PUBLISHED
APRIL 27, 1943.
BY A. P. C.

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MECHANICAL CLOSING DEVICES FOR INJECTION MOULDING MACHINES

Filed Feb. 24, 1939

Serial No. 258,329

2 Sheets-Sheet 1

Fig. 2

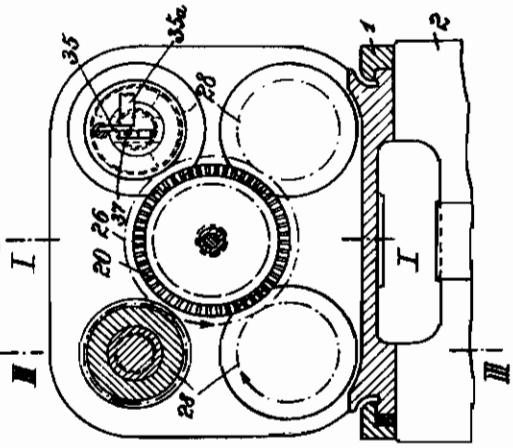
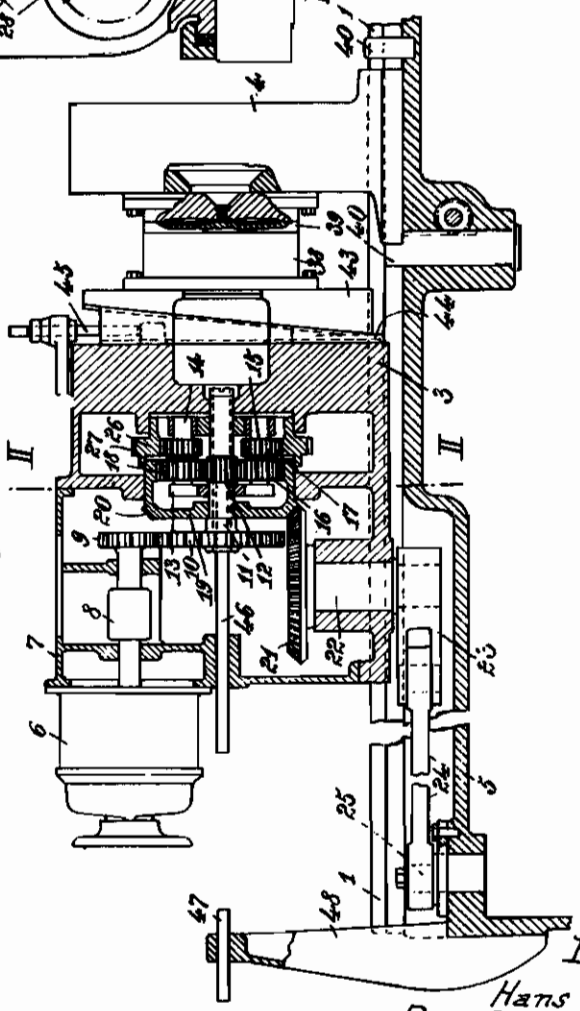


Fig. 1



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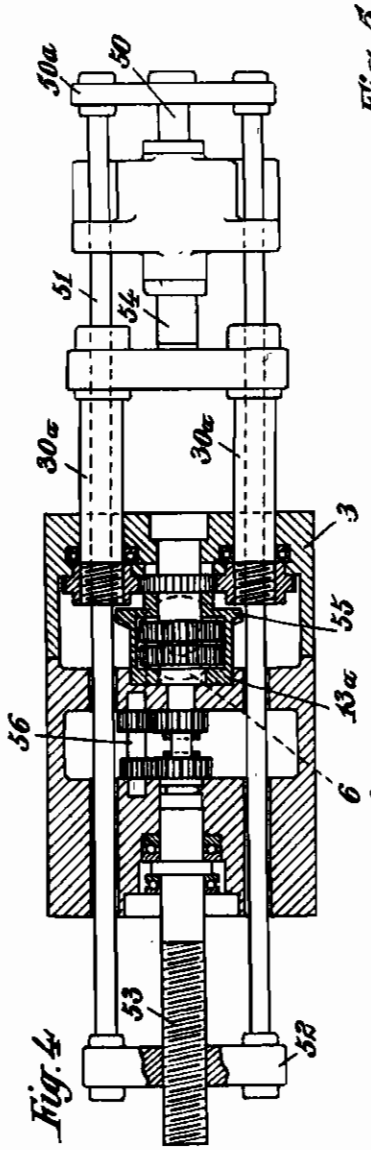

