Sept. 20, 1971 R. HERMES 3,605,825

METHOD AND APPARATUS FOR FILLING THE DIE OF A POWDER PRESS, ESPECIALLY OF A METAL POWDER PRESS

Filed Sept. 30, 1969 4 Sheets-Sheet 1

Fig. 1

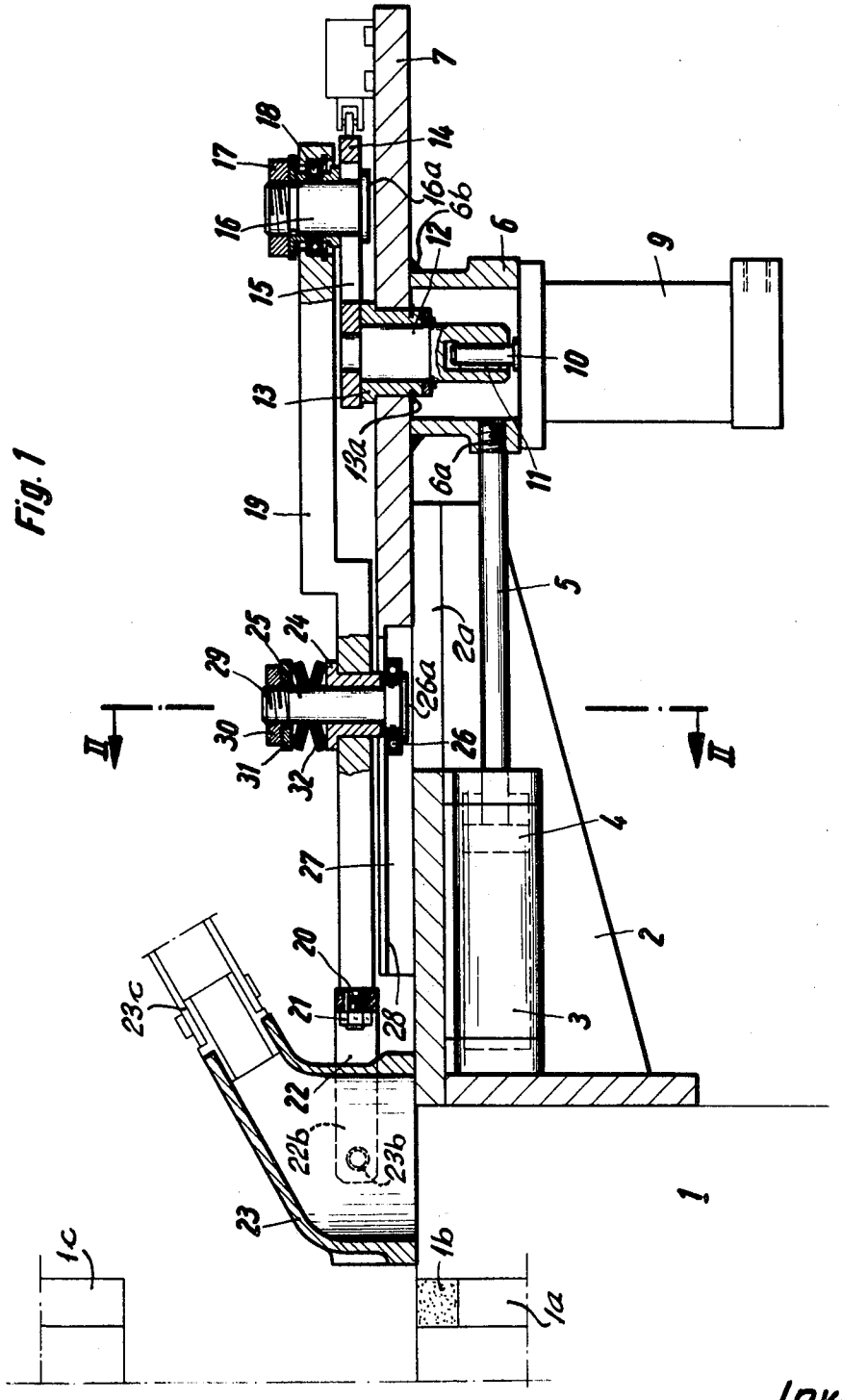

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Fig. 2

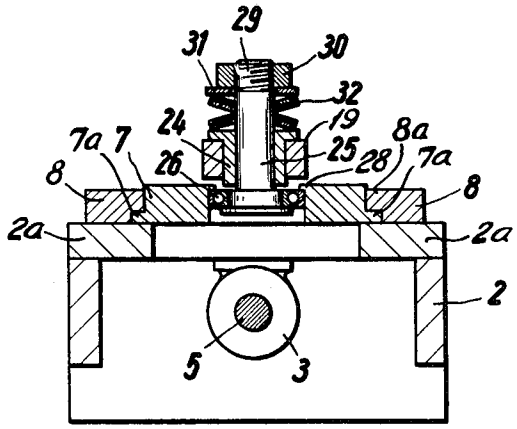

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Fig. 3

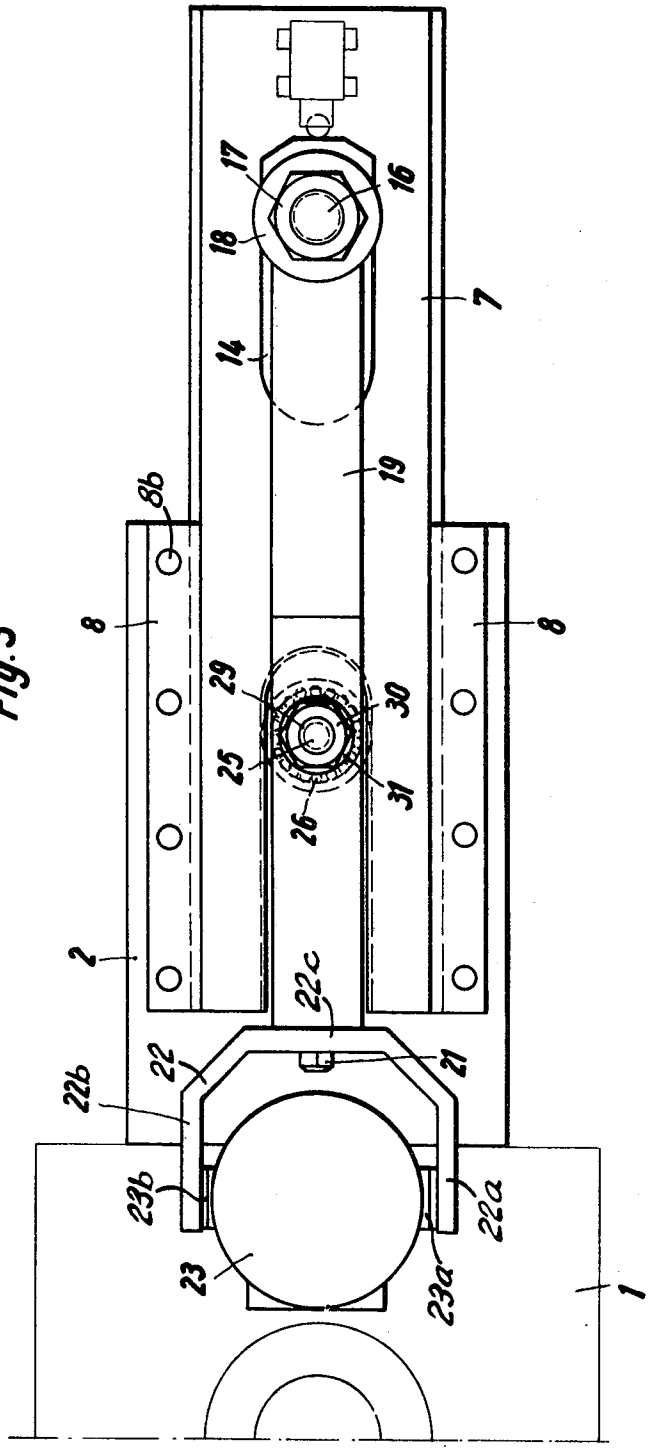

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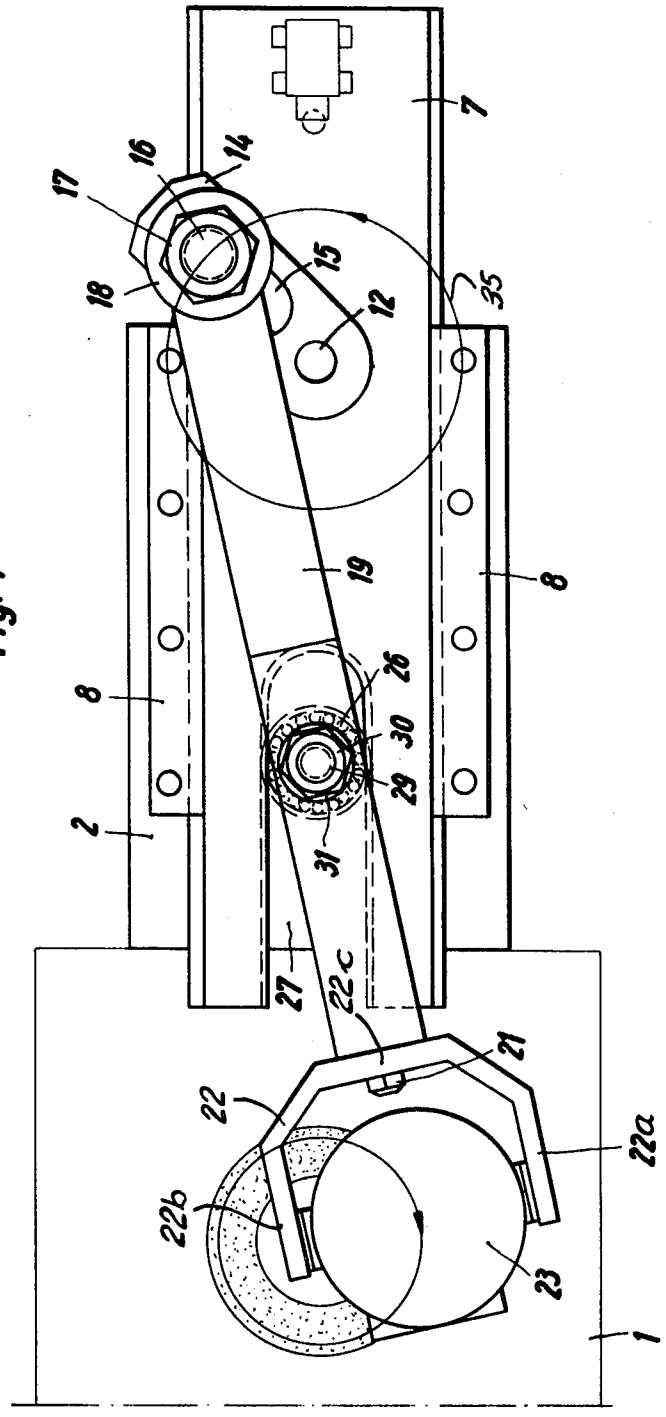
Fig. 4



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3,605,825

METHOD AND APPARATUS FOR FILLING THE DIE OF A POWDER PRESS, ESPECIALLY OF A METAL POWDER PRESS

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Int. Cl. B22f 9/00
U.S. Cl. 141—1 15 Claims

ABSTRACT OF THE DISCLOSURE

