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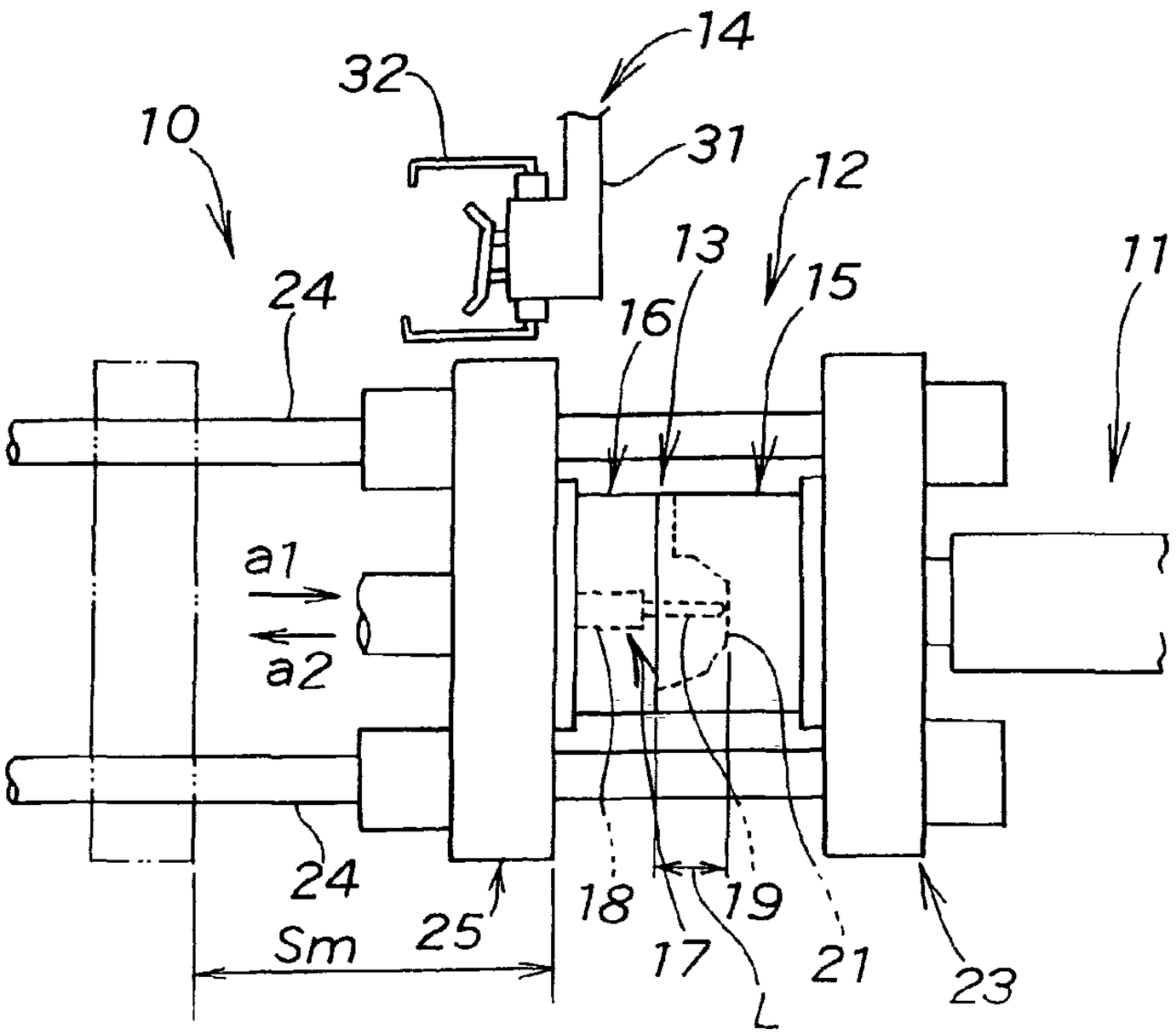
(54) Titre : PROCEDE D'EXPLOITATION D'UN DISPOSITIF DE MOULAGE PAR INJECTION
(54) Title: METHOD FOR OPERATING INJECTION MOLDING APPARATUS