Fig. 4

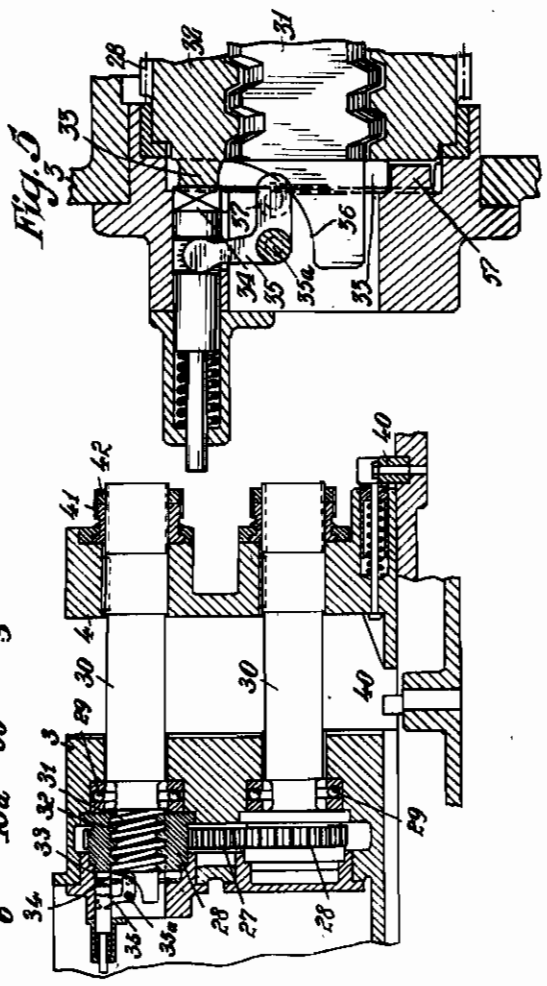

Fig. 3

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ALIEN PROPERTY CUSTODIAN

MECHANICAL CLOSING DEVICES FOR INJECTION MOULDING MACHINES

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Application filed February 24, 1939

In injection metal or plastic masses, high pressures, which may amount particularly in the case of plastic masses to over 1,000 atmospheres, occur within the mould. Consequently, when the injecting parts are of large superficial area, the mould, which generally is in two parts, is opened by forces which may amount to 100 tons or more. These forces must be taken up by the locking means, and the expansion of this locking means must be kept within very narrow limits.

A mould closing device has two carriers, one for each half of the mould. Normally these slide tables for the moulds, so far as they are mechanically driven, are opened, closed and locked by eccentrics, toggle levers or double toggle levers. For the purpose of locking, the movable slide table of the mould is pressed against the fixed slide table of the mould by the toggle lever. The toggle lever bears against the frame of the injecting moulding machine or against the rails or tie rods, which are connected with the fixed slide table of the mould or have an abutment for the latter respectively. Due to the great length of the hitherto usual locking means, the mould cannot be closed safely even by employing great locking forces, as in consequence of the great forces within the mould due to the injection procedure, the deformations of the locking pieces reach values which cause an undesirable separation of the halves of the mould from each other.

In accordance with the invention, the locking of the slide tables of the mould is effected by mechanically driven means in such a way that the locking forces which act against the forces for opening the mould are directly transmitted from one slide table of the mould to the other. This arrangement enables the locking means to be kept short, with the result that expansion of the locking means is reduced to a negligible amount.

Screw bolts and nuts are employed, in accordance with the present invention, as locking means, by means of which pressure is brought to bear upon both the slide tables of the mould. The drive engages the nuts. An electric driving motor is directly attached to the movable slide table of the mould, in accordance with the present invention. This motor serves both for closing and opening the closing device of the mould. The mounting of the motor upon one of the slide tables of the mould has the advantage that the necessary force for the locking members may be transmitted in the shortest way to the said nuts. Moreover a shortening in the length of the construction of the machine is thereby achieved.