Filling the die of a powder press, especially of a metal powder press, wherein the powder is filled into the die or matrix through a filler member which performs a rotational movement, particularly a substantially circular rotational movement. The apparatus for performing such filling process comprises a filler member which is attached to one end of a lever, the other end of which is connected to a crank drive arrangement. The lever itself is supported, preferably at its center, in a longitudinal slot of a lever support member which is in turn slidably supported on a base member and driven by a piston and cylinder arrangement operatively positioned between the base member and the lever support member. The crank drive is driven by a motor connected through a shaft to the crank drive, the shaft extending preferably through said lever support member.

BACKGROUND OF THE INVENTION

The present invention relates to a method and apparatus for filling the female die or matrix of a powder press, especially of a metal powder press. Such filling devices comprise generally a funnel shaped container having an output connected to a so-called filler member.

It is known in the art to push the filler member in a linear movement across the die or matrix and to withdraw it also in a linear movement after the filling has been completed. Reference is made to United States Patent 2,499,980. The linear withdrawal motion of the filler member across the die or matrix which is filled with powder, densified the powder in the die in such a manner that the powder is not uniformly distributed over the entire die because the pushing back of the filler member tends to accumulate the powder on one side of the die but not on the opposite side. Such nonuniform densification is generally disadvantageous and especially undesirable in connection with high quality parts.