(57) Abrégé/Abstract:
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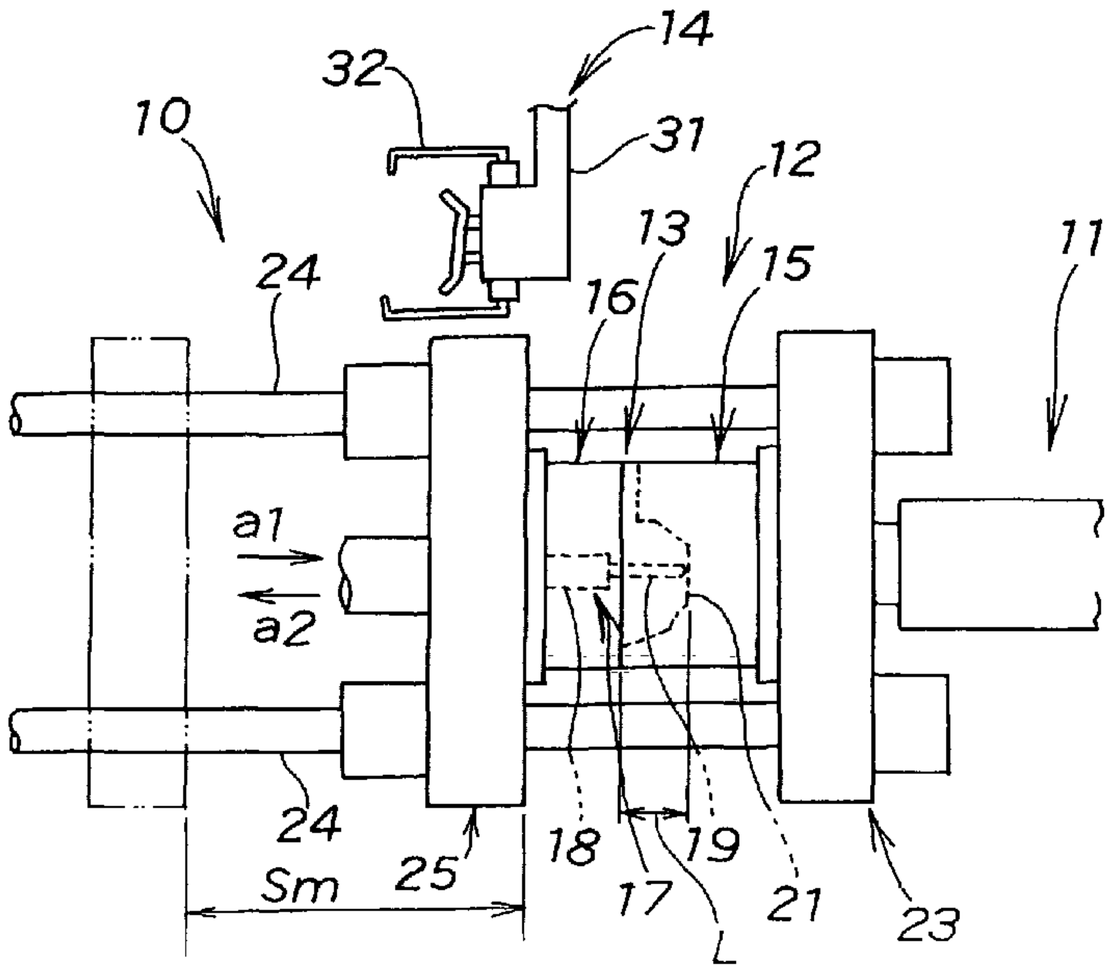
(54) Title: METHOD FOR OPERATING INJECTION MOLDING APPARATUS



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DESCRIPTION

METHOD FOR OPERATING INJECTION MOLDING APPARATUS

TECHNICAL FIELD

The present invention relates generally to a method for operating an injection molding apparatus, and in particular to a method for taking a molded product out of a mold assembly of the apparatus.

BACKGROUND ART

Fig. 8 hereof shows a conventional injection molding apparatus 100. The apparatus 100 includes a mold assembly 101. The mold assembly 101 has a stationary mold 102 and a movable mold 103. The apparatus 100 also includes an injection device 104 for injecting resin into a cavity (not designated) jointly defined by the molds 102, 103, and a removing device 105 for taking molded products out of the mold assembly 101. The device 105 has a chuck 106 for holding the molded products. The injection molding apparatus 100 is operated as follows.

After the cavity is filled with the resin, the movable mold 103 moves back a distance S1 to thereby open the mold assembly 101. It is noted that the distance S1 is kept constant regardless of any type of the mold assembly 101. With the mold assembly 101 in the opened position, the device 105 is lowered as shown by an arrow A and then the chuck 106 is opened. The device 105 having the chuck 106 opened is thereafter advanced or moved towards a resin molded product 107, as shown by an arrow B. Subsequently,

an ejector pin 108 provided in the mold 103 is caused to advance or protrude to eject the product 107 into the opened chuck 106. The chuck 106 is then closed to grasp the product 107.