The invention will now be described with reference to the accompanying drawings, showing by way of example one embodiment:

In the drawings:

Figure 1 is a section through the locking device of the mould on the line 1—1 of Figure 2,

Figure 2 is a section on the line 2—2 of Figure 1,

Figure 3 shows a horizontal section on the line 3—3 of Figure 2 and

Figure 4 shows a further embodiment of the invention given as an example.

As shown, only the two guide rails 1 of the casting machine are represented and also the machine bed 2 which serves as a guide surface for both the slide tables 3 and 4 of the moulds. Also, a part 5 of the bed 2 is illustrated in Figure 1, which will be referred to later. The driving motor 6 of the closing device of the moulds is directly flanged on to the casting housing 7, which again is screwed to the movable slide table 3 of the moulds. The motor shaft is connected within the cast casing 7 through a friction coupling 8 with a toothed wheel 9 mounted in the housing 7. The toothed wheel 9 engages the toothed wheel 10. This toothed wheel 10 is fixed on to the hollow shaft 11 mounted in the axis of the closing device of the moulds. A toothed wheel 12 is mounted on this hollow shaft. Moreover the cast body 13 is rotatably mounted on this hollow shaft by a ball bearing (not shown). This cast body carries two axle pieces 14. Rotatably mounted upon the axle pieces 14 are double toothed wheels 15 with two toothed rims 16 and 17 differing in diameter and number of teeth. The toothed rim 18 is engaged on the one hand with the toothed wheel 12 and on the other hand with a toothed rim 10 which is secured in the interior of the pot shaped wheel 19. This wheel is rotatably mounted upon the shaft 11 between the toothed wheels 10 and 12. It possesses besides the toothing 18 bevel teeth 20 which engage with a correspondingly toothed bevel wheel 21. This bevel wheel is attached to the axle 22, which is rotatably mounted in the movable slide table of the mould. Upon the free extremity of the axle 22 is keyed a crank 23 which forms, together with the rod 24, a crank gear. The rod 24 is pivotally connected with the bolt 25 which is fixedly inserted in the engine bed 5.

The teeth 17 of the double toothed wheels 15 are engaged with an internally toothed wheel 26, which latter is rotatably mounted partly in a flange of the movable slide table 3 of the mould and partly on the periphery of the toothed wheel 19. The toothed wheel 26 has a smaller diameter than the toothed rim 18. Accordingly the number of the teeth is also smaller.

The toothed wheel 26 is provided further with external teeth 27, which engage four externally toothed nuts 28 rotatably mounted in the movable slide table 3. The nuts 28 bear against the slide of the moulds through the ball bearing 29. The nuts 28 in association with the screw bolts 30 serve to lock the mould. The screw bolts are adjustably fixed in the slide table 4 of the mould,

they are provided each at their front end with a thread 31 which can be brought into engagement with a corresponding internal thread 32 of the nuts 28. The bolts 30 are flattened over the entire length of the thread 31. The internal thread 32 of the nuts 28 has corresponding cut away portions. These cut away portions enable, when the nuts 28 are in appropriate angular position, the screw bolts 30 with their threads 31 to be inserted in the nuts, in order to bring about later the engagement of the threads 31 and 32 upon corresponding rotation of the nuts.

The operation of the device is as follows:

If in the case of the open position of the device the motor 6 is switched on, the toothed wheels 9 and 10, the toothed wheel 12 and in consequence also the double toothed wheels 15 are driven through the adjustable friction coupling 8.

When the mould is open the nuts 28 are prevented from rotating by a catch. For this purpose a cavity 33 is provided on one of the nuts into which cavity a locking bolt 34 extends when the device is in an open position. The bolt 34 can be brought out of engagement by a bell crank lever 35 mounted on a stationary pivot 35a if a cam-shaped surface 36 provided on the screw bolt 30 hits against the lever arm 37 of the lever 35 and rotates it in an anti-clockwise direction.