In view of the above, it is a main object of the invention to uniformly fill the die with powder while simultaneously avoiding the above drawbacks.

More specifically, it is an object of this invention to provide a method and apparatus which will assure a uniform densification of the powder in the die during and subsequent to the filling.

A still further object of the invention is to replace the mentioned linear back and forth movement of the filler member by a rotational movement, especially by a circular or a substantially circular movement.

SUMMARY OF THE INVENTION

Briefly, in accordance with the invention, the above objects have been achieved by a method in which the powder is filled into the die or matrix by guiding a filler member in a circular movement or in a substantially circular movement above the die or matrix preferably in contact with the die or matrix.

In the apparatus according to the invention, the filler member is connected to a crank drive arrangement through a lever. The lever is supported in a slide member or support which is operatively connected to a cylinder and piston arrangement for moving the slide member back and forth on a fixed base member.

In order that the invention may be clearly understood, it will now be described, by way of example, with reference to the accompanying drawings, wherein:

FIG. 1 is a longitudinal sectional view through the apparatus according to the present invention;

FIG. 2 is a sectional view along line II—II shown in FIG. 1;

FIG. 3 is a top view of the apparatus according to FIG. 1 with the filler member in a retracted position; and

FIG. 4 is a top view illustrating the rotation of the filler member.

In FIG. 1 a die plate **1** carries a female die or matrix filled with powder **1***b*. A male die **1***c* is movably supported above the matrix **1***a*.

A base member **2** is rigidly attached to the die plate **1**. The top of the base member **2** forms a glide bed **2***a*. The base member **2** supports a piston and cylinder arrangement having a cylinder **3** with a piston **4** supported for sliding movement therein and having attached thereto a piston rod **5**. The opposite end of the pistod rod **5** is connected to a bushing **6**, for example, by a threaded connection **6***a*. The bushing **6** is attached to a lever support member **7**, for example, as by a weldment **6***b*.

The lever support member **7** is slidable back and forth on the glide bed **2***a* of the base member **2** by means of the piston and cylinder arrangement **3**, **4** to properly guide the lever support member **7**. The glide bed **2***a* is provided with guide rods **8**. This is best seen in FIG. 2 where the lever support **7** is provided along its length with shoulders **7***a* which are held against the glide bed **2***a* by cooperating shoulders **8***a* of the guide rods **8**.

To the bushing **6** there is attached a drive motor **9**, for example, by threaded bolts, not shown. The motor has a drive shaft **10** which drives a shaft **12** for example, through a groove and key connection **11**. The shaft **12** extends through the bushing **6** and is supported by bearing member **13** in the lever support **7**. The bearing member **13** may, for example, be a sleeve bearing held in a fixed position in the lever support **7**, for example, by a snap ring **13***a*.

Attached to the upper end of the shaft **12** is a crank comprising a crank arm **14** with a longitudinal slot **15** in which a journal pin **16** is slidably supported.

The filling of the die or matrix **1***a* is accomplished by a funnel shaped filler member **23** which is attached to one end of a lever **19**, for example, by a yoke member **22** having free arms **22***a* and **22***b* and a center portion **22***c* (see FIGS. 3 or 4). The connection between the center portion **22***c* of the yoke **22** and said one end of the lever **19**, for example, by means of a partially threaded pin **20** and a nut **21** permits a rotational movement of the yoke **22** relative to the lever **19**.

The free ends **22***a* and **22***b* of the yoke **22** are connected to the filler member **23** by journal means **23***a* and **23***b* so as to permit a cardan joint type movement of the filler member **23** relative to the yoke **22**.

The opposite end of the lever member **19** is connected to said lever crank drive by a bearing **18** through which said journal pin **16** extends. The bearing **18** is preferably a ball bearing and the upper end of the journal pin **16** is threaded to cooperate with a nut **17**. By tightening nut **17** the journal pin **16** is held in a desired position through a flange member **16***a* which bears against the sides of the crank arm **14** adjacent its longitudinal slot **15** through which the journal pin **16** extends.

The filler member **23** comprises at its upper end connecting means **23***c* for joining the filler member **23** to a filling funnel, not shown. The metal powder is contained in the filler member **23** during the filling of the filler member from the funnel because its bottom opening is closed by the top of the plate **1** in the retracted position of the filler member **23** as shown in FIG. 1.