The pin 108 is retracted, and thereafter the device 105 having the product 107 held in the chuck 106 is retracted or moved back towards the stationary mold 102, as shown in Fig. 9. Finally, as shown by an arrow C, the device 105 is raised to its original position as indicated by a double-dot-and-dash line.

The sequence of the above-described operation of the apparatus 100 will be discussed using a time chart as shown in Fig. 10.

The opening operation of the movable mold 103 is brought to ON state at a time T1, that is, the movable mold 103 starts to move back. The opening operation of the mold 103 is brought to OFF state at a time T2. In other words, the mold 103 finishes the backward movement. At the time T2, the lowering operation of the device 105 is brought to ON state. This means that the device 105 starts to be lowered. The lowering operation of the device 105 is brought to OFF state, that is, the former is completed at a time T3. At the time T3, the opening operation of the chuck 106 is brought to ON state. In this state, the chuck 106 starts to open. The chuck 106 finishes its opening operation at a time T4. Namely, the opening operation is brought to OFF state. At the time T4, the advancing operation of the device 105 is placed in ON state. That is, the device 105 starts to advance or move towards the product 107. The advancing operation of the device 105 is brought to OFF state, or the former is terminated at a time T5. The ejector pin

108 begins advancing or protruding at the time T5. That is, the advancing operation of the pin 108 is brought to ON state. The advancing operation of the pin 108 is placed in OFF state, or the former is completed at a time T6. At the time T6, the closing operation of the chuck 106 is brought to ON state, namely, the chuck 106 starts to close. The closing operation of the chuck 106 is placed in OFF state or completed at a time T7. The retracting operation of the pin 108 is brought to ON state at the time T7. In other words, the pin 108 starts to be retracted at the time T7. The retracting operation of the pin 108 is terminated or placed in OFF state at a time T8. The device 105 begins moving back towards the stationary mold 102 at the time T8 and completes the backward movement at a time T9. Namely, the retracting operation of the device 105 is brought to ON state at the time T8 and then to OFF state at the time T9. Then, the device 105 starts to be raised at the time T9. That is, the raising operation of the device 105 is placed in ON state at the time T9. The raising operation of the device 105 is completed, or brought to OFF state at a time T10. A period of time between the time T1 and the time T10 is required to take the molded product 107 out of the mold assembly 101. Such a period of time is hereinafter referred to as "removal cycle S0". The aforementioned respective operations are performed in sequence for removal of the molded product 107 from the mold assembly 101.

Using the thus arranged apparatus 100, the molded products of good quality can be reliably manufactured. The molded products can be less efficiently removed from the mold assembly 101, however. For removal of the products with improved efficiency, it may be

suggested that the respective operations be more quickly performed to shorten the removal cycle S0. The molded products removed by such quick operations would be poor in quality, however. There is a need to shorten the removal cycle without having to perform the respective operations quickly so as to take the molded products out of the mold assembly with improved efficiency.

DISCLOSURE OF THE INVENTION

An object of the present invention is to provide a method for operating an injection molding apparatus designed to take molded products out therefrom in a shortened time.

According to one aspect of the present invention, there is provided a method for operating an injection molding apparatus including a stationary mold, a movable mold for producing a molded product in cooperation with the stationary mold, an ejector pin mounted within the movable mold, and a product removing arm for taking the product out, the method comprising the steps of: moving the movable mold towards an opened position with the product held in intimate contact with the ejector pin; moving the product removing arm towards a space defined between the stationary mold and the movable mold before the movable mold reaches the opened position; advancing the ejector pin to eject the product before the product removing arm arrives in the space; grasping with the product removing arm the product within the space; moving the ejector pin towards a retracted position; and moving the product removing arm out of the space before the ejector pin reaches the retracted position.

The arm starts to move towards the space by the time the

movable mold is moved to the opened position. In other words, the movement of the arm can be commenced earlier.

During the movement of the arm, the product starts to be ejected. This means that the forward movement of the ejector pin can be commenced earlier.

The arm starts to move out of the space by the time the ejector pin is moved to the retracted position. Namely, the movement of the arm holding the product can be commenced earlier.

Those operations of the arm and the ejector pin makes it possible to shorten a period of time required to take the product out.

Preferably, the movable mold is moved to the opened position by a distance set depending upon a size of the product.

The size of the product refers to an amount by which the product is deepened in a direction transverse with respect to the direction of movement of the arm. If the product is small in size, the movable mold is opened a small distance. This makes it possible for the movable mold to move to the opened position within a shorter time. Moving the movable mold the small distance permits the arm to start to move further earlier.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic view showing an injection molding apparatus having a mold assembly in a closed position and a product removing device in an uppermost position;

Fig. 2 is analogous to Fig. 1 except that the mold assembly is shifted towards an opened position and the product removing device is lowered from the uppermost position;

Fig. 3 is analogous to Fig. 2 except that the mold assembly is in the opened position, the product removing device is further lowered, an ejector pin of the mold assembly starts to advance, and a chuck of the product removing device is in an opened position;

Fig. 4 is analogous to Fig. 3 except that the product removing device is in a lowermost position and the ejector pin is in an advanced position to eject a molded product into the opened chuck;

Fig. 5 is analogous to Fig. 4 except that the chuck is closed holding the molded product;

Fig. 6 is analogous to Fig. 5 except that the product removing device starts to be raised from the lowermost position towards the uppermost position and the ejector pin is retracted;

Fig. 7 is a time chart showing a sequence of operation of the injection molding apparatus for taking the molded product out therefrom;

Fig. 8 is a schematic view showing a conventional injection molding apparatus having a mold assembly in an opened position, and a product removing device ready to be lowered;

Fig. 9 is similar to Fig. 8 except that the product removing device starts to be raised holding a molded product; and

Fig. 10 is a time chart showing a sequence of operation of the conventional injection molding apparatus for taking the molded product out therefrom.

BEST MODE FOR CARRYING OUT THE INVENTION

Referring to Fig. 1, there is shown an injection molding apparatus 10 including an injection device 11, a clamping mechanism 12, and a control device (not shown) for controlling the injection

device 11 and the clamping mechanism 12. The clamping mechanism 12 has a mold assembly 13 mounted therein. The apparatus 10 further includes a product removing device 14 disposed above the clamping mechanism 12. The device 14 is vertically movable as will be discussed later.

The mold assembly 13 includes a stationary mold 15 and a movable mold 16 movable into and out of engagement with the stationary mold 15. As will be described later in detail, the movable mold 16 is movable in a substantially horizontal direction transverse with respect to the direction of vertical movement of the device 14. The movable mold 16 includes an ejecting means 17 having a cylinder 18 and an ejector pin 19. The cylinder 18 is mounted within the movable mold 16. The pin 19 is movable between an advanced position and a retracted position through the cylinder 18, as will be discussed later. The mold 16 has a parting surface 21.

The clamping mechanism 12 has a stationary platen 23 having tie bars 24, 24 attached thereto, and a movable platen 25 slidably mounted on the tie bars 24, 24. The movable platen 25 slides, as shown by an arrow a1, to move the movable mold 16 to a closed position. In the closed position, the movable mold 16 is in clamping engagement with the stationary mold 15 with a given pressure exerted thereon. The movable platen 25 also slides backwardly by a distance or amount (hereinafter referred to as "opening amount") Sm, as shown by an arrow a2, to an open position as indicated by a double-dot-and-dash line. This causes the movable mold 16 to move back to a retracted position or an opened position. In the opened position, the mold

16 is out of clamping engagement with the mold 15.

The opening amount Sm is set depending upon the size L of a molded product 35 (see Fig. 2) the molds 15, 16 produce in cooperation with each other. More specifically, the opening amount Sm by which the movable mold 16 is moved back is set such that the product removing device 14 takes the molded product 35 out from the clamping mechanism 12 or mold assembly 13 without interfering with the parting surface 21 of the mold 15.

The size of the molded product 35, as used herein, refers to an amount L by which the product 35 is deepened in a direction transverse with respect to the direction of vertical movement of the device 14. The amount L depends upon a configuration of the product 35. It will be understood that an amount or distance by which the movable mold 16 is moved to the opened position is set depending upon the size of the product 35, as is the opening amount Sm.

The product removing device 14 includes a product removing arm 31 for taking the product 35 out from the clamping mechanism 12 or mold assembly 13, a chuck 32 mounted on the arm 31, and a control device (not shown) for controlling the arm 31 and the chuck 32. The device 14, or the arm 31 as shown in Fig. 1 is in an uppermost or ready position located above the clamping mechanism 12 or mold assembly 13.

Discussion will be made as to how the injection molding apparatus 10 is operated in accordance with the present invention.

First, the mold assembly 13 having the movable mold 16 held in the closed position is filled with resin. More specifically,

resin material is melted or subjected to plastication using the injection device 11. The device 11 then injects the thus melted resin of a given amount into the mold assembly 13. The resin is then held within the mold assembly 13 for a predetermined time interval, after which the movable mold 16 starts to move back towards the opened position, as shown by the arrow a2.

Turning to Fig. 2, the arm 31 starts to be lowered from the uppermost position, as shown by an arrow a3, so that the former enters a space S defined between the stationary mold 15 and the movable mold 16 which is being moved back towards the opened position. More specifically, by the time the movable platen 25 is opened or moved the opening amount Sm, for example, when the same is moved a distance or amount smaller than the amount Sm by a distance or amount Ss, the arm 31 is moved downwardly to a position located directly below the uppermost position and in the proximity of the movable mold 16. It is to be understood that the arm 31 starts to be lowered before the movable mold 16 reaches the opened position. Held in intimate contact with the movable mold 16 or the ejector pin 19, the molded product 35 is moved away from the stationary mold 15 along with the movable mold 16.

The backward movement of the movable mold 16 towards the opened position and the lowering operation of the arm 31 are carried out in accordance with a certain time relation as will be described with reference to Fig. 7, such that the arm 31 enters into the space S without interfering with the mold 16 and the product 35. In the illustrated embodiment, the arm 31 is designed to begin entering into the space S after the movable mold 16 is retracted

to thereby provide the space S.

As shown in Fig. 3, while the arm 31 moves downwardly, the molded product 35 starts to be ejected. At this time, the movable mold 16 is in the retracted or opened position. More specifically, while the arm 31 is lowered, the chuck 32 commences and completes its opening operation as shown by an arrow a4 and the cylinder 18 operates such that the ejector pin 19 starts to advance as shown by an arrow a5. This causes the molded product 35 to move away from the surface 21 of the movable mold 16. In the illustrated embodiment, the opening operation of the chuck 32 is terminated, after which the pin 19 starts to advance.

As shown in Fig. 4, the arm 31 moves further downwardly and reaches a lowermost position located within the space S. Thereafter, the ejector pin 19 finishes advancing or protruding in a direction of arrow a6 to thereby eject the product 35 away from the movable mold 16.

As shown in Fig. 5, the arm 31 grasps the product 35 within the space S. More specifically, the chuck 32 is closed to hold the product 35 within the space S. Thereafter, the cylinder 18 operates in such a manner that the pin 19 starts to be retracted as shown by an arrow a7.

As shown in Fig. 6, while the pin 19 is retracted as shown by the arrow a7, the arm 31 starts to be raised as shown by an arrow a8. More specifically, the arm 31 moves vertically and upwardly from within the space S or from the lowermost position where the arm 31 has grasped the product 35. The arm 31 goes up to the original ready or uppermost position (see Fig. 1) located

directly above the lowermost position. Arrival of the arm 31 at the ready position completes one removal of the product 35 from the mold assembly 13. It is meant that the removal of the product 25 is carried out once. For further removal of another molded product, the movable mold 16 starts to move to the closed position and then to the opened position in the aforementioned manner, after which the respective operations of the arm 31, the chuck 32, and the pin 19 are performed again in sequence as described hereinbefore. It is noted that the arm 31 which has moved back to the ready position is brought to a given position where the product 35 is released from the arm 31 for the purpose of subsequent process.

Description will be made with reference to a time chart of Fig. 7 as to the foregoing operation of the injection molding apparatus 10.

The mold assembly 13 starts to open at a time K1. That is, at the time K1, the movable mold 16 starts to move back towards the opened position. The opening operation of the mold assembly 13 is placed in ON state at the time K1. For a period of time from the time K1 to a time K2, the mold assembly 13 keeps performing the opening operation. The opening operation of the mold assembly 13 is thus brought to OFF state or completed at the time K2. It will be appreciated that the movable mold 16 is in the opened position at the time K2.

During the opening operation of the mold assembly 13, that is, at a time H1 between the time K1 and the time K2, the arm 31 starts to be lowered from the uppermost position towards the lowermost position within the space S formed between the stationary

mold 15 and the movable mold 16. This means that the lowering operation of the arm 31 is brought to ON state at the time H1. As will be discussed later in detail, the lowering operation of the arm 31 is brought to OFF state at a time H2.

During the lowering operation of the arm 31, that is, at a time C1, the opening operation of the chuck 32 is brought to ON state. In other words, the opening operation of the mold assembly 13 is terminated, after which the chuck 32 starts to open at the time C1. At a time C2, the opening operation of the chuck 32 is placed in OFF state or completed. Namely, the chuck 32 is in an opened position at the time C2.

During the lowering operation of the arm 31, therefore, the chuck 32 is brought from a closed position to the opened position. With the chuck 32 in the opened position, the advancing operation of the pin 19 is brought to ON state at a time P1. In other words, after the chuck 32 is opened, the ejector pin 19 starts to advance or protrude at the time P1. As can be seen from the time chart of Fig. 7, the pin 19 begins advancing before the time H2 at which the arm 31 reaches the lowermost position within the space S. The advancing operation of the pin 19 is brought to OFF state at a time P2. This means that the pin 19 finishes the advancing operation after the arm 31 reaches the lowermost position. At the time P2, the pin 19 is in the advanced position to eject the product 35 into the opened chuck 32.

The chuck 32 starts to close at a time C3 substantially concurrently with the completion of the advancing operation of the pin 19. That is, the closing operation of the chuck 32 is

brought to ON state at the time C3. The closing operation of the chuck 32 is completed or placed in OFF state at a time C4 to thereby grasp the molded product 35 within the space S.

The ejector pin 19 starts to be retracted at a time P3 substantially concurrently with the completion of the closing operation of the chuck 32. In other words, the retracting operation of the pin 19 is brought to ON state at the time P3. Over a period of time from the time P3 to a time P4, the pin 19 is moved from the advanced position to the retracted position. The retracting operation of the pin 19 is brought to OFF state at the time P4.

During the retracting operation of the pin 19, the raising operation of the arm 31 is commenced or placed in ON state. More specifically, the arm 31 starts to be raised at a time H3 between the time P3 and the time P4. The raising operation of the arm 31 is brought to OFF state or completed at a time H4. In other words, the arm 31 reaches the uppermost position at the time H4. It is to be noted that the arm 31 starts to be raised from the lowermost position within the space S before the pin 19 reaches the retracted position.

Taking the product 35 out of the mold assembly 13 requires a period of time from the time K1 to the time H4. Namely, such a period of time is "removal cycle" Sn similarly to the removal cycle S0 as explained hereinbefore. The removal cycle Sn is shorter than the removal cycle S0 as described in relation to Fig. 10.

The product removing arm 31 of the machine 14 used in a method for operating the injection molding apparatus 10 starts to be lowered earlier than a product removing arm of the machine 105

used in the conventional method as previously described in relation to Fig. 8 through Fig. 10. The chuck 32 starts and finishes the opening operation within the period of time during which the arm 31 is lowered. Within the same period of time, the ejector pin 19 starts to advance or protrude. This means that the pin 19 starts to advance earlier than the pin 108 as shown in Fig. 8 and Fig. 9. Moreover, the arm 31 of the machine 14 starts to be raised earlier than the arm of the machine 105. This makes it possible to shorten a period of time necessary to take the product out of the mold assembly. Namely, the removal cycle is shortened.

The product removing arm 31 moves only vertically and downwardly to grasp the molded product 35. In other words, unlike the injection molding apparatus as found in Fig. 8 and Fig. 9, the arm 31 need not advance towards or retreat from the product 35. Thus, the removal cycle Sn is shortened by a period of time which would be otherwise required to move towards or away from the molded product.

Depending upon the size of the product 35, the opening amount Sm can be set to be small. This leads to a shortened period of time between the time K1 and the K2 during which the mold assembly 13 is being opened. Provision of the shortened period of time allows the arm 31 to start to be lowered before the time H1. This results in further shortened removal cycle Sn.

The injection molding apparatus 10 including the product removing machine 14 and the mold assembly 13 is only exemplary one and may be arranged in a variety of other ways to serve the aforementioned functions.

The respective operations of the apparatus 10 may be controlled in various ways. For example, the apparatus 10 may include sensors, timers, or the combination thereof for providing information necessary to perform, or commence and complete the individual operations as described above.

Industrial Applicability

The inventive method for operating the injection molding apparatus involves the following three main steps of: (1) moving the product removing arm towards the space defined between the stationary mold and the movable mold during the movement of the movable mold to the opened position; (2) advancing the ejector pin to eject the product during the movement of the arm towards the space; and (3) moving the arm out of the space during the retraction of the ejector pin. Providing these three steps makes it possible to shorten a period of time required to remove the molded product out. Moreover, the amount by which the movable arm is opened can be made small where the product is small in size. Thus, the movement of the movable mold to the opened position requires a shortened time. Accordingly, the arm can start to move earlier. This leads to further shortened period of time required to remove the molded product. The inventive method is thus useful particularly in the field of injection molding.

CLAIMS

1. A method for operating an injection molding apparatus including a stationary mold, a movable mold for producing a molded product in cooperation with said stationary mold, an ejector pin mounted within said movable mold, and a product removing arm for taking the product out, the method comprising the steps of:

moving said movable mold towards an opened position with the product held in intimate contact with said ejector pin;

moving said product removing arm towards a space defined between said stationary mold and said movable mold before said movable mold reaches the opened position;

advancing said ejector pin to eject the product before said product removing arm arrives in the space;

grasping with said product removing arm the product within the space;

moving said ejector pin towards a retracted position; and

moving said product removing arm out of the space before said ejector pin reaches the retracted position.

2. A method for operating the injection molding apparatus according to claim 1, wherein said movable mold is moved to the opened position by a distance set depending upon a size of the product.

FIG.1

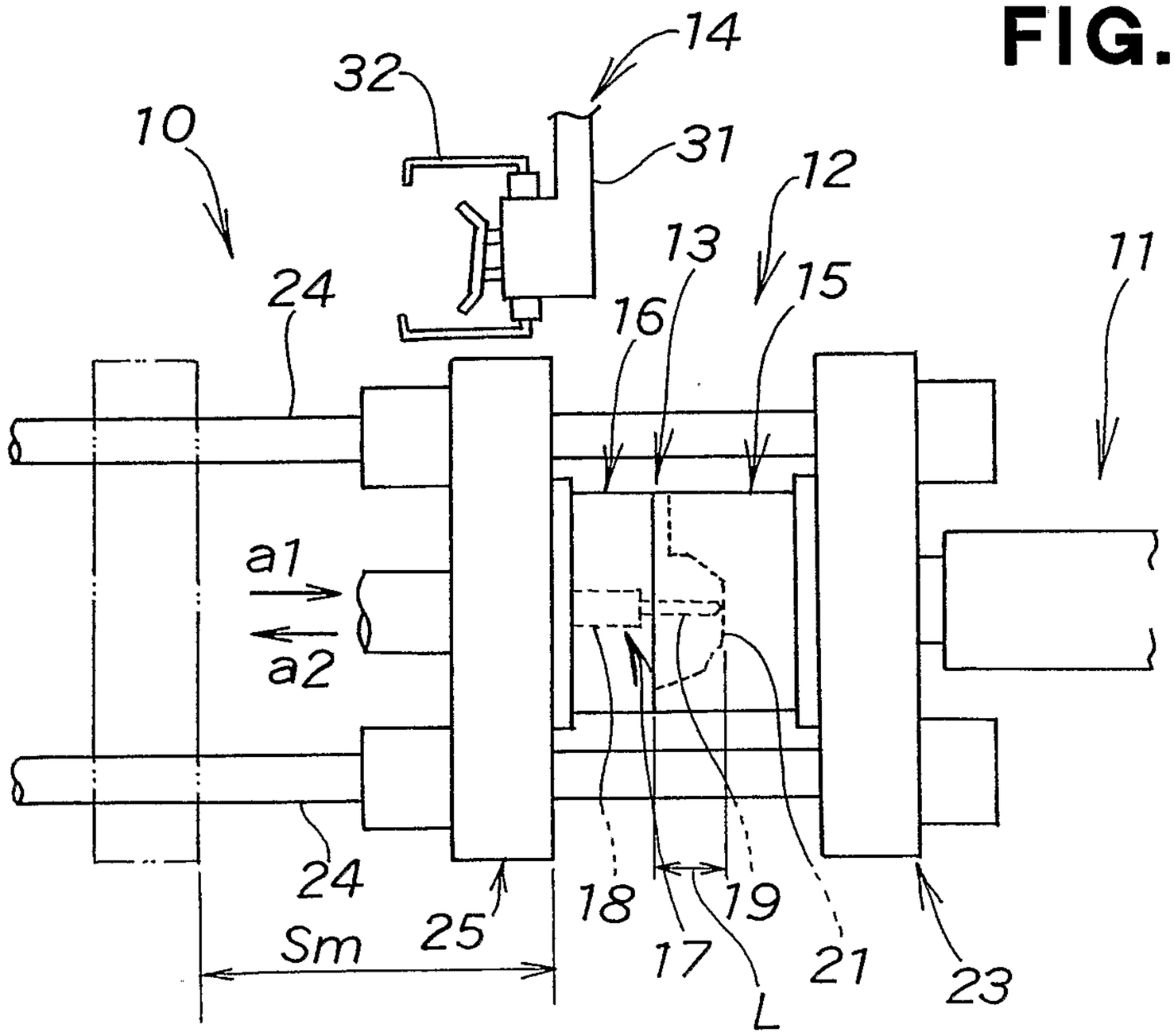

14
32
31
10
12
13
11
24
15
16
a1
a2
24
25
18
19
Sm
17
21
23
L

FIG.2

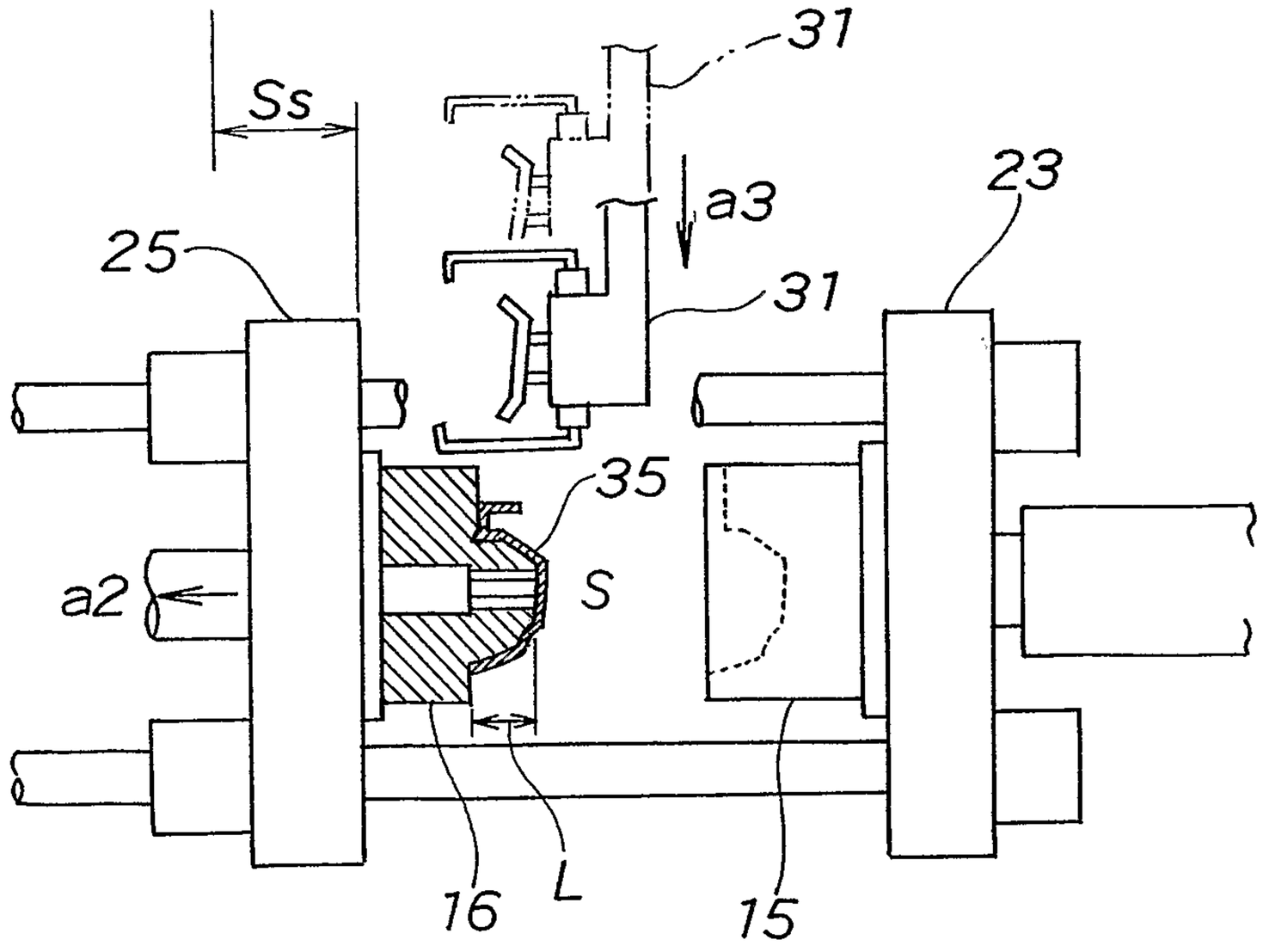

31
Ss
a3
23
25
31
35
a2
S
16
L
15

FIG.3