The locking of the nut 28 prevents rotation of the toothed wheel 28. The double toothed wheels 15 then roll upon the toothed wheel 26 and drive simultaneously the wheel 19 and in consequence the bevel wheel 21. By means of the crank gear 23, 24 the slide table of the mould is then moved into the closing position. The half 38 of the mould connected with the slide table 3 of the mould bears against the half 39 of the mould connected with the slide table 4. The slide table 4 is moved against an abutment 40. The nuts 28 are unlocked during this movement. The wheel 26 may now rotate, whilst the wheel 19 is held fast, as the rotation of the crank gear 23, 24 is limited by abutments. The unlocking of the nuts 28 takes place shortly before the termination of the closing movement approximately when the threads 31, 32 of the screw bolts and of the nuts are distanced at a half pitch of the thread from the final engaging position. The closing movement terminates as soon as both threads may engage each other. From now on a rotation of the nuts may take place. The closing movement may be obtained by spindle- or toothed rack and pinion drive instead of by crank gear.

The locking is effected by rotation of the nuts 28 through which the screw bolts are stressed. With increasing stressing the required torque moment of the motor and thereby rate of charge of the motor increases. If the current surpasses a determined value, the motor is then switched off by a relay. It is also possible to adjust the friction coupling 8 in such a way that with a determined torque moment the coupling of the motor with the toothed wheel 4 is released.

When the injecting and cooling process is terminated, the motor is again switched on but in an opposite sense of rotation. In this connection the pressure generated between the threads and the friction produced thereby is so great that the wheel 26 is held fast. The double toothed wheels 15 then again rotate the wheel 19 and thereby the crank gear 23, 24, that is to say both slide tables of the mould are moved first in the opening direction. Upon a short movement in common, the slide table of the moulds 4 abuts against the fixed stop 40. If this stop is taken away the slide table 4 of the mould abuts against a second stop only by travelling a greater distance, in order to remove the mould further from the injecting nozzle before opening. By means of the stop a further rotation of the wheel 18 is prevented. The motor then causes a rotation of the wheel 26 and in consequence a rotation of the nuts 28. For the initial movement of the nuts a sufficient torque moment of the motor 6 is already available at this moment which is still assisted by the momentum of the motor armature of the toothed wheel and other parts.

As soon as the nuts 28 have rotated through an angle of 90°, they are prevented from further rotation by an abutment, that is to say the wheel 26 comes to a standstill. As the locking between both the slide tables of the mould is released, the wheel 19 can continue to rotate and move the half of the mould 3 to the inner position. When this position is reached, the driving motor is switched off by an end contact.

It has been already mentioned that the screw bolts 30 are adjustably fixed in the slide tables 4 of the mould. Nuts 41 serve for this purpose which are screwed upon the ends of the threaded bolts 30. Lock nuts 42 ensure that the adjusted position shall always be maintained. This adjustable fixing enables differences in length of the individual screw bolts to be compensated in order to obtain a uniform tightening of the arrangement by a plurality of locking bolts.

If screw bolts are used as described for locking the halves of the mould, the distance between both halves of the mould 3 and 4 is fixed. In order to allow the balancing of any differences in the thickness of the individual parts of the mould, the half 38 of the mould is fixed upon a wedge-shaped slide table 43, which can be set by a wedge 44 with the aid of a screw 45.

The formation of the shaft 11 as a hollow shaft has the advantage that an ejecting rod 46 may be passed therethrough. Shortly before the open position is reached, this rod abuts against an abutment 47 which is secured to a rim 48 of the housing part 5.

As shown in Figure 4, the motor may be employed simultaneously also for driving an injecting piston 50. This is illustrated diagrammatically in Figure 4 as follows:

The bolts 30a are tubular. Through these tubes extend the bars 51, which in turn are connected with the piston 50 through a bridge 52 with the interposition of a spring buffer, and are rigidly connected at their other ends with a crosshead 52, in the centre of which is mounted the spindle 53.

This spindle serves instead of the crank drive 23, 24 for the movement of the rear slide table 3 of the mould and when the heating of the slide table of the mould is finished drives the piston in the injecting cylinder 54 through the intermediary of the tie rod 51.

Finally, the drive from the motor 6 to the casting body 13a in which the double toothed wheels 15 are mounted in the case of this embodiment takes place directly from the bevel wheel toothing 55.

In order to be able to regulate the velocity of the closing movement of the rear slide table 3 of the mould, and also the speed of the piston, a countershaft 56 is built in within the drive of the spindle 53 to provide at least two speeds.

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