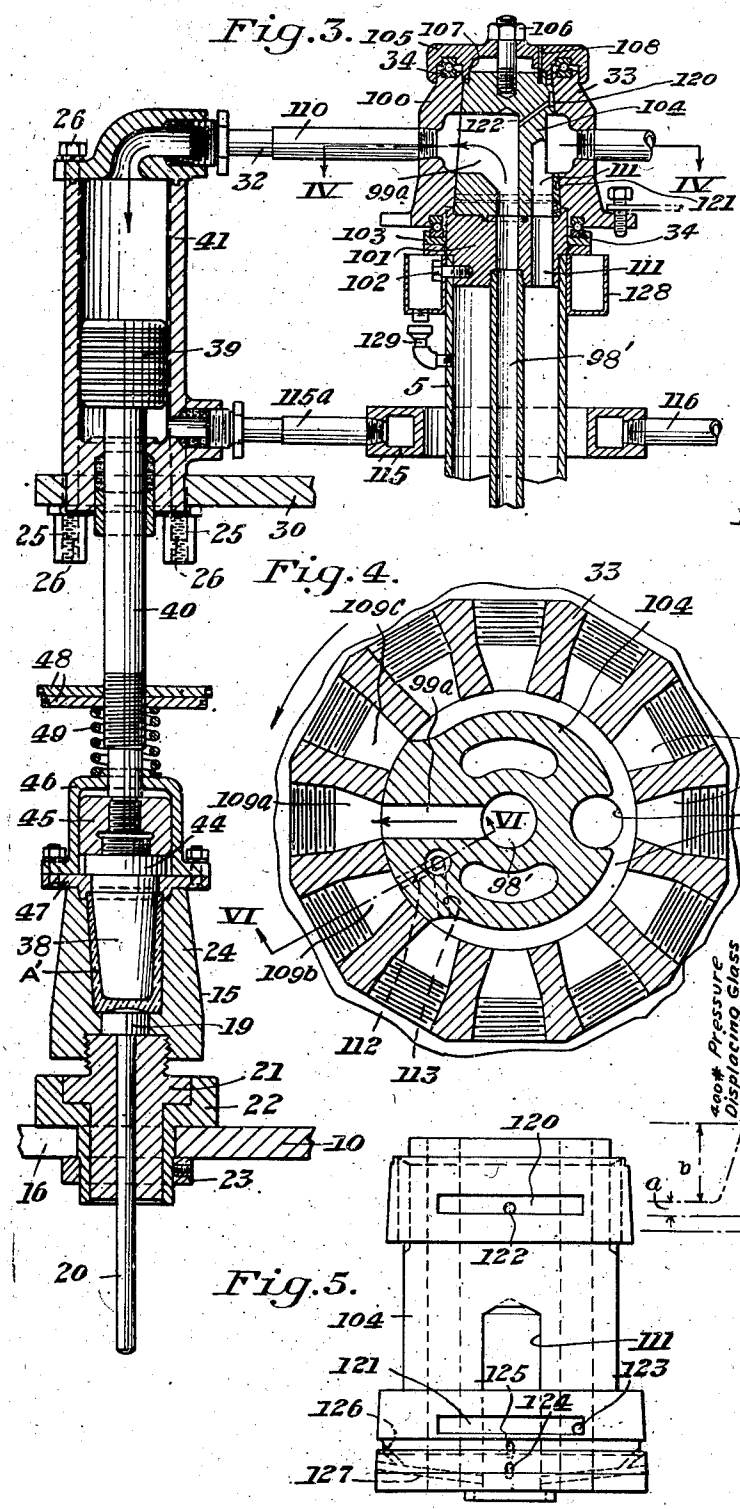


Fig. 6.

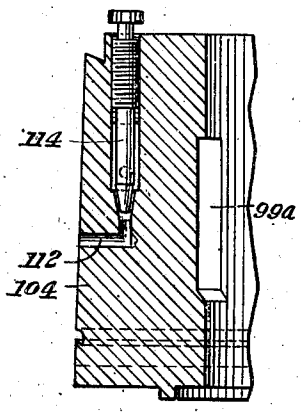


Fig. 4.

Fig. 13.

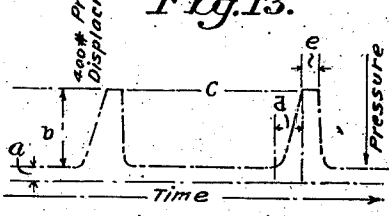


Fig. 5.

INVENTOR

Edwin E. Slick

By Thomas G. Miller

Attorney

Aug. 21, 1945. E. E. SLICK 2,383,349

GLASSWARE WORKING APPARATUS

Original Filed Feb. 17, 1936 5 Sheets-Sheet 4

Fig. 7.

