Dec. 10, 1940. D. I. DU BOIS 2,224,767

APPARATUS FOR MAKING ARTICLES SUCH AS GLASSWARE

Filed July 7, 1936 9 Sheets-Sheet 1

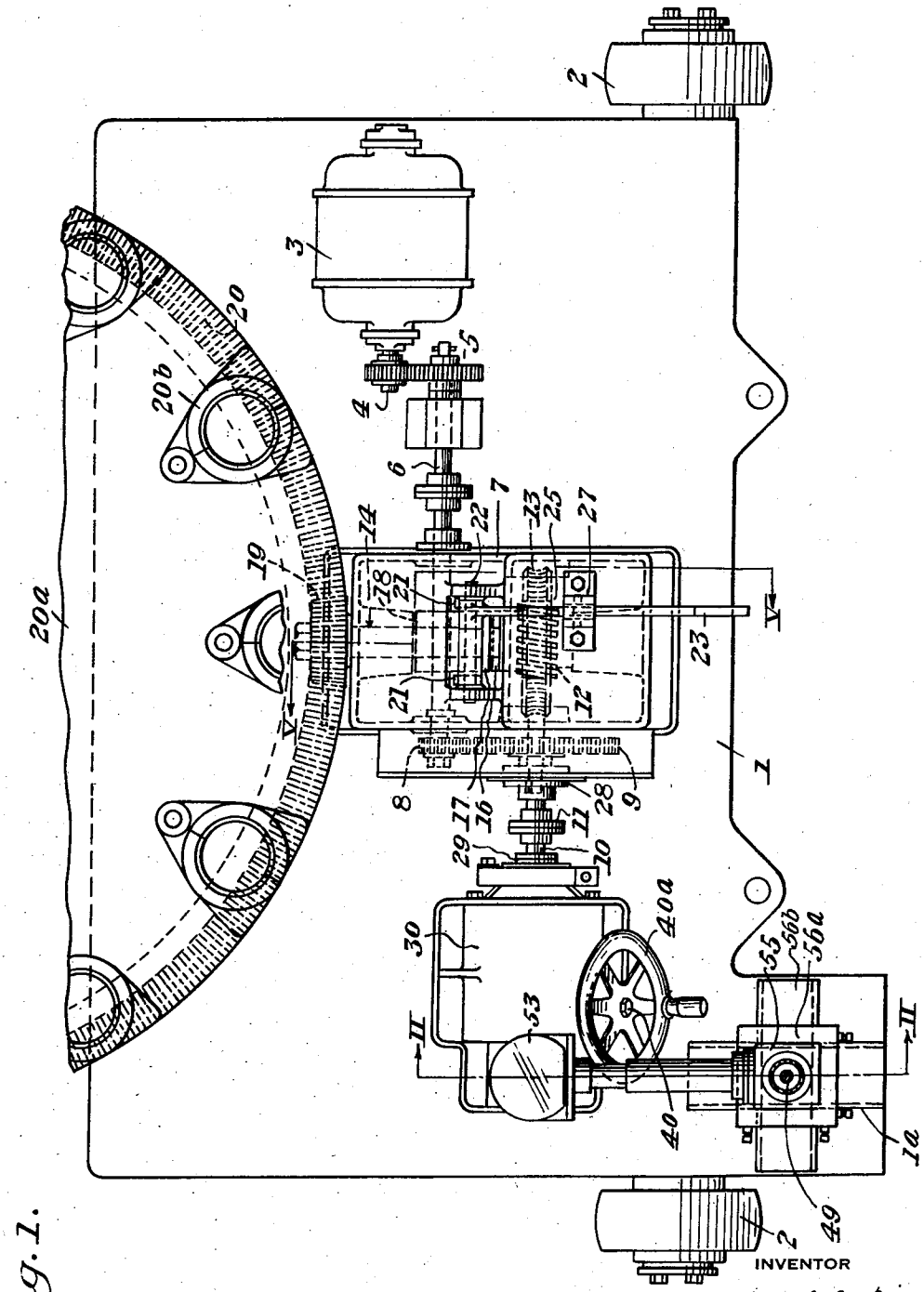


Fig. 1.

INVENTOR

David I. Du Bois

By C. P. Byrnes

his attorney

Dec. 10, 1940. D. I. DU BOIS 2,224,767

APPARATUS FOR MAKING ARTICLES SUCH AS GLASSWARE

Filed July 7, 1936 9 Sheets-Sheet 2

Fig. 9.

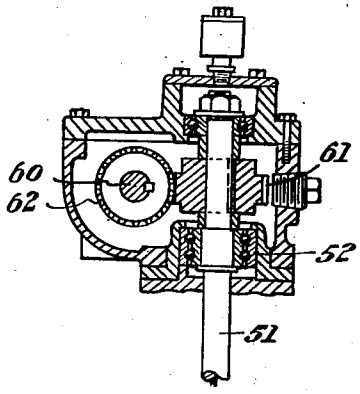


Fig. 2.

INVENTOR

David I. Du Bois

By C. P. Byrnes

his attorney

Dec. 10, 1940. D. I. DU BOIS 2,224,767

APPARATUS FOR MAKING ARTICLES SUCH AS GLASSWARE

Filed July 7, 1936 9 Sheets-Sheet 3

Fig. 4.

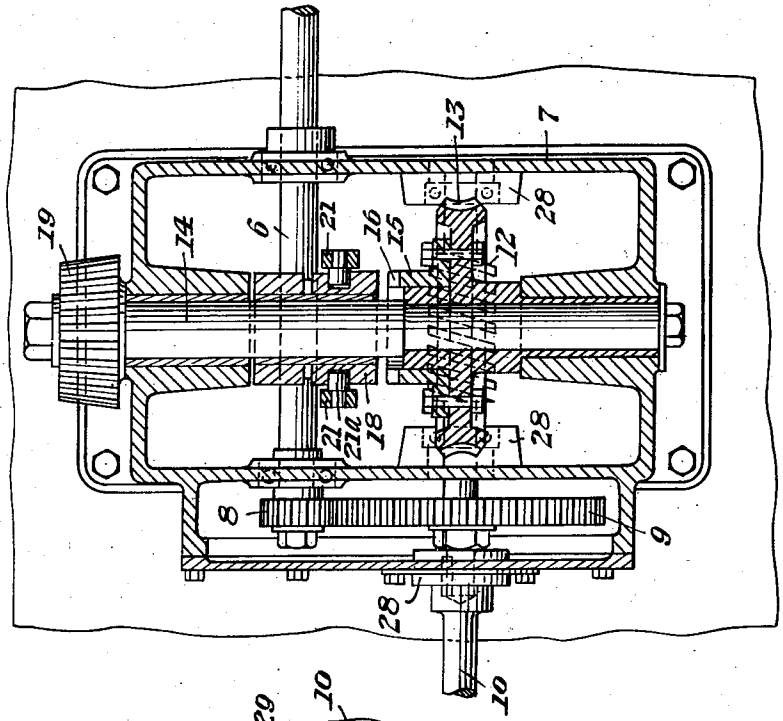
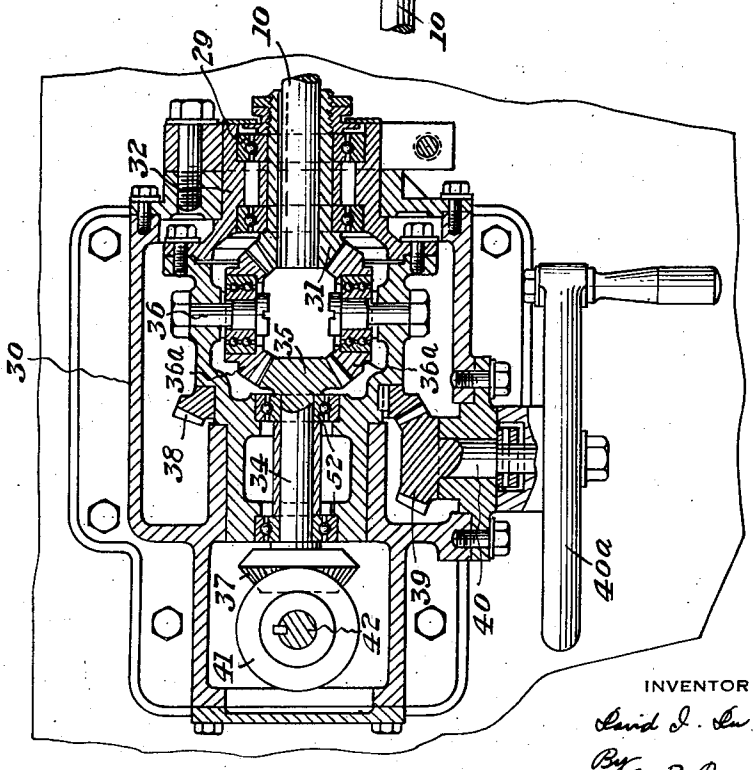


Fig. 3.