The lever **19** is journaled in the lever support member **7** by means of a bearing **24**, preferably a sleeve bearing, extending through a hole in the lever **19** and by means of a journal pin **25** extending through said bearing **24** and having attached to its lower end a further bearing **26**. The bearing **26** is preferably a ball bearing the inner race of which is attached to the journal pin **25**, for example, by means of a flange **26***a* and the outer race of which bears aaginst shoulders **28** defining a longitudinal slot **27** in the lever support member **7**.

The shoulders **28** limit any upward motion of the just described journal arrangement for the lever **19**, such upward motion being caused by a spring member **32** surrounding the journal pin **25** above the lever **19** and bearing against the sleeve bearing **24** in accordance with the adjustment of a nut **30** on a threaded end **29** of the journal pin **25**. If desired, a washer member **31** may be positioned between the nut **30** and the pressure spring **32**. By adjusting the nut **30** the desired pressure may be established. By loosening the nut **30**, the journal or pivot axis for the lever **19** may be adjusted back and forth along the slot **27** in the lever support **7**.

The guide rods **8** are attached to the glide bed **2***a* of the base member **2**, for example, by screws **8***b*.

The apparatus according to the present invention operates as follows: In FIGS. 1 and 3 the filler member **23** is shown in its retracted position during the powder pressing operation when the upper die **1***c* moves from the elevated position shown in FIG. 1 to compress powder **1***b* in the lower die **1***a*. If the lower die or matrix **1***a* is to be filled, the upper die **1***c* is raised and pressure such as oil or air pressure is supplied to the right hand side of the piston **4** so that it moves to the left. Thus, the lever support **7** along with the bushing **6** slide to the left. Such movement of the piston **4** moves the filler member **23** into the die filling position since the mechanism for rotating the filler member **23** is supported on the lever support **7**. Thus, the filler member **23** is moved into the matrix filling position above the die or matrix **1***a*.

When the filler member **23** has reached its desired filling position, the motor **9** is energized, for example, by of a trip dog attached to the support **7**. The motor **9** drives through its shaft **10** the shaft **12** whereby the crank arm **14** moves the journal pin **16** and thus the end of lever **19** along a circular path **35** as best in FIG. 4. As a result, the journal arrangement including journal pin **25** and the lever **19** also effect a back and forth movement along the slot **27** of support **7**. This combined rotational and back and forth movement of the lever **19** causes a substantially circular movement of the filler member **23**.

When the die or matrix **1***a* has been filled, the motor **9** is de-energized and the pressure on piston **4** in cylinder **3** is reversed so that it is now applied to the left hand side of the piston **4** whereby the lever support **7** is moved to the right thereby taking along the rotating means for the filler member as well as the filler member **30** itself.

The pressure exerting means, for example, the pressure spring **32** which is held in its position by the nut **30** and the washer **31** presses the lever **19** downwardly whereby the lever is held in proper position by the journal pin **25** and by the ball bearing **26**. The force of the spring is thus transmitted through the lever **19** to the filler member **23** whereby the filler member is pressed against the upper edge of the die or matrix **1***a*. This has the advantage that the powder cannot flow out of the portion of the bottom opening of the filler member which portion is not over the mouth of the die **1***a*. In

order to enable the filler member **23** to adapt itself to the surface of the die **1***a* it is provided with said yoke **22** which supports the filler member **23** in the manner of a cardan or universal joint.

By shifting the journal pin **16** radially inward or outward with respect to the axis of shaft **12** in its slot **15** of the crank arm **14**, it is possible to vary the diameter of the circle **35** and thus the rotation or substantially rotational movement of the filler member **23**.

The apparatus according to the invention assures a uniform filling of the die or matrix, in that the diameter of the circular movement of the filler member **23**, as well as the rotational speed and the direction of rotation in the clockwise or counterclockwise direction are adjustable. It is further possible to move or guide the filler member **23** along several circular or substantially circular filling movements depending on the arrangement of the drive circuit including motor **9**. It is also possible to effect simple linear back and forth movements, if desired, through the piston and cylinder arrangement **3**, **4**, in which case the motor **9** would not be energized.

By effecting several rotational movements each having a small radius it is possible to provide a kind of vibratory movement of the filler member **23** relative to the die or matrix. This may be particularly desirable where the powder in the die is to be uniformly densified in and throughout the shape of a complicated part. It is not critical if the movement of the filler member **23** deviates slightly from a circular movement because the size of the opening at the bottom of the filler member **23** is large enough in order to compensate for such deviations, if any.