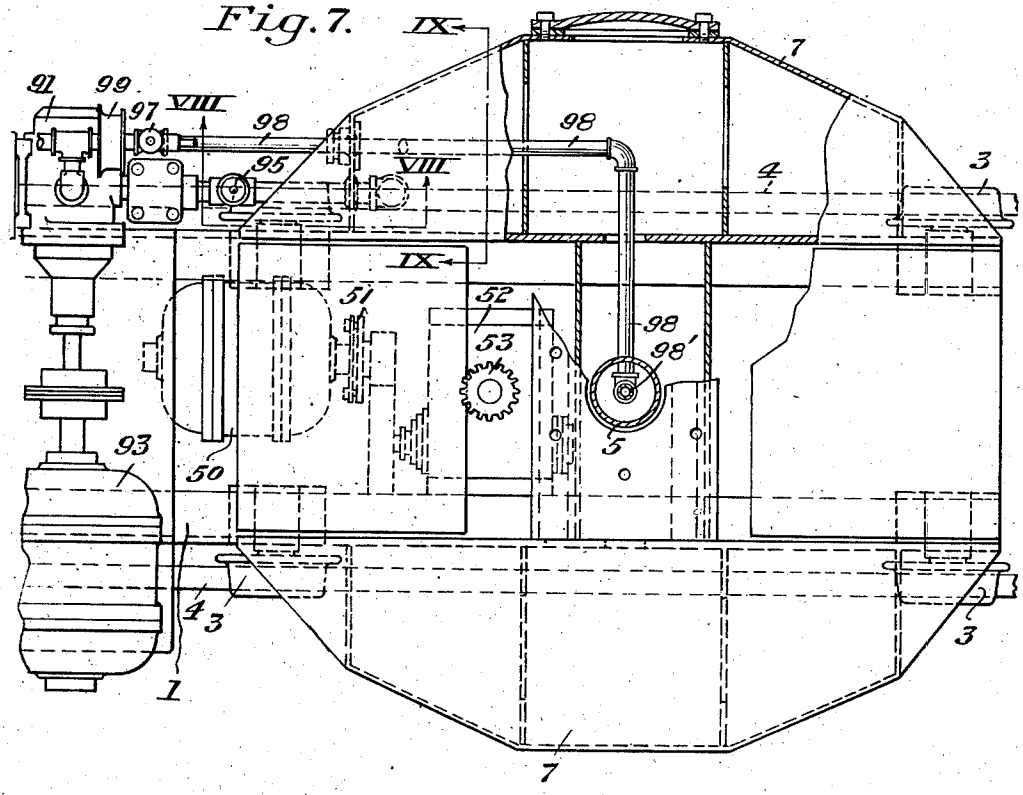


Fig. 8

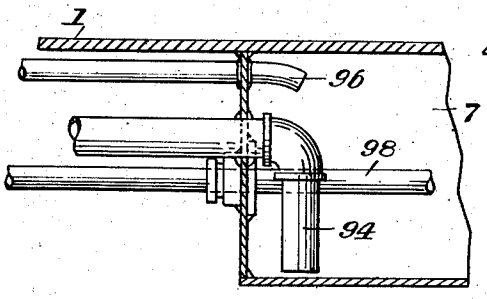
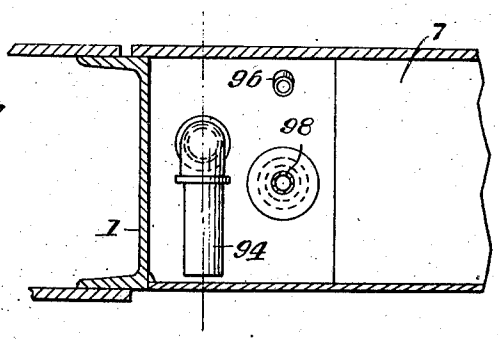


Fig. 9.



INVENTOR

Edwin E. Slick

By Thomas G. Miller

Attorney

Aug. 21, 1945. E. E. SLICK 2,383,349

GLASSWARE WORKING APPARATUS

Original Filed Feb. 17, 1936 5 Sheets-Sheet 5

Fig. 10.

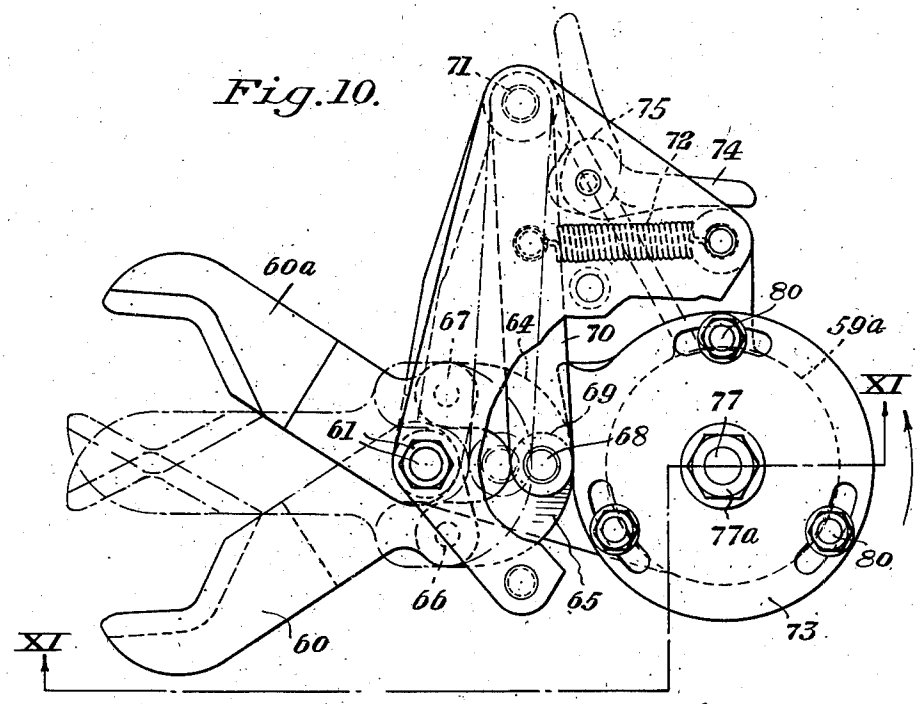


Fig. 11.

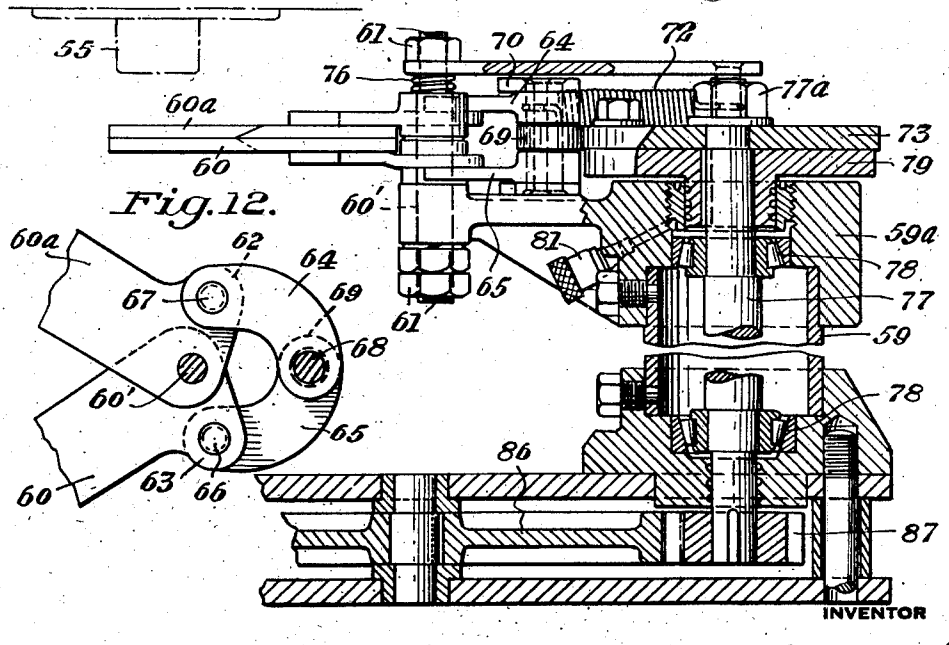


Fig. 12.

INVENTOR

Edwin E. Slick

By Thomas G. Miller

Attorney.

Patented Aug. 21, 1945 2,383,349

UNITED STATES PATENT OFFICE

2,383,349

GLASSWARE WORKING APPARATUS

Edwin E. Slick, Pittsburgh, Pa.

Continuation of application Serial No. 64,227, February 17, 1936. This application May 27, 1940, Serial No. 337,545

9 Claims. (Cl. 49—5)

This invention pertains to improved procedure for carrying out glassware making operations and to apparatus employed in connection therewith, and more particularly, to improved procedure for shaping articles while in motion. Those skilled in this particular art know that the so-called improvements in glassware making or shaping apparatus have in no sense brought about a simplification of the procedure and of the mechanisms employed. On the other hand, the mechanisms have increased in complexity of design and intricacy of operation.

In view of the above considerations, it has been an object of my invention to provide a new and improved, simplified procedure for forming glassware.

I have found that the new development in the art of forming glassware have not only added to the complexity of the apparatus and the intricacy of the operations, but have also made the installation and maintenance costs of layout almost prohibitive from the standpoint of the small operator.

It has been another object of my invention to utilize an entirely new principle in a glassware making procedure such that the efficiency of operation will be increased and that many intricate features may be eliminated, and that a more effective control of the forming operations may be had.

Another object of my invention has been to obtain the desirable features of a mechanically-operated forming apparatus without incorporating the undesirable features.

A further object has been to provide a mechanically compact glassware making unit which simplifies control.

A still further object of my invention has been to provide an article forming machine which is capable of effectively handling a continuous fluid stream flow of molten material and which will handle such material in a smooth, positive, and effective manner.

These and many other objects of my invention will appear to those skilled in the art from the following description taken in view of the claims and the appended drawings of which—

Figure 1 is a top plan view of an apparatus embodying the features of my invention;

Figure 2 is a side elevation partially in section and taken along the line II—II of Figure 1;

Figure 3 is an enlarged sectional elevation taken along the line III—III of Figure 1;

Figure 4 is a horizontal section taken along the line IV—IV of Figure 3;

Figure 5 is a vertical elevation of an inner or core portion of a distributor valve shown in section in Figure 4;

Figure 6 is a fragmental section taken on the line VI—VI of Figure 4;

Figure 7 is a top plan view of the lower portion of apparatus illustrated in Figures 1 and 2 and showing a fluid reservoir;

Figures 8 and 9 are fragmental sections taken along the lines VIII—VIII and IX—IX, respectively, of Figure 7;

Figure 10 is an enlarged top plan detail of a shear mechanism shown in Figures 1 and 2;

Figure 11 is a sectional elevation taken along the line XI—XI of Figure 10;

Figure 12 is a sectional detail of linkage for operating shears of Figures 10 and 11; and

Figure 13 is a pressure-time curve showing the economy of hydraulically forming articles in accordance with my invention.

I have found that I can effectively handle molten glass having a high fluidity and which is fed as a continuous stream from the forehearth or orifice of a furnace and can do this without controlling or interrupting the flow of the stream in the manner heretofore thought to be necessary. I have also been able to carry out the actual shaping operations with a smooth efficiency and with a more complete control of the steps involved.

In accordance with the principles of my invention, I have provided a glass forehearth having a suitable feed orifice and a stationary but adjustable flow control needle or other suitable means. That is, I provide a needle which may be set at a certain position in accordance with the temperature, the head of glass, and the volume of it which is to be fed through the orifice. During the actual operation of the machine, however, this needle remains stationary after its position has been set for conditions such as outlined above.

I have also provided a suitable driving mechanism for continuously turning a rotatable table which carries a plurality of radially-positioned mold cups. The mechanism drives a station-mounted pair of shears which are alined with the orifice to quickly cut or separate the correct amount of glass for each mold cup as the glass flows out of such orifice. The number of cups, their paths of movement, as well as their speed of movement, are controlled so that as a portion of the glass is separated or cut off with a lightning-like action, it immediately drops into and is received by a moving mold which at that instant is in the path of the drop. Of course, the proportioning will be such that there is always a mold in position for receiving a glass portion when cut or separated, although the stream itself is continuous, has a high heat, and thus, is fluid rather than viscous. The speed of the cup movement and of the glass flow are adjusted to give the desired shape and size of the separated glass portion.

I believe that I have been the first to effec-

tively utilize a continuous flow fluid stream of glass in a ware-forming procedure. When the glass portions are cut, the temperature is such that immediately after cutting, the separated portions are reheated and shear marks eliminated; this feature being of very great importance. Another advantage is that the forming operations are accomplished with greatly increased economy.

The problem involved in successfully employing a continuous fluid stream of glass is not limited to the provision of a suitable number of cups which are progressively moved to receive each separated portion of the stream, but also involves the provision of forming mechanism which progressively, quickly, and surely forms a good quality article, and does it in such a manner as to leave time enough for the article or blank to be discharged from its mold cup, for the mold cup to cool, and then to move to a position to receive a new charge. By solving these problems, I have not only been able to utilize a new method of glass feed, but have also been able to form quality ware at a new high rate of production.

In order to carry out the forming operations while the mold cups continuously rotate, I provide each cup with an individual pressing mechanism whose operation is timed in such a manner that sureness, quickness, and smoothness of forming action has been attained, and the power required for the forming operations has been cut down to an extent heretofore thought to be impossible while still properly controlling the steps of the forming operations.

The mold cups are adapted by cam track or other suitable means to move in and out with respect to their rotative axis in order that each cup will receive a glass portion or gather at its "out position, and will receive a pressing plunger at its "in" position to form an article or blank.

In connection with the forming operations, I have embodied an entirely new principle which results in a marked increase in efficiency, particularly from the standpoint of smoothness of operation and of economy of power. This principle comprises the employment of a liquid or some other relatively non-compressible fluid, such as water or oil as a direct acting actuating hydraulic medium for each of the individual pressing mechanisms. When I speak of a hydraulic medium or a hydraulic fluid, I have particular reference to an incompressible material of liquid form such as water, oil, etc. I have found that the lag which normally accompanies the pneumatic or air type of plunger action is entirely eliminated, and this is very important in view of the necessity for an extremely speedy forming operation as required by the continuous stream feed of the molten glass. The positiveness, sensitiveness, and effectiveness of a mechanical camming action are obtained without the consequent loss in control. The postiveness and smoothness of the action as controlled by a suitable valve system is indeed remarkable.

Further, in accordance with the principles of my invention, I have provided a piston to which a "former" or a blank "presser" is attached. The piston is hydraulically actuated in its forming stroke and is pneumatically actuated on its return stroke by the counter pressure of a compressible fluid. This compressible fluid is forced out of one end of the piston chamber into a closed extension chamber or accumulator by the piston during its forming stroke. Thus, energy of the forming stroke is stored and later utilized to return the piston and the attached blank "former" to its original position. The flow of hydraulic fluid to and from the piston chamber is automatically controlled by a distributor valve which is, in turn, controlled by the rotation of the carrier and its associated mold cups. The hydraulic fluid is supplied to the valve, and thus, to the various forming mechanisms in such a manner that the pressure is automatically and practically instantaneously adjusted to the power requirements of each step of the operation of a given forming mechanism. As a result, the saving in energy and power is enormous, see the curve of Figure 13.

It is also true that a better control is had of the steps involved in forming a given blank or article; for example, the pressure used to move the "former" to a cooperating position with a mold cup is approximately that required to overcome friction, see *a* of Figure 13. The pressure used to actually form or press out a blank in the mold cup is of a much higher value, see *b*. Such pressure is later "backed off" by the valve to finish the operation. The "build up" of pressure is automatic; it "builds up" as the need arises in a manner similar to the action of an electric motor when a load is applied. A relief valve prevents a "build up" of pressure beyond desired limits, and thus, prevents damage if, for example, foreign matter was accidentally introduced into a mold cup.

A pin valve mechanism controls the release or exhaust of the hydraulic fluid from the piston chamber to cause the counter-pressure to at first slowly move the "former" off the blank, and then, the main distributor valve releases the fluid, in order to permit the piston and its associated "former" to snap back to its original position. These control features also result in uniform articles of superior quality.

The amount of work actually done in carrying out the forming operations of my invention is relatively small since it is only utilized as required. As distinguished from this, a pneumatic system utilizes substantially the same amount of energy during preliminary and return movements of the piston as when the associated plunger is actually forming an article in a mold cup. The lag which accompanies the use of a compressible fluid in the forming stroke of a piston also contributes to the power lost. I obtain the power economy and quick action of a mechanical system, but on the other hand, obtain a simplicity and an effectiveness of control of the steps of forming an article which are impossible with a mechanical system.

In the curve of Figure 13, time has been plotted as an abscissa, since power is a function of it, and pressure has been plotted as an ordinate. Unlike the pneumatic system which is connected to a large tank located at a distant point and in which compressed air is maintained at its highest work value for moving a presser during both its forming and return strokes, it shows that pressure is applied and proportioned in my system only in accordance with the actual requirements of the system. The period of time represented by *c* also represents a power or energy saving not possible in a pneumatic system.

By employing an accumulator for returning the piston, I have effected a two-fold saving of power. And, I have so simplified the procedure that I have been able to provide a mechanically compact unit which may be moved from place to place or from forehearth to forehearth as needed. During the starting up operation, I can continuously rotate the machine to pick up and dis-

charge glass portions until the cups reach the proper temperature and the glass portions themselves have the required characteristics. That is, the drive mechanism for the hydraulic pumps which supply fluid to actuate the "formers" can be shut off until conditions are such that good quality articles can be continuously formed.

Referring to the drawings, and particularly to Figures 1 and 2, I have provided a stationary framework or base portion 1 upon which is mounted the operating mechanism of the embodiment of my invention disclosed. This base or frame member 1 is preferably mounted on a suitable carriage which comprises axles 2, spaced pairs of wheels 3, and a track 4; in this manner the machine may be moved from one place to another in the plant.

The framework 1 is provided with a centrally-located, vertically and upwardly extending central-column member 5, about which carrier portions of the apparatus are adapted to rotate. A suitable mold carrier or table 10 rotates on the column 5 and has a downwardly extending sleeve-flange portion 11 which is removably secured to a bearing annulus and ring gear member 12. The carrier 10 has a removably secured upwardly extending cylindrical frame portion 13 which is also removably secured to and which supports an upper carrier member 30. As seen, the lower bearing annulus 12 is journaled upon a slightly reduced portion of the main column 5 by bearings 14 which are supported at their lower extremities upon a stationary cap member 6 that is removably secured to the frame 1.

As shown particularly in Figure 1, a suitable number, in this case twelve, mold cups 15 have been provided. Each cup 15 is slidably mounted in a radial slot 16 in the carrier 10 and is moved inwardly by a cam track 18a (see Figures 1 and 2) mounted on frame 1 against a removable abutment plate 17 and moved outwardly against the edge of the carrier in timed relationship with the rotation of the carrier by a cam track 18 mounted on the stationary frame 1. In this manner, each individual cup 15 is moved outwardly to receive a glass charge, as shown to the right of Figure 2 (see also station B of Figure 1), and then, may be moved inwardly as shown to the left of Figure 2 (see also station C of Figure 1), in order that a forming operation may be accomplished. Each cup 15 is preferably provided with a suitable knock-out mechanism 19 having an extending stem 20 which is adapted to ride on a cam track 20a mounted to extend upwardly from the stationary frame 1. The cup 15 cools between discharge station A and charging station B; the cam tracks 18 and 20a may be adjusted to vary the position of station A, in order to change the period during which a formed article is carried or a mold cup is cooled.

The upper carrier member 30 is mounted to extend outwardly and support a plurality of individual blank forming mechanisms 31, in this case, twelve. Each mechanism 31 is provided at its upper end with a suitable telescopic pressure line 32 connected to a valve-housing chamber-member 33 which is rotatably journaled by bearings 34. Each forming mechanism 31 comprises a suitable plunger or "former" 38 which is adapted to enter a mold cup 15 in the manner shown in Figure 5 to press out and form a blank. There is also a piston 39 connected to the plunger by a rod 40 and operating in a cylinder 41. As seen, I have provided each cup with an individual pressing or forming mechanism and such pressing or forming mechanism is mounted directly in alinement with an associated cup 15 when that cup has been moved to its inner position on its carrier 10; and, since both the upper and lower carriers 30 and 10 are connected together, it will appear that they rotate in synchronism and that the pressing mechanism is always ready for operating upon a gob in the mold cup.

In order to strengthen the upper carrier 30 and to hold it in the proper spaced relationship with respect to the lower carrier 10, I have provided a plurality of vertically extending positioning rods 42 which are screwed into the lower carrier and are bolted to the upper carrier. A drip pan 43 is removably mounted to extend between the chambered valve housing 33 and the upper ends of the piston chambers 41.

Referring particularly to Figure 3, it is seen that plunger 38 has an upper flange or annulus 44 that abuts a slide head 45, both of which are removably mounted on a threaded extension portion of the connecting rod 40. The slide head 45 moves within a housing cap 46, and an article edging annulus 47 is bolted to a lower flange of the housing cap 46 to limit the maximum downward movement of plunger or "former" 38. A pair of disc-like plates 48 are adjustably mounted on rod 40 to control the compression of a spiral positioning spring 49. This spring 49 normally maintains the upper end of the slide head 45 in abutment with the inner top wall of the housing cap 46. Figure 3 shows that slide head 45 is at its lower position when the former 38 is pressing out a blank or article; the arrangement prevents injury to the apparatus if the proper movement of the presser or former 38 is obstructed.

The length of stroke of the piston 39 is suitably adjusted by turn buckles 25, which are threaded on rods 26 that extend from the carrier 30 to cooperate with plates 48.

The cup 15 comprises a core portion 21, the knock out rod 20 which extends therethrough, a mounting sleeve 22, a removably mounted cam annulus 23, and a replaceable forming cup portion 24.

The operating mechanism for rotating the carriers 10 and 30 may be of any suitable form such as a motor 50 provided with a suitable clutch 51, gear reduction unit 52 and drive gear 53. As seen particularly in Figure 2, the bearing annulus 12 of the carrier 10 is provided with an outer gear portion which meshes and is driven by the gear 53.

The feeding mechanism shown includes a forehearth 54 having a refractory orifice 55, positioning plates 56, and an adjustable control needle 57. Since, in carrying out my invention, I utilize a continuous stream of hot liquid-like glass 58 as distinguished from an interrupted stream of viscous glass, it is only necessary to preliminarily adjust the needle 57 to provide the desired fluid flow as based upon the temperature of the glass, its volume and head.

It will be apparent that I supply a continuous gravity flow of fluid or molten glass whose rate is preliminarily adjusted by the stopper or needle 57. Unlike the phase control method of feeding, the natural gravity flow of the molten glass is not periodically augmented or retarded by a reciprocating plunger or rotating bell to form shaped gobs. In other words, in my invention, shears momentarily interrupt without substantially backing up gravity flow. The time of this interruption is sufficient to permit a charge to be received by one cup and a new cup to be presented for receiving the next successive charge.

For separating the stream into charges, I provide a suitable shear mechanism which has a vertically extending column 59 mounted upon the stationary frame 1. Adjacent the top of the column 59, I have mounted a removable cap 59a upon which is supported the operating mechanism of the shears. The shear operating mechanism includes a pair of shear blades 60 and 60a pivotally mounted on a shank 60' by suitable bolt means 61 which, at its lower end, is bolted to an extension of the cap member 59a. Each sheer blade at its rear end is provided with two oppositely-positioned outwardly-projecting tabs 62 and 63; and actuating links 64 and 65 are pivotally connected to the tabs by studs 66 and 67 for moving the blades to open and closed positions. The links 64 and 65 are pivotally connected together at a common point by a cam-roller support-stud 68 upon which is also mounted cam roller 69, as well as a positioning arm 70. The positioning arm 70 is pivotally mounted on the stationary cap member 59a at its other end by a stud 71. A spiral spring 72 is connected between the arm 70 and the cap 59a for normally holding the arm cam roller 69 tightly against a rotating cam disc 73. A spiral spring 76 resiliently holds the blades 60 and 60a on shaft 60'.

I have also provided a trip cam for holding the shear or scissor blades in their closed position, independently of the operation of the cam 73; this trip cam comprises a finger lever 74 pivotally mounted on the stationary cap portion 59a and having a cam face 75 adapted to abut the arm 70 and press it outwardly away from the operating cam 73. As shown, the actuating cam disc 73 is centrally axled to a vertical operating shaft 77 which is journaled by suitable bearings 78 within the cap 59a and the column 59. A lubricating cup 81 is shown in Figure 11. Beneath the cam disc 73 is a rotatable plate 79 keyed to shaft 77 and having bolts 80 extending upwardly therefrom. The cam 73 may be moved to the extent of the slots shown in Figure 10, for adjusting the cutting operation of the shears to the proper timed relationship with respect to the rotation of the drive shaft 77.

The shear mechanism is driven in a timed relationship with respect to the rotation of the carrier members 10 and 30, since it is driven by the ring-gear annulus-member 12, see particularly Figures 2 and 11. In this connection, I have provided a suitable gear 82 meshing with the ring gear 12 and keyed to a rotating shaft 83, upon one end of which is keyed a suitable gear 84 which meshes with a chain of pinions 85 and 86. The chain of pinions in turn meshes with a small gear 87 keyed to the drive shaft 77.

For carrying out the forming or pressing operations, I have provided, as shown particularly in Figures 1, 2, 7, 8, and 9, a suitable reservoir 7 for hydraulic fluid, such as water or oil, a pair of rotary pumps 90 and 91 connected in parallel and driven by motors 92 and 93. The pumps 90 and 91 have a suction line 94, a valve 95 for controlling the flow therethrough, a relief line 96 and an automatic relief valve 97. A pressure line 98 is connected to a vertical pipe 98' which extends upwardly through the central column 5 of the machine. The numeral 99 represents a suitable pressure gauge. Of course, both the relief line 96 and the suction line 94 enter the reservoir 7. The inside of the column 5 acts as an exhaust line for forming mechanisms 31, since it is connected at its lower end by a pipe 8 to a reservoir 7, see Figure 2.

The control mechanism includes a distributing valve 100 mounted at the top of the central column 5, see particularly Figures 2, 3 to 6, inclusive. This valve comprises a base portion 101 removably secured to the column 5 by suitable bolt means 102. The base 101 has an annulus portion 102 adjacent its upper face for supporting the lower bearing 34. A central core portion 104 rests upon, is keyed to and extends above the base portion 101. It has a cap member 105 secured thereto by bolt means 106 and locked with respect thereto by extensions 107 and pins 108. The cap portion 105 is grooved to receive the upper bearings 34 and the rotary outer chamber housing portion 33. As seen, the chamber housing 33 extends between the upper and lower bearings 34 and rotates about the central core portion 104.

In Figures 3, 4, 5, and 6, I have shown the operation of the valve. The chamber housing member 33 is provided with the same number of chambers 109 as there are pressure cylinders 41, and each of these chambers is connected by a telescopic pipe 110 to its respective piston chamber. In Figure 3, the pressure line is shown connected directly to the cylinder 41 and the plunger 38 is forming an article A' in the mold cup 15.

The position of the rotary distributor valve shown in Figure 4 indicates its relationship when one forming mechanism is applying maximum pressure to the gather in a mold cup. All but two of the chambers 109b and 109c are directly connected to the exhaust passageways 111 of the valve, while the chambers immediately adjacent the chamber 109a which is receiving the hydraulic fluid are completely shut off from any flow, except that the chamber 109b is connected by suitable passageways 112 and 113 to the exhaust 111; the flow through these passageways is controlled by an adjustable needle valve 114, see particularly Figure 6. That is, when the chamber 109a is receiving pressing fluid, the chamber 109b has been cut off from any pressing fluid and has been slightly opened to the exhaust, in order that an accumulator mechanism which will be hereinafter described, can slowly initiate a return movement of the plunger 38. However, after this short period of slow movement, the rotation of the carriers brings the chamber 109b directly in line with the exhaust passageway 111 and permits the accumulator to immediately snap back the piston 39 and its associated plunger 38 to their original positions. Viewed from Figure 4, the chamber 109c is closed off to the exhaust 111 immediately before it is opened to the pressure chamber 99a.

As shown, the lower end of each piston chamber 41 is connected through the pipe 115a to an annular accumulator header 115 which, in turn, is connected through suitable piping 116 to an accumulator chamber 117 which extends inwardly and vertically along the rotary frame 13. A suitable gauge 118 has been provided. In order to have a smoothly acting rotary distributor core 104 which will not lock during certain periods of its movement, I have provided suitable balancing dead-end slots 120, 121, connected by passageways 122 and 123 to the pressure chamber 99a, see Figure 5. Drain passages 124, 125, 126 and 127 are connected to the exhaust chamber 111a. I have also provided an annularly extending drip trough 128 connected by a drain pipe 129 to a liquid return passage 111 in the valve base 109.

From the above explanation and description, it will appear that at a definite time during the rotation of the carrier, one of the pressure chambers 109 will aline with the inlet chamber 99a of the valve, resulting in a forward movement of the piston 39 and a forming of a blank A'. This same movement also backs up the fluid on the other side of the piston and forces it down into the accumulator chamber 117, compressing it and building up a counter-pressure which is gauged to a value which will be sufficient to cause the piston 39 to quickly snap back after the forming operation. Of course, as above pointed out, the action is slow at first, since the exhaust from the upper portion of the cylinder is at first limited by the passageways 112 and 113 and the needle valve 114.

Since, as previously indicated, I employ a relatively non-compressible fluid for moving the piston 39 forwardly and a relatively compressible fluid, such as air, or part air and part water, for moving the piston back, I have been able to effect an economy of power heretofore impossible.

In carrying out the operation of the machine, I preliminarily adjust the timing between the rotation of the cup carrier 10 and the actuation of the shears 60 and 60a, by loosening bolts 77 and 80 (see Fig. 10), and moving cam 73 with respect to shaft 77. This is done in order that each glass portion separated from the continuous stream 58 by the shears will be received by a cup 15 which arrives at the proper instant. The pumps 90 and 91 are preferably continuously rotated, in order that they can quickly and automatically change from an idling to a power operation as the steps of forming operations demand.

In the economy curve of Figure 13, *c* represents the period of time between successive pressing operations, *d* represents the period of time during which the "former" is moving upon or is forming a gather in a mold cup, and *e* represents the period during the finishing of the article (excess pressure being relieved by a safety valve). Each falling or right portion of the curve represents the fall of pressure after the forming operation. In a preferred procedure the pressure does not begin to rise during the forward stroke of the "former" until the gather in the mold cup is contacted. Although the active hydraulic pressures shown in this curve have been found to be effective, they are merely illustrative to clearly set forth the economy and efficiency of my operative procedure. The actual pressures used will of course vary with the type of article, type of the material being formed, and with other considerations; but, in any event, the operative principles of my invention still apply.

The saving in power or energy effected by the employment of my invention is very great and can be better appreciated by a study of Figure 13 of the drawings. Where an accumulator is employed, the source of hydraulic pressure such as a pump must operate at maximum pressure, say, 400 pounds, until the accumulator chamber is filled up. On the other hand, as shown in this figure, the maximum pressure is only employed periodically during the steps of forming articles in the plurality of mold cups. For providing this hydraulic pressure, I have shown pumps 91 and 92 which may be of any standard pressure pump construction and are designed and operated to provide a substantially constant supply of hydraulic fluid at a substantially constant rate or velocity. It is thus apparent that the pumps may be of a positive displacement type in order to better insure the supply of a substantially constant quantity of hydraulic fluid to the pressing agencies at a pressure that varies in accordance with the power requirements of the operation of the machine. It will be noted that this supply is substantially continuous, as the valve shown in Figure 4 successively introduces the fluid into the pressure chambers of the plurality of shaping mechanisms. Thus, by employing a substantially continuously supplied and substantially constant quantity of hydraulic pressure fluid, I effect an enormous saving of energy as particularly applied to two or more shaping operations which are successively effected. Geared, plunger, centrifugal, or other suitable types of pumps may be employed. The arrangement also very materially speeds up the pressing operations and makes possible the utilization for the first time of what may be termed a hot fluid-like (low viscosity) open-orifice or continuous stream feed.

My invention is not limited to the forming of glassware or of plastics, but has a wide field of application in forming articles. While I have described but one embodiment of my invention, it will be apparent that many changes, modifications, substitutions, additions and omissions, or combinations thereof, may be made without departing from the spirit and scope of the invention as indicated in the appended claims.

This is a continuation of my copending application Serial No. 64,227, filed February 17, 1936, entitled "Glassware working apparatus."

I claim:

1. In a machine for forming hot fluid-like, viscous, or plastic material into a suitable shape where variations in power requirements occur during the operation of the machine and during the forming operations, a forming means, hydraulic pressure means operably associated with said forming means for moving said forming means to a forming position and for forming the material thereafter without interrupting the movement of said forming means, and means operably associated with said hydraulic pressure means, said last-mentioned means supplying hydraulic pressure energy to said hydraulic pressure means at a constant rate and at a pressure that is directly proportional to the resistance encountered by said forming means in its movement, to first overcome resistance encountered in moving said forming means to a forming position, and thereafter, to increase the pressure energy as the forming operation progresses and as the material cools and becomes more viscous.

2. In a machine for making shaped articles, a support, a carrier movably mounted on said support, means for moving said carrier, mold cups on said carrier, means cooperating with each of said mold cups for shaping an article therein, a pressure cylinder, a piston mounted in said pressure cylinder and operably connected to said shaping means, a source of hydraulic pressure operably connected to said pressure cylinder for moving said piston and said shaping means in a forming stroke, valvular means having a pair of chamber portions, one of said portions being movable with said carrier and with respect to the other chamber portion for periodically cutting off flow of hydraulic pressure to said pressure cylinder, and means operatively associated with said piston and said shaping means combination for returning said combination to an in-

operative position after a shape has been provided.

3. In a machine for making shaped articles, a support, carrier means rotatably mounted on said support, mold cups on said carrier, a pressure means for each mold cup on said carrier for shaping material therein, means on said carrier intermittently actuating each presser to shape material in each of said mold cups, valvular means on said support and having a portion rotatable with said carrier means, means providing hydraulic pressure for actuating each of said pressers, an operable connection between said hydraulic pressure means and each of said pressers, said valve being operably-positioned in such connection between said hydraulic pressure means and each of said pressers, said valve being constructed and arranged and having another portion operably mounted with respect to said rotatable portion to intermittently supply actuating pressure fluid to each presser during the rotative movement of said rotatable portion with said carrier means.

4. In a machine for making shaped articles, a support, carrier means operably mounted on said support, mold cups on said carrier means, pressers on said carrier, each of said pressers being constructed and arranged to shape material in one of said mold cups, presser cylinders on said carrier means, a piston mounted in each of said presser cylinders and connected to one of said pressers, means providing hydraulic pressure and being operably connected to said piston cylinders for moving said pistons therein, valvular means for periodically cutting off flow of hydraulic fluid pressure from said hydraulic pressure means to each of said piston chambers after a shape has been formed in a mold cup by one of said pressers, said pistons being constructed and arranged to move said pressers to a shaping position and to thereafter shape material in said cups, and means energized by said hydraulic pressure means for returning said pressers to original inoperative positions after material has been shaped in said cups, and means for controlling the effective counter action of said fluid for returning said pressers and their associated pistons in a desired manner.

5. In a continuously moving machine for making shapes, a support frame, a carrier movably mounted on said support frame, means continuously moving said carrier on said support frame, mold cups on said carrier, blank-forming plungers for said mold cups, piston means operably associated with said plungers for actuating them, a primary means providing fluid pressure and being operably connected with respect to said pistons to move them in one direction, a secondary means providing fluid independently of said primary means and being operably connected with respect to said pistons to move them in an opposite direction, said secondary means also being constructed and arranged and operably connected with respect to said pistons in such a manner that it will be energized by the movement of said pistons produced by said primary means, a distributor valve operably timed to the movement of said mold cups and having means controlling actuation of said pistons in succession by said primary and secondary means.

6. Apparatus of the class described comprising a succession of hydraulic press units mounted on a carrier, each unit including a cylinder with a piston therein, means for continuously rotating the carrier, a pressure line opening into one end of each cylinder, a counterpressure line opening into the other end of each cylinder, a distributing valve movable with the carrier for successively connecting each of said pressure lines with a source of fluid pressure and subsequently to an exhaust passage to first apply pressure to the piston and then relieve pressure in each cylinder in turn, and a common closed reservoir with which all said counterpressure lines communicate, said common reservoir being closed to retain a compressible fluid under pressure whereby said reservoir serves as an accumulator to effect the return stroke of the pistons as their pressure lines are successively opened to the exhaust passage.

7. Glass molding apparatus comprising a support and a turntable on the support, a plurality of molds thereon spaced from one another at equal angles, means for continuously rotating the turntable, a plurality of individual press units on the turntable, each having a fluid pressure cylinder with a pressure pipe at one end, a counterpressure pipe at the other end of each cylinder, a pressure distributing valve to which all the inlet pipes connect comprising an annulus that rotates with the turntable having a port for each inlet pipe, and a fixed valve member in the annulus having a pressure port and an exhaust channel whereby the ports in the annulus successively move past the pressure port and then the exhaust port, and a third port in said valve having a restricted passageway leading into said exhaust port whereby to break the pressure in the cylinders before fully opening them to exhaust, and a closed reservoir to which the counterpressure pipes lead.

8. Glass molding apparatus comprising a support, a turntable on the support having a plurality of molds thereon spaced from one another at equal angles, a succession of press units on the turntable, there being one press unit for each mold, means adjacent one portion of the periphery of the turntable for feeding a charge of glass into each mold in succession, said molds being radially movable on the table toward and away from the periphery thereof in order to receive the charge when moved out toward the periphery and to be engaged by its press unit when it is moved inwardly, cooperating cam means on the molds and on the support for effecting such radial movement of the molds, and means for operating the press units in sequence.

9. Apparatus of the class described comprising a support, a turntable on the support having a central vertical column, a plurality of molds on the turntable spaced from one another at equal angles, a press unit on the turntable for each mold, each press unit including a cylinder with a piston therein, means for rotating the turntable, a stationary valve member at the top of said column having pressure inlet and exhaust ports thereon, a rotary valve member on the turntable cooperating with the stationary one and having a port therein for each cylinder, each port being connected with its respective cylinder, a counterpressure passage leading from the opposite end of each cylinder, and a closed reservoir having compressible fluid trapped therein mounted on the turntable with which all of said counterpressure passages communicate.

EDWIN E. SLICK.