INVENTOR

David I. Du Bois

By C. P. Byrnes

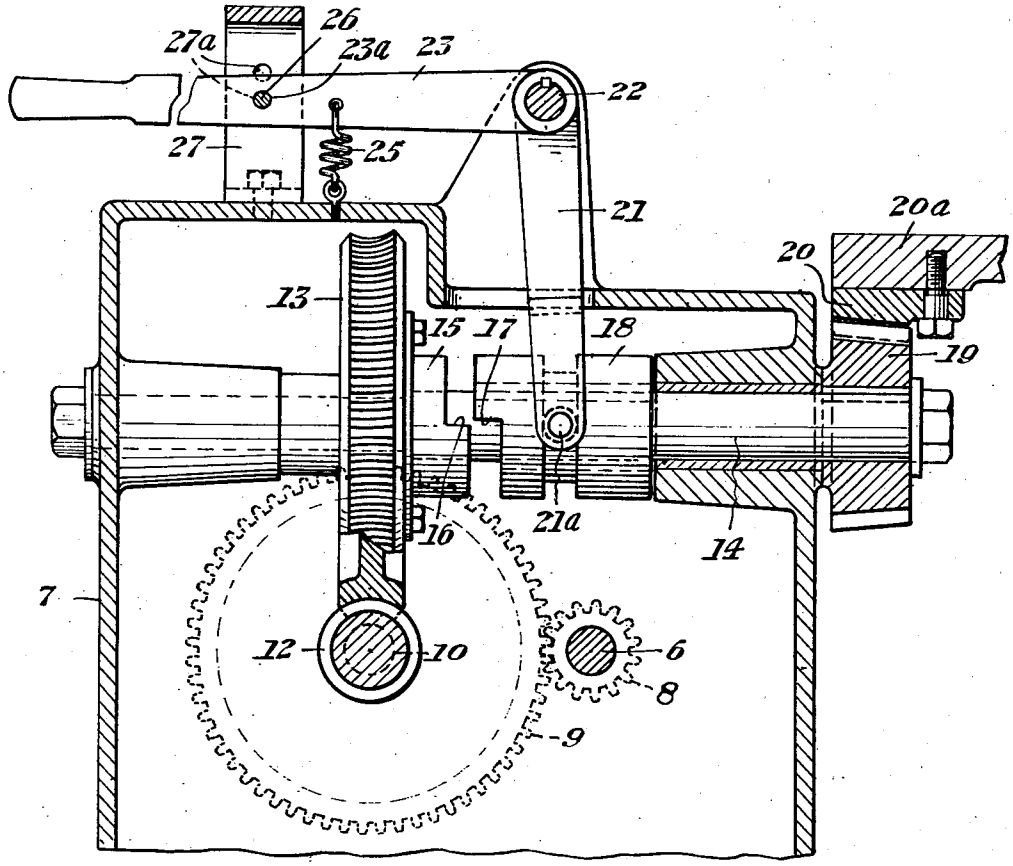
His attorney

Dec. 10, 1940. D. I. DU BOIS 2,224,767

APPARATUS FOR MAKING ARTICLES SUCH AS GLASSWARE

Filed July 7, 1936 9 Sheets-Sheet 4

Fig. 5.



INVENTOR

David I. DuBois

By C. P. Byrnes

His attorney

Dec. 10, 1940. D. I. DU BOIS 2,224,767

APPARATUS FOR MAKING ARTICLES SUCH AS GLASSWARE

Filed July 7, 1936 9 Sheets-Sheet 5

Fig. 6.

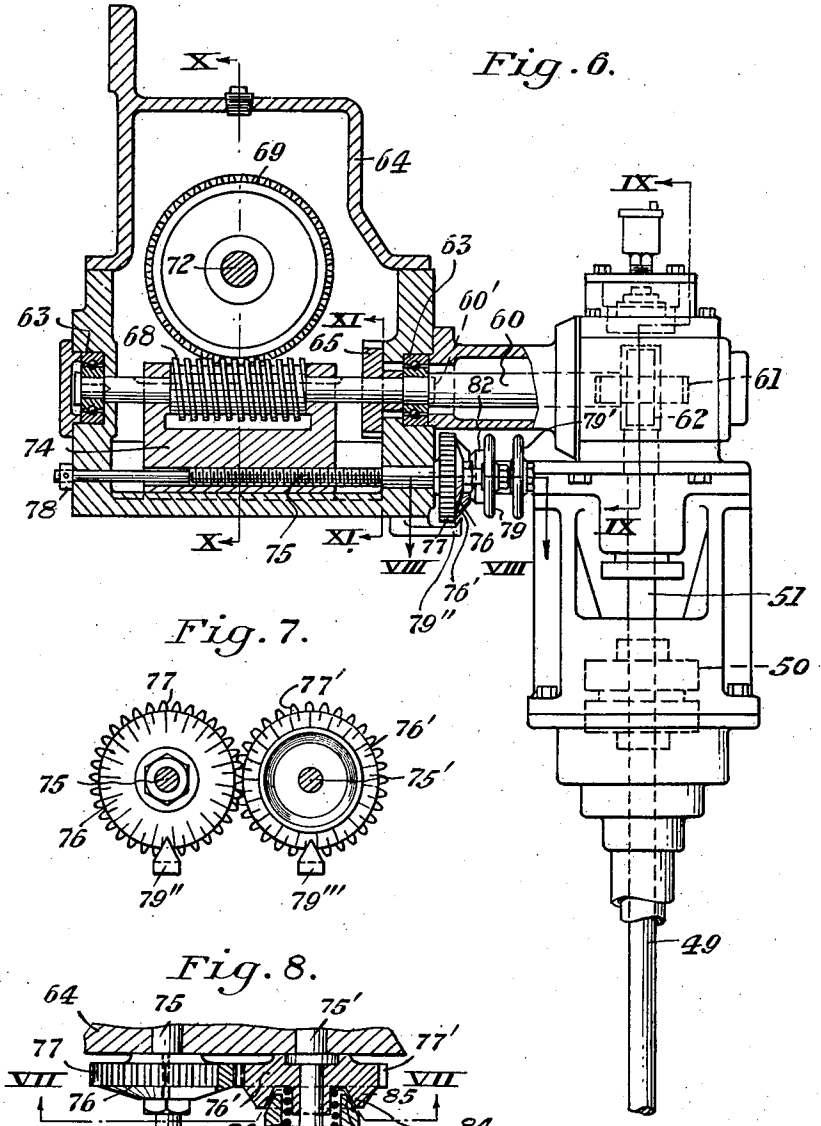


Fig. 7.

Fig. 8.

INVENTOR
David I. Du Bois
By C. P. Byrnes
his attorney

Dec. 10, 1940. D. I. DU BOIS 2,224,767

APPARATUS FOR MAKING ARTICLES SUCH AS GLASSWARE

Filed July 7, 1936 9 Sheets-Sheet 6

Fig. 10.

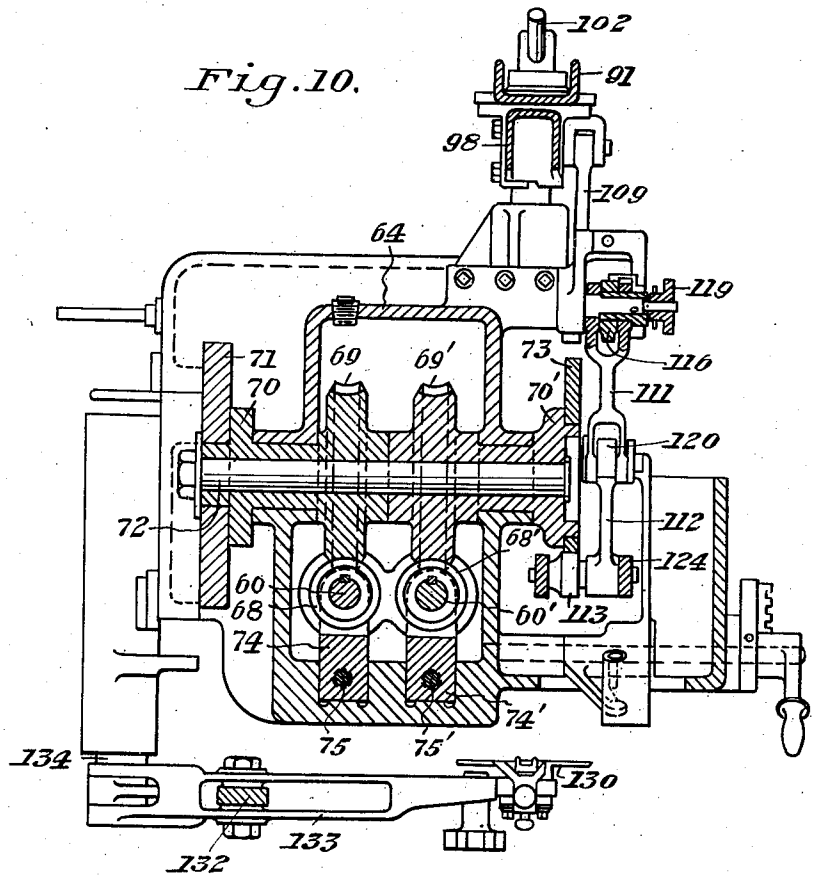
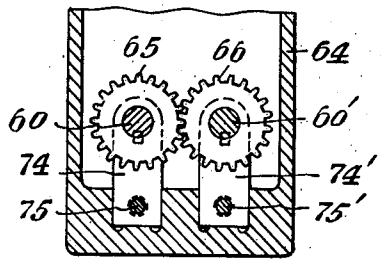


Fig. 11.



INVENTOR
David I. Du Bois
By C. P. Byrnes
his attorney

Dec. 10, 1940. D. I. DU BOIS 2,224,767

APPARATUS FOR MAKING ARTICLES SUCH AS GLASSWARE

Filed July 7, 1936 9 Sheets-Sheet 7

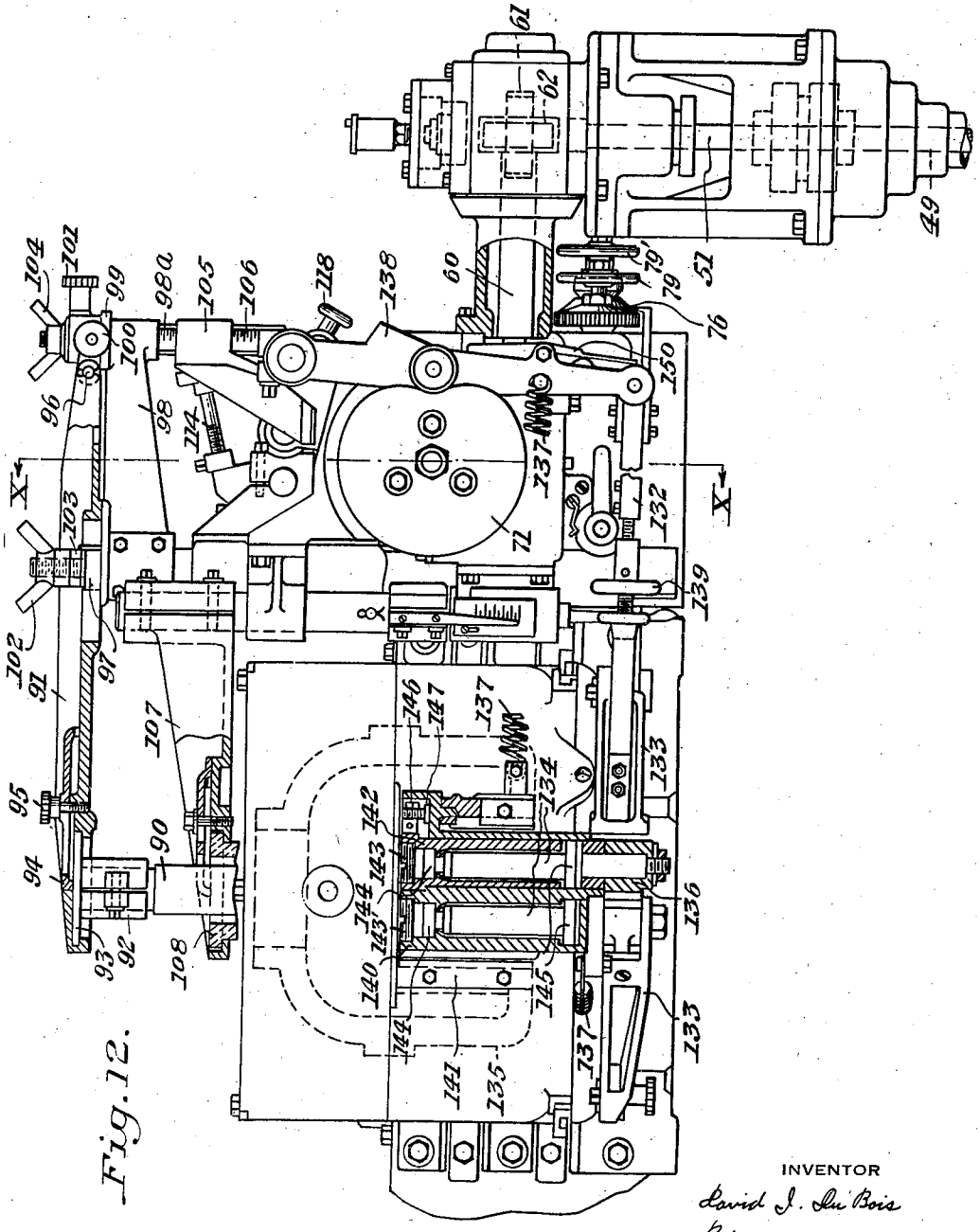


Fig. 12.

INVENTOR
David I. Du Bois
By C. P. Byrnes
His attorney

Dec. 10, 1940. D. I. DU BOIS 2,224,767

APPARATUS FOR MAKING ARTICLES SUCH AS GLASSWARE

Filed July 7, 1936 9 Sheets-Sheet 8

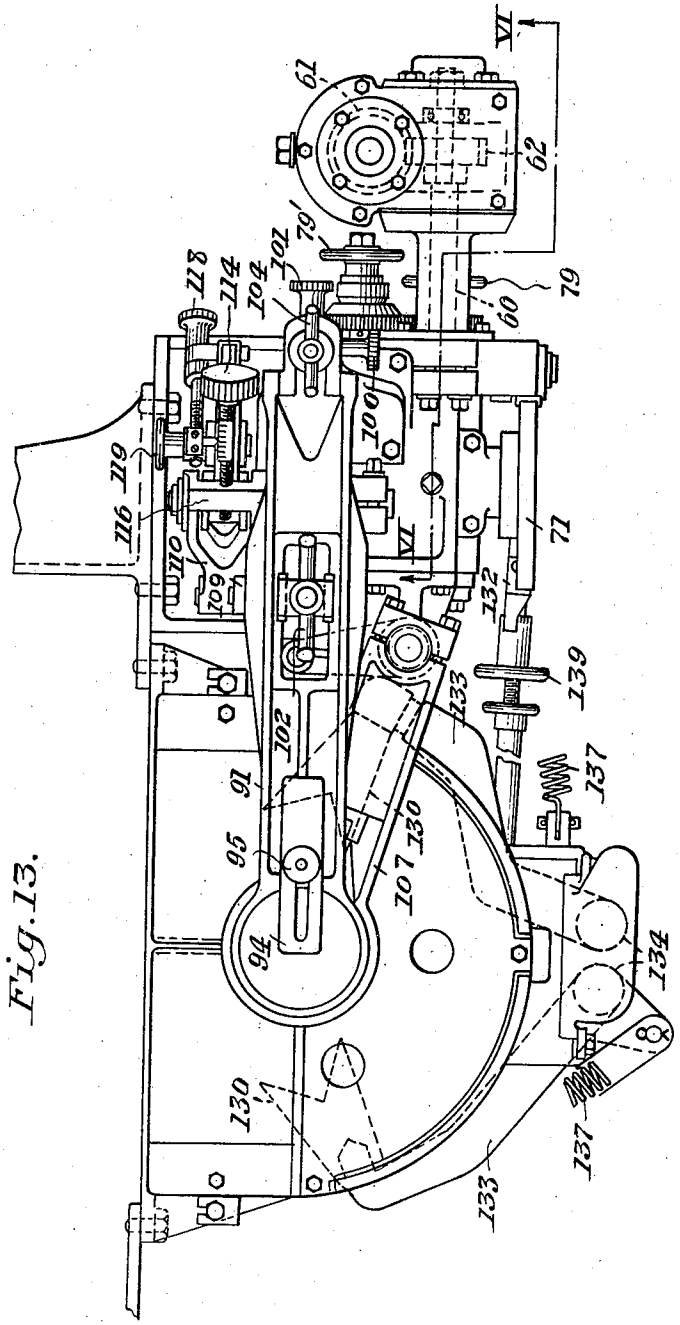


Fig. 13.

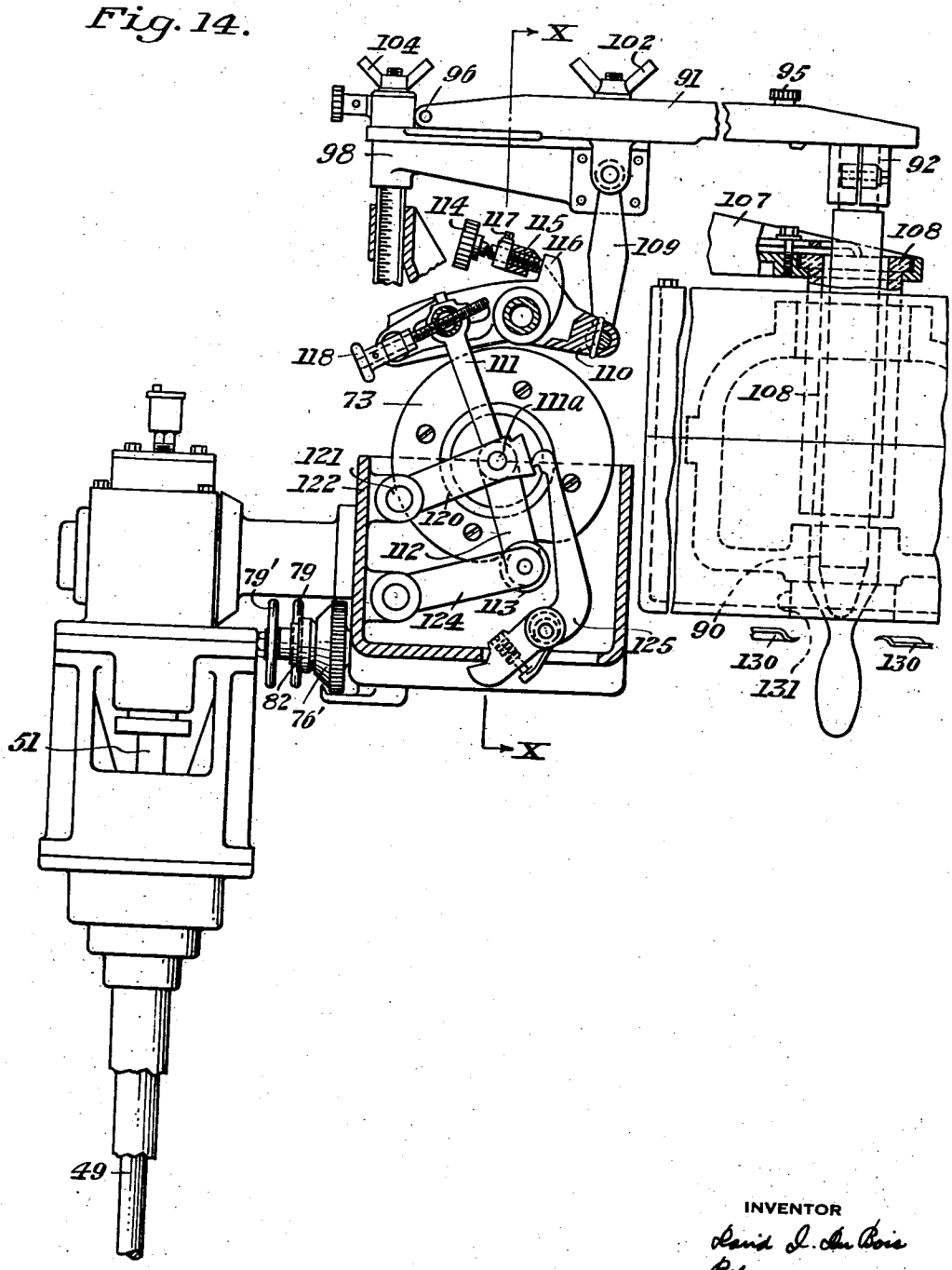
INVENTOR
David I. Du Bois
By C. P. Byrnes
His attorney

Dec. 10, 1940. D. I. DU BOIS 2,224,767

APPARATUS FOR MAKING ARTICLES SUCH AS GLASSWARE

Filed July 7, 1936 9 Sheets-Sheet 9

Fig. 14.



INVENTOR
David I. Du Bois
By C. P. Byrnes
his attorney

Patented Dec. 10, 1940 2,224,767

UNITED STATES PATENT OFFICE

2,224,767

APPARATUS FOR MAKING ARTICLES SUCH AS GLASSWARE

David Irvin Du Bois, Millville, N. J., assignor, by mesne assignments, to Armstrong Cork Company, Manheim Township, Lancaster County, Pa., a corporation of Pennsylvania

Application July 7, 1936, Serial No. 89,307

6 Claims. (Cl. 49—5)

This invention relates to controlling steps involved in a procedure for making articles from molten glass and other viscous and/or plastic materials, and more particularly, to apparatus for regulating the movement and the characteristics of the material employed.

Many problems arise in the making of articles such as insulators, tableware, etc., from plastic and/or viscous materials and I have found that these problems may be traced directly or indirectly to problems of control of the various steps involved. I have divided these control problems into three groups, the first is the proper coordination, control and/or phasing of the feeding steps. The second is the proper coordination, control and/or phasing of the forming steps, and the third is the proper coordination, etc., of the feeding steps individually and collectively with respect to the forming steps, and at the same time, with respect to each other.

Previous to my invention, the problems have not been attacked from the standpoint of control alone, but have been confused, misunderstood, and/or submerged behind the cloak of a seeming need for a change in the construction of the elements used in the feeding and/or the forming operations, such as the impeller, the shears, etc. However, I have found that any suitable type of feeding or forming elements may be controlled in such a manner that the problems involved are very definitely solved.

I have particular reference to the problems which arise in connection with a continuously moving forming machine and an automatic feeder that intermittently feeds successive gobs or gathers of the material. The advantages of such a type of machine are well known to the art and need not be here reiterated. However, it is also true that the problems of control involved in such a type of machine are more complex than those involved in an intermittent machine, since a charge or gob of material must be fed or delivered to the molds while the latter are moving.

Questions of temperature, pressure head, degree of plasticity or viscosity, size, shape, weight, etc., of the material, must all be considered, particularly in connection with the feeding steps. By reference to "feeding steps," I include a proper control and delivery of suitable shapes and/or sizes of plastic or molten portions of the material from an orifice, separating or severing gobs, gathers, or portions from the main body of the material, and delivering such separated portions to the forming apparatus.

Although it has heretofore been possible to deliver gobs to continuously moving mold cups, yet the demands of control involved have limited the flexibility of operation of this type of apparatus, and this is particularly true, since under present day conditions, it is necessary to provide apparatus capable of forming a wide variety of articles of various shapes, lengths, widths, weights, and/or characteristics.

In considering the problems of control, it must be understood that I have reference to control that may be accomplished while the apparatus is in operation. This is especially important from the standpoint of the feeding apparatus which includes an impeller, shears, and an orifice for supplying the material. That is, it is important to maintain the feeding apparatus in operation at all times, even when the forming apparatus is stopped for repairs or for a change of mold size or shape. If the feeding operation is stopped, the glass or other material will tend to freeze, and hence necessitate considerable work before normal operation can be restored. In general, any stoppage of feeding changes the temperature conditions at or adjacent to the orifice. Many other troubles arise in this connection which are well known to the art.

Previous to my invention, it has been common practice to only vary the impeller timing or phasing during the operation of the machine upon the supposition that the size, shape, form, etc., of the gob or portion of the material fed to the molds was dependent primarily upon the operation of the impeller. However, I find that the shear operation is just as important as the impeller in this connection, and further, that a control for merely changing the phase relationship between the impeller and some other operative parts of the machine is not enough to meet the problems involved. For example, the temperature, the physical and/or chemical characteristics, the pressure head, etc., of the glass or other material in the forehearth may vary during the operation of the machine with the result that the articles formed will lack uniformity and may even be deformed or improperly shaped under the conditions of control heretofore possible of accomplishment during the continuous operation of an apparatus.

And, in view of these and many other considerations, it has been an object of my invention to provide improvements of control in connection with apparatus for making articles from plastic and/or viscous materials.

Another object of my invention has been the

provision of phase control apparatus for meeting the previously enumerated problems.

Another object has been the provision of individual phase control features for the operative elements of an automatic feed mechanism and a continuously movable forming apparatus.

A further object has been to provide a more flexible, sensitive and/or effective means for controlling the operative relationships between elements of feeding and of article forming apparatus.

A still further object has been to provide an article making machine of improved operative and/or structural characteristics.

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

In carrying out my invention, I preferably drive a forming machine and an automatic feeding mechanism through the agency of a common prime mover. The forming machine is continuously rotated and suitable driving connections are interposed between the forming machine and the automatic feeding mechanism. I also suitably interpose timing apparatus between driving connections. The automatic feed mechanism preferably includes a suitable feed orifice, an impeller or plunger for controlling the masses or for segregating gobs or gathers of plastic or viscous material from the batch in the forehearth adjacent the orifice, and also includes a shear mechanism for separating or segregating gathers or gobs from the main body or batch of the material.

For purposes of illustration, I have shown the principles of my invention embodied in an apparatus for forming glassware. However, it will be understood that my invention may be applied to any suitable apparatus employing fluid, viscous, and/or plastic materials for forming articles.

In the process of shaping articles, a gob, mass, or charge is segregated from a parent body of the plastic or molten mass by an impeller and after having been suitably proportioned or sized, is severed and either dropped directly into a mold beneath the feeding mechanism, or is guided by a trough or some similar means into a mold. The forming apparatus includes a plurality of molds mounted on a rotatable support, in order that a succession of molds may be moved into charge receiving, forming, and delivering positions. After charges in the molds have been suitably formed or pressed, the molds may be opened and a take-off mechanism employed. The novel features of my invention can be applied to any suitable type of forming mechanism.

Further, in accordance with my invention, I preferably drive the shears and the impeller or plunger from the same drive shaft and interpose timing or phase change apparatus between the drive shaft and each of these mechanisms. Phase-change structures are located, constructed, and operated in such a manner that the shears and impeller may be separately adjusted for periodicity and may also be adjusted as a unit for periodicity with reference to other apparatus such as the forming mechanism. Also, in accordance with my invention, the phasing between the forming machine and the feeder mechanism as a whole may be changed during the continuous operation of the apparatus.

In view of the provision of the above features of control, and also of them in combination with a clutch interposed between the driving connections of the prime mover and the forming machine, I have been able to accomplish a flexibility of control heretofore thought to be impossible, and the results are indeed astonishing. Among the changes possible in view of my invention are changes in: the phasing between the feeder mechanism as a whole and the forming mechanism, the phasing of the impeller with respect to the shears independently or dependently of the forming mechanism, the phasing of the shears with respect to the impeller dependently or independently of the forming mechanism, the phasing of the shears with respect to the forming mechanism dependently or independently of the phasing of the impeller, and the phasing of the impeller to the forming mechanism dependently or independently of the shear mechanism. The phasing between shears and the impeller may be adjustetd and controlled while the automatic feeding mechanism is operating and while the forming mechanism is idle.

Based upon the above features of control, I have been able to provide a charge of glass or some other suitable viscous or plastic material adjacent the plunger or impeller whose size, shape, outline, characteristics, etc., may be effectively controlled during the continuous operation of the machine irrespective of temperature, pressure head, and other physical and/or chemical changes in the batch of glass.

I have also been able to so control the shearing or gob separating operations that the gob controlling, forming, or segregating action of the impeller may be supplemented and aided by the action of the shear mechanism. As a result, I have been able to provide glass masses, charges, or separated portions of the material which have the exact physical characteristics desired and which characteristics are the best for forming a particular type of article.

It is also true that I have been able during long periods of operation of the article making machine, to continuously accomplish forming operations and to successively provide articles having a high degree of uniformity and regularity. As a result, the forming of defective or non-uniform articles is a thing of the past.

Referring to the drawings:

Figure 1 is a plan showing article forming apparatus and a driving mechanism constructed in accordance with the principles of my invention, certain parts being shown in section;

Figure 2 is a vertical sectional view taken along the line II—II of Figure 1 and showing driving connections for the feeder mechanism;

Figures 3 and 4 are enlarged horizontal sections showing structural details and taken on the axis of shafts 10 and 14, respectively;

Figure 5 is a side elevation of a clutch shift mechanism taken along the line V—V of Figure 1;

Figure 6 is a front elevation in section on the line VI—VI of Figure 13;

Figure 7 is a partial sectional elevation of a detail and taken along the line VII—VII of Figure 8;

Figure 8 is a partial plan section showing the detail of Figure 7 and taken along the line VIII—VIII of Figure 6;

Figure 9 is a partial side section in elevation taken along the line IX—IX of Figure 6;

Figure 10 is a sectional elevation on the line X—X of Figures 6, 12, and 14;

Figure 11 is a partial sectional elevation of a detail and taken along the line XI—XI of Figure 6;

Figure 12 is a front elevation of a shear operating mechanism, some of the parts being broken away and shown in section;

Figure 13 is a plan of the mechanism of Figure 12; and

Figure 14 is a partial sectional elevation taken from the rear of the feeder and showing a plunger or impeller feed apparatus.

In the plan view of Figure 1, I disclose a common motivating mechanism or prime mover for glass feeding and forming apparatus. I have shown a suitable mount structure for the entire machine, which includes a base member 1 having suitable wheels 2, in order that it may be moved from place to place in the shop. A prime mover which is indicated as a motor 3, is provided with a primary drive shaft 4, and is connected to a gear reduction unit 5 and a secondary drive shaft 6 that is journaled within a gear box 7. The secondary shaft 6 has a pinion 8 keyed thereto and meshing with a gear 9 that is keyed to a tertiary drive shaft 10. The tertiary drive shaft 10 is in two parts that are connected together by a suitable coupling 11; the right hand part has a worm 12 secured thereto which drives a worm gear wheel 13 that is rotatably journaled on a forming table drive shaft 14. The worm gear 13 (see particularly Figures 4 and 5) is provided with a hub portion 15 having clutch teeth 16 that engage with clutch teeth 17 of a movable clutch member 18 that is slidably splined to the table drive shaft 14. The extreme end of the table drive shaft 14 is provided with a beveled gear 19 meshing with a ring gear 20 (see Figure 1) that is removably secured to a rotatable mold or forming table 20*a*. A plurality of molds 20*b* are carried on the table 20*a*.

As seen particularly in Figure 5, the tertiary drive shaft 10 will drive the table drive shaft 14 when the teeth 17 of the clutch member 18 have been moved into meshing engagement with the teeth 16. To accomplish this shifting action, any suitable mechanism may be employed, and for the purpose of illustration, I have shown a simple form of manual control mechanism which includes a pair of oppositely-positioned shift levers 21 that are pivotally mounted at 22 on a bifurcated extension of the gear box 7. A hand lever 23 is secured to the pair of shift levers 21 by the shaft 22. The other end of each shift lever 21 is provided with clutch operating pins 21*a* which are adapted to ride in an annular groove of the slidable clutch member 18. A spring 25 normally maintains the clutch out of a meshing relationship, and a pin or cotter 26 is employed adapted to cooperate with a hole 23*a* in the lever 23 and holes 27*a* in a bracket 27 for holding the arm in either of its two positions, that is, with the clutch teeth in meshed position and in disengaged position respectively. As will be seen from the drawings, the clutch connections are such that the table drive shaft 14 can only be reconnected to the tertiary drive member 10 in the same time or phase relationship as before.

As seen in Figures 1 and 3, the shaft 10 is journaled within bearings 28 of the gear box 7 and within bearings 29 of a transmission box 30. A bevel gear 31 is keyed to the left end of the shaft 10 and is journaled by the bearings 29 within a trunnion bearing member or differential control housing 32 that is adjustably mounted within the transmission box 30. A short control shaft 34 is journaled within the left hand portion of the trunnion member 32 and at one end has a bevel gear 35 keyed thereto that is similar to the bevel gear 31 on the shaft 10. Extending radially of the housing 32 is a pair of oppositely-positioned removable stud shafts 36 upon each of which is journaled a bevel gear 36a which meshes with the bevel gears 31 and 35 of the shafts 10 and 34, respectively. The other end of the short control shaft 34 is provided with a bevel gear 37 that is removably secured thereto and drives the automatic feeding mechanism in a manner hereinafter described.

In order to change the phase relationship between the shaft 10 and the feeder drive shaft 34, I have provided means for rotating the trunnion or housing 32 and its associated bevel gears 36*a* within the box 30. The trunnion 32 is provided with a bevel ring gear 38 that meshes with a bevel pinion 39 mounted on a shaft 40 that is manually turned or rotated by hand wheel 40*a*.

Since, for the purpose of feeding viscous or plastic materials, it is desirable to mount the feeding mechanism on an upward level or plane with respect to the forming mechanism, I have provided a drive structure for connecting the phase change transmission of Figure 3 with the driving mechanism of the shears and the impeller, see particularly Figure 2. This mechanism includes a bevel gear 41 removably secured to the lower end of a vertical shaft 42 and operatively engaging the bevel drive gear 37. A beveled gear 43 is removably secured to the other end of the shaft 42 and cooperates with a bevel gear 44 of a horizontal telescopic shaft. This shaft includes slidable portions 45 and 46. A bevel gear 47 is removably mounted on the extending end of shaft 46 and meshes with a bevel gear 48 that is secured to a vertical telescopic shaft 49. The vertical shaft 49 is connected through a flexible coupling 50 to the lower end of a feed mechanism drive shaft 51.

As seen, suitable bearings 52 are provided for journaling the shafts 34, 42, 45—46, 49 and 51. The vertical shaft 42 and the horizontal shaft 45—46 are held in an operative relationship by a journal box 53 that is swiveled to a vertical housing 54 extending from the base 1 of the machine. In a like manner, the other end of the horizontal shaft 45—46 and the lower end of the vertical shaft 49 are journaled within a second journal box 55 that is swiveled about a vertically adjustable pedestal member 56 which is mounted in a bearing member 56*a* slidably adjustable on a slide member 56*b* which is also slidably adjustable in a right angle direction on a guide 1*a* of the base 1. It will thus be seen that the shaft 49 may be swung about the shaft 45—46 and the shaft 45—46 may be swiveled about the shaft 42, thus permitting the feeding mechanism to be properly aligned with reference to the differential drive mechanism. The shaft portion 45 is slidably splined to the hollow shaft portion 46 in order to permit horizontal movement of the shaft and the shaft 49 is of similar telescopic construction to permit vertical adjustment of it.

Drive mechanism for the feeding apparatus

As shown particularly in Figures 6, 10, 12, and 14, I intermittently feed segregated portions or gobs of the plastic or viscous material, and intermittently cut off or separate each of these portions from the batch. As previously pointed out, each separated portion is delivered to a mold or blank and is then suitably formed. An impeller

or plunger 90 segregates and/or forms the gobs of material and feeds them from an orifice. A pair of shears 130 cuts off the gobs from the main body of the batch of material and aids in forming and/or feeding the gobs to the mold or blank of a suitable article forming apparatus.

In order to effectively and positively control the operations of the impeller 90 independently of as well as concurrently with the operations of the shears 130, I drive both from the same drive shaft 51 through the agency of independent cam means for each. Phase change or timing control mechanism is interposed between the impeller 90 and the drive shaft as well as between the shears 130 and the drive shaft. In this manner, I am able to positively and effectively control the timing of the shears independently of the forming apparatus and/or independently of the impeller, and vice versa. For example, the control of the various operations is so complete that the shears can be utilized to accomplish entirely new functions. The ultimate result, of course, is that better and more uniform articles are produced.

The actuating mechanism includes a worm shaft 60 that is driven by the vertical shaft 51 through the agency of helical gears 61 and 62, see Figure 9. The worm shaft 60, which is shown as the left hand shaft of Figures 10 and 11, is journaled by suitable bearings 63 within a gear box 64, see Figure 6, and is provided with a pinion 65 meshing with a similar pinion 66 keyed to a secondary or driven worm shaft 60'. The latter shaft 60' is journaled in a similar manner within the gear box 64 and is thus driven in a timed relationship with the shaft 60 through the agency of pinions 65 and 66.

The left hand worm shaft 60 of Figures 10 and 11 is provided with a worm 68 slidably splined thereto and meshing with a worm gear 69 (see also Figure 6) that is provided with a hub portion 70 for removably supporting a shear control cam disk 71. The assembly which includes the shear control cam 71 and the shear control worm gear 69 is rotatably mounted upon a journal shaft 72 extending across the gear box 64. In a similar manner, the secondary worm shaft 60' is provided with a worm 68' that meshes with a plunger control worm gear 69' which is provided with a hub portion 70' upon which is adjustably and removably mounted a plunger control cam 73. The latter assembly which includes the gear 69' and the associated cam 73 are also rotatably mounted upon the journal shaft 72.

The phase change or timing mechanism

In order to adjust the timing relationship between the shear drive worm shaft 60 and the worm gear 69, I have provided a bifurcated block 74 which abuts and holds in position each end of the slidably feathered worm 68, see Figure 6. An adjusting shaft 75 is threaded within the block 74 and is provided with a scaled indicator disk 76 having gear teeth 77. The threaded adjustment shaft 75 is rotatably mounted to extend through the opposite walls of the gear box 64 and is held in position at one end by the indicator disk 76 and at the other side by a small annulus 78. It should be noted that the disk 76 is securely but removably mounted on the shaft 75 for rotation therewith. The worm 68' for driving the impeller cam 73 is in a like manner adjusted by a threaded shaft 75'. However, this shaft 75' extends beyond the shaft 75 and is provided with a scaled indicator disk or pinion member 76' having pinion teeth 77'. The pinion member 76' is rotatably mounted on its axial shaft 75' and its teeth 77' mesh with the teeth 77 of the disk 76. A compression clutch element 82 is slidably keyed to a reduced extension 75'*a* of the shaft 75' and is provided with projecting clutch teeth 83 that are adapted to cooperate and engage with clutch teeth 84 of an annulus 85 projecting from the face of the pinion 76'. The clutch element 82 is secured to a sleeve-like annulus member 81 that is also secured to hand wheel 79' and is slidably splined on shaft extension 75'*a* to provide a telescopic connection therewith. Pointers 79'' and 79''' cooperate with the scaled indicator disks 76 and 76', respectively.

It will thus be seen that the timing relationship between the worm 68 and the cam drive worm gear 69 may be controlled by turning the hand wheel 79 and thus the threaded shaft 75, to move the block or yoke 74, and thus to move the worm 68 along a keyway in its actuating shaft 60. In a similar manner, the timing between the worm 68' and the gear 69' may be controlled by actuating the hand wheel 79'. It will also appear that the adjustment of the wheel 79' for controlling the timing or phasing between the main driving shaft 51 and the impeller 90 is entirely independent of any adjustment of the mechanism 79 which controls the timing between the drive shaft 51 and the shears 130. However, both adjustments can be accomplished simultaneously by pushing the wheel 79' inwardly so as to move extension shaft 75'*a* within the annulus 82. An expansion spring 86 normally holds the clutch element 82 in an unlocked relationship with respect to the pinion 76' and it will thus be seen that an inward movement of the clutch member 82 will cause the teeth 84 and 83 to engage and produce a rotation of the disk 76' of the impeller control mechanism and thus, in turn, of the disk 76 of the shear control mechanism.

The plunger operating mechanism

As seen in Figures 10 and 14, the cam 73 actuates an extruding means or plunger 90 which is mounted on an arm 91. The plunger is periodically reciprocated to form and/or segregate charges or gobs. The connections between the arm 91 and the plunger 90 are such that the plunger may be removed without disturbing the adjustment of the arm. The upper end of the plunger is clamped in a removable chuck 92 having a circular plate 93 (see Figure 12) mounted in an opening formed in the arm and held in place by a clamp member 94 and a thumb knurl nut 95.

As shown particularly in Figures 12 and 14, one end of the arm 91 has pivotal connection with a rod 97 which slides vertically in spaced guide bearings adjusted to be clamped to bracket 98. The pin 96 is used as a fulcrum point in case of changing an impeller or the like and normally the reciprocations of the arm 91 are vertical under the actuating connection hereinafter described. This construction permits the arm 91 to be adjusted laterally in one direction to centralize the plunger with respect to the outlet ring or orifice 131 by sliding the arm on the bracket 98 or by swinging it on the rod 97, or by a combination of such adjustments. A post 98*a* projects vertically from both sides of the bracket and the upper end of it is loosely embraced by a square collar 99 that carries the hinge pin 96.

The collar 99 and its associated parts are ad-

justed laterally with relation to the bracket 98 by thumb screws 100 and 101 threaded into the post 98a at right angles to each other. Each screw passes through a horizontal slot in the collar in which it is held from longitudinal movement by suitable collars. By turning the screw 101, the arm may be adjusted transversely by swinging it about the upper end of the rod 98a. The arm 91 is preferably clamped in position after adjustment by a wing nut 102 threaded on top of the rod 97 and bearing on a clamp 103 and by a wing nut 104 threaded on the top of the post 98a.

The rod 97 passes through a slot in the arm 91 in such a manner that when the wing nut 102 is loosened, the arm 91 may be slid upon or pivoted about the upper end of the rod 97. When the wing nut 102 is loosened, the clamp may be turned lengthwise of the arm and this permits it to be lifted without moving the nut or the clamp from the rod 97. The lower end of the post 98a projects downwardly and is engaged in a bearing 105 in order to prevent it from turning and thereby displacing the plunger. I have shown graduations 106 which indicate the vertical position of the plunger with respect to the outlet.

I also provide an arm 107 which has suitable structure for removably supporting a plunger tube 108. The above details have been merely set forth to explain the structure disclosed and they are only suggested arrangements that are not important to the present invention, since other suitable structures may be employed for supporting a plunger mechanism.

As shown particularly in Figure 14, the plunger arm 91 and the associated plunger 90 are reciprocated through a link 109, a two-part rocker arm 110, a link 111, a link 112, and a roller 113 which operatively engages the cam disk 73. As seen, the rocker arm 110 includes two parts which are pivotally connected together and are adjustably held in a given relationship with respect to each other by a thumb nut 114 which is threaded to screw within a bifurcated portion 115 of one portion of the arm to abut against a tail 116 of the other portion of the arm. A screw nut 117 is adapted to hold the adjustment screw 114 in a given adjusted position. The nut 114 accomplishes an adjustment of the lower limit of the movement of the plunger 90.

It will also be seen that the connection between the rocker arm 110 and the link 111 is an adjustable one through the agency of an adjusting screw 118 which shifts the upper end of the link 111 along a slot in the arm 110. The connection comprises a pin threaded and having a hand nut 119, see particularly Figure 13, bearing against a collar which clamps the arm between a head on the pin and the collar. The screw 118 controls or adjusts the upper limit of movement of the plunger 90.

The link 111 is at its other end pivotally mounted on a shaft 111a of a radius arm 120 that is pivoted at 121 to the housing portion 122. The second link 112 is at one end pivoted to the radius arm 120 by the pin 111a, and at its other end, pivotally supports a roller 113 and is pivotally connected to a secondary radius arm 124 that is also pivotally mounted on the casing 122. As seen, an upper edge of the primary radius arm 120 is notched to receive a hooked portion of a lock lever 125 that is also pivotally mounted on the casing 122. To lock the plunger in an inoperative position, it is only necessary to move the radius arm 122 so that it latches with the lever 125.

It is preferable to removably mount the plunger control cam disk 73 on its support by suitable set screws 73a; it may also be adjusted along the face of such support.

The shear mechanism

The charges, gathers, or glass gobs produced by successive operations of the plunger are severed by a shear mechanism which is adapted to operate in a timed relationship with respect to the plunger mechanism. Shear blades 130 are mounted to reciprocate below an outlet ring 131, see Figures 12, 13, and 14. Provision is made for adjusting the shears 130 to and from the outlet and for adjusting one shear blade with relation to the other, in order to bring them into a proper shearing relationship before the operation of the feeding mechanism is initiated. The blades 130 are mounted on two-part arms 133 which oscillate about parallel axes under the front of the forehearth.

Shear arms 133 are fixed on lower ends of shafts 134 that are pivotally mounted in the front of a bowl casing 135. The shear arms 133 are connected to move together by gear segments 136 mounted in the forked ends of the respective arms. They are operated in their severing movement by springs 137 as shown particularly in Figures 12 and 13. In their opening movement, they are actuated by the link 132 which has a universal joint connection with the right hand arm 133, see particularly Figure 12. The arm 132 is actuated by a vertically extending lever 138 that is pivotally mounted on the framework and oscillated in one direction by the removable shear cam 71 and in the other direction by the previously mentioned spring 137.

The relationship between the shear cam lever 138 and the shear blades may be adjusted to provide more or less overlap in their closed positions by a hand wheel 139 that is fixed on the right and left hand portions of the lever 132 and connects them together.

When it is desired to change the level of the severing plane so as to cut closer to or farther from the outlet, both shear blades are adjusted together in order to preserve their cutting relationship. This vertical adjustment is provided by mounting the shear carrying shafts 134 in sleeve-like slides 140 which are carried in vertical ways formed in the front of the bowl casing 135 to which it is secured by jibs 141. The shaft 134 that carries the left hand shear arm shown in Figure 12 is provided with suitable anti-friction bearings mounted directly in the slide 140. However, the right hand shaft 134 is not mounted directly in the slide, but is carried by an auxiliary sleeve 142 in order to permit adjustment of this shear blade with relation to the other. This sleeve is mounted in such a manner that longitudinal movement is permitted by the end cap 143 which engages the top of the upper bearings 144. The lower bearings are indicated by the numeral 145. The sleeve 142 carries a projecting lug 146 that is threaded to receive an adjustment screw 147 mounted in the slide 140. The screw is provided with a hand wheel by which it may be turned to move the sleeve 142 vertically in the slide 140 and thus to adjust one shear blade vertically with reference to the other.

A latch member 150 has been provided for holding the shears in an inoperative position when desired. Some suitable form of means

may be also provided for cooling shears and, if it is desirable, for horizontally adjusting one blade with respect to the other. However, these features are all well known to the art and need not here be set forth since they constitute no part of the present invention.

From the above description, it will thus appear that the shears may be preliminarily adjusted to operate in a suitable manner with respect to each other and may, in accordance with the present invention, also be adjusted to change their phasing or timing with relation to the plunger, former, and other apparatus during a continuous operation of the feeding mechanism.

In the operation of the machine, the plunger mechanism periodically provides gobs or gathers adjacent the orifice which are periodically severed by the shears and suitably delivered to the forming apparatus. By reason of the timing control features previously pointed out, I am able to set the plunger or impeller 90 to provide a definite length, shape, and/or weight of gob by phasing it with respect to the forming machine 20*a* and to then set the shears in such a manner as to cause the severance of gobs in the exact phasing previously set between the plunger and the forming machine, or if desired, to cause the severance before or after the phasing previously set. In this manner, the forming and feeding mechanism can be quickly adjusted during the operation of the machine to obtain almost any combination of results. In other words, the shears may be adjusted to cut the segregated mass at just the instant the impeller has properly shaped and projected it, such that the shears do not contribute to the shape, length, etc., of the gather received by the mold table; or, the shears may be adjusted to cut the mass before the impeller has finished shaping and projecting it, for example, before an elongated neck has been formed by the mass of segregated material, to produce stubby cut-off portions; or the shears may be adjusted to cut the mass at a period of time after the impeller has finished its operation or during its retractive movement, for example, after the segregated mass has elongated considerably, to produce a fine cut and/or a slender gather. Thus, the shears may be employed to contribute to or to offset the ordinary operation of the impeller or may be employed to exactly coincide with the phasing of the impeller—the breadth and sensitiveness of control make possible exceptionally minute phasing changes to meet any working conditions. If desired, the shears may be first timed to the movement of the mold table and the impeller independently after-timed or phased. It will be apparent to those skilled in the art that the forming machine phase-change transmission type of differential may be termed a so-called continuous full cycle or full phase-change-differential. That is, it can be continuously rotated in one direction to change the phase relationship between the feeding and forming mechanisms through a complete cycle of changes back to the original relationship. It will also be apparent that this phase-change transmission type of differential enables the operator to adjust the machine, in order that the relatively fine adjustment type of differentials (for the plunger and shear mechanisms) may operate on the desired scale range. A worm gearing is used to obtain high ratios, to transmit power, and to obtain smoothness of action plus a self-locking relationship. Thus, it will be apparent that the worm type of differential used for the plunger and shear mechanisms is, in effect, a micrometer adjustment type.

It should be understood that the features of my invention are applicable to feeding and article making machinery in general and it will appear that many changes can be effected in the particular apparatus as disclosed to illustrate a preferred form of my invention, as well as in the procedure set forth and the specific details thereof, without departing from the invention intended to be defined in the claims.

This application is a continuation in part of my application Ser. No. 66,318, filed February 24, 1936 which in turn is a continuation in part of my divisional application 624,713 filed July 26, 1932 which was a division of my original application Ser. No. 462,802 filed June 21, 1930 which matured into Patent No. 2,052,343 dated August 25, 1936.

I claim:

1. In a machine for manufacturing articles from viscous or plastic material such as molten glass, mass feed means, mass severing means, mass forming means, and individual means for timing the operation of each of said above-mentioned means as a whole independently of the operation of another of said means while the machine is in operation.

2. In an apparatus for feeding a viscous or plastic material such as molten glass from a container in successive masses and for controlling the shape, weight, and characteristics of the masses and for forming the masses thus fed, a feeder mechanism, a forming mechanism, operating means for driving said feeder and forming mechanisms, a transmission-differential phase-change apparatus for changing the timing relationship between said forming mechanism and said feeder mechanism, a worm and a worm gear operatively meshing in relation to each other and connecting said transmission differential phase change means to said feeder mechanism, and means for changing the phase relationship between said worm and worm gear.

3. In an apparatus for feeding a viscous or plastic material such as molten glass from a container in successive masses and for controlling the shape, weight, and characteristics of the masses and for forming the masses thus fed, a feeder mechanism including a plunger and a severing means, a forming mechanism, operating means, said operating means being operatively-connected to said forming mechanism, a transmission-differential phase change means operatively-connected to said forming mechanism, a pair of worms operatively connected to said transmission-differential, a worm gear operatively meshing with each of said worms, one of said worm gears being connected to said severing means and the other of said worm gears being operatively-connected to said plunger, and means for moving said worms differentially with respect to their respective worm gears for adjusting the phase relationships between said shear means and said plunger and said forming mechanism.

4. In a machine for feeding a viscous or plastic material such as molten glass in successive masses having a controlled shape, weight, and characteristics and for forming the masses thus-fed, an automatic feeding mechanism having a pair of operative elements, a continuously moving article forming mechanism, a prime mover for actuating said feeding and said article form-

ing mechanisms, elements operatively connecting said prime mover and said article forming mechanism and connecting said prime mover and said feeding mechanism, phase control apparatus having a cycle range of phase control for varying the phase relationship between said article forming mechanism and said feeding mechanism as a whole, and additional fine adjustment phase control apparatus for changing the phase relationship independently between said elements of said feeding mechanism and between said feeding mechanism as a unit and said article forming mechanism, said additional apparatus being adjusted independently of said first-mentioned phase change apparatus.

5. In an apparatus for intermittently feeding plastic or viscous materials such as molten glass, a feeder mechanism which includes an impeller and severing means, actuating means for said feeder mechanism, a primary drive shaft operably connected to said actuating means, a cam shaft, a pair of cams rotatably mounted on said cam shaft, one of said cams being operably connected to said impeller and the other of said cams being operably connected to said severing means, a secondary drive shaft operably connected to said primary drive shaft, a pair of meshing gear elements operably connecting one of said shafts to one of said cams, and a second pair of meshing gear elements operably connecting the other of said shafts to the other of said cams, and means to change the phase relation between said pairs of gear elements while they are being driven by said actuating means.

6. In an apparatus for intermittently feeding plastic or viscous materials such as molten glass, a feeder mechanism which includes an impeller and severing means, actuating means for said feeder mechanism, a primary drive shaft operably connected to said actuating means, a cam shaft, a pair of cams rotatably mounted on said cam shaft, one of said cams being operably connected to said impeller and the other of said cams being operably connected to said severing means, a secondary drive shaft operably connected to said primary drive shaft, a pair of meshing gear elements operably connecting one of said shafts to one of said cams, and a second pair of meshing gear elements operably connecting the other of said shafts to the other of said cams, a separate yoke element operatively associated with each of said pairs of meshing gear elements, individual threaded shafts to actuate each of said yoke elements and to change the phase relation between each of said pairs of gear elements while they are being driven by said actuating means, and individual manual control means operating each of said threaded shafts, so that the phase relation of said impeller may be changed independently of said severing means and vice versa, and clutch means to operate said threaded shafts together, so that the phase relation of said impeller and of said severing means may be changed simultaneously.

DAVID IRVIN DU BOIS.