What I claim is:

1. A method for filling the die cavity of a powder press with powder said die cavity having an edge defining a filling mouth opening communicating with the interior of said cavity, comprising filling a filler member with the powder, said filler member comprising means defining a container having sidewalls and an open bottom defined by the lower edges of the sidewalls, guiding the filler member in a rotational movement in the plane of the mouth of said die cavity while simultaneously releasing the powder from said filler member into the die cavity, said rotational movement being such that the edges of the filler member sequentially intersect the entire edge of the mouth during said rotational movement, and withdrawing the filler member along a path in the plane of the mouth of the cavity when the die cavity is filled with powder.

2. The method according to claim **1**, further comprising supporting said filler member so as to enable it to perform said guided rotational movement in contact with said die.

3. Apparatus for filling the die cavity of a powder press with powder, said die cavity having an edge defining a filling mouth opening communicating with the interior of said cavity, comprising a filler member, said filler member comprising means defining a container having sidewalls and an open bottom defined by the lower edges of the sidewalls, means for guiding the filler member in rotational movement in the plane of the mouth of the cavity such that the edges of the filler member sequentially intersect the entire edge of the mouth during said rotational movement and means for withdrawing the filler member along a path in the plane of the mouth of the die cavity when the die cavity is filled with powder.

4. An apparatus for filling the die cavity of a powder press with a powder, comprising a die including a cavity having an edge defining a filling mouth opening communicating with the interior of said cavity, a filler member, a lever, means for connecting said filler member to an end of said lever adjacent said die cavity, lever drive and motion control means operatively connected to the opposite end of said lever for imparting to the filler member a rotational movement in the plane of the mouth of

the cavity such that the edges of the filler member sequentially intersect the entire edge of the mouth during said rotational movement, a base member, lever support means glidingly supported on said base member for movement toward and away from said die cavity along a path in the plane of the mouth of the die cavity and drive means operatively connected to the lever support means for driving the lever support means in said movement toward and away from said die cavity.

5. The apparatus according to claim **4**, wherein said lever support means comprise a slide having a longitudinal slot therein, a first bearing positioned in the lever intermediate its ends, a journal means extending through said first bearing in the lever, second bearing means attached to one end of said journal means and glidingly supported in said slot in the slide and fastening means attached to the other end of the journal means for securing the journal means in said first bearing.

6. The apparatus according to claim **5**, wherein said first bearing is a sleeve bearing.

7. The apparatus according to claim **5**, wherein said second bearing is a ballbearing having an inner race attached to said journal means and an outer race glidingly held in said slot.

8. The apparatus according to claim **5**, further comprising pressure exerting means positioned between said first bearing and said fastening means, said slot having shoulders against which said second bearing means is held by said pressure exerting means.

9. The apparatus according to claim **8**, wherein the journal means comprise a threaded end, said fastening means comprising an adjustable nut, said pressure exerting means, comprising a pressure spring bearing against said nut.

10. The apparatus according to claim **4**, wherein said connecting means comprise a yoke having free ends and a center portion, means for rotatably connecting the yoke center portion to said one end of the lever, and means for rotatably attaching said filler member to said free ends of the yoke.

11. The apparatus according to claim **4**, wherein said lever motion control means comprise a crank arm journaled to said lever support means and connection means for connecting said crank arm to the other end of said lever.

12. The apparatus according to claim **11**, wherein the lever motion control means comprise a shaft, bearing means for supporting said shaft in said lever support means, a crank arm drive member connected to one end of said shaft, said crank arm being rigidly connected to the other end of said shaft, a slot in said crank arm and means shiftable in said crank arm slot for journalling the crank arm to the other end of the lever.

13. The apparatus according to claim **12**, further comprising a bushing attached to said lever support means, said crank arm drive member being attached to said bushing and connected to said shaft extending through said bushing.

14. The apparatus according to claim **4**, wherein said drive means comprise a piston and cylinder arrangement operatively positioned between said base member and said lever support means.

15. The apparatus according to claim **14**, wherein said base member comprises guide rods for the lever support means, said piston and cylinder arrangement comprising a piston rod connected to said lever support means, for moving the lever support means along said guide rods toward and away from said die cavity.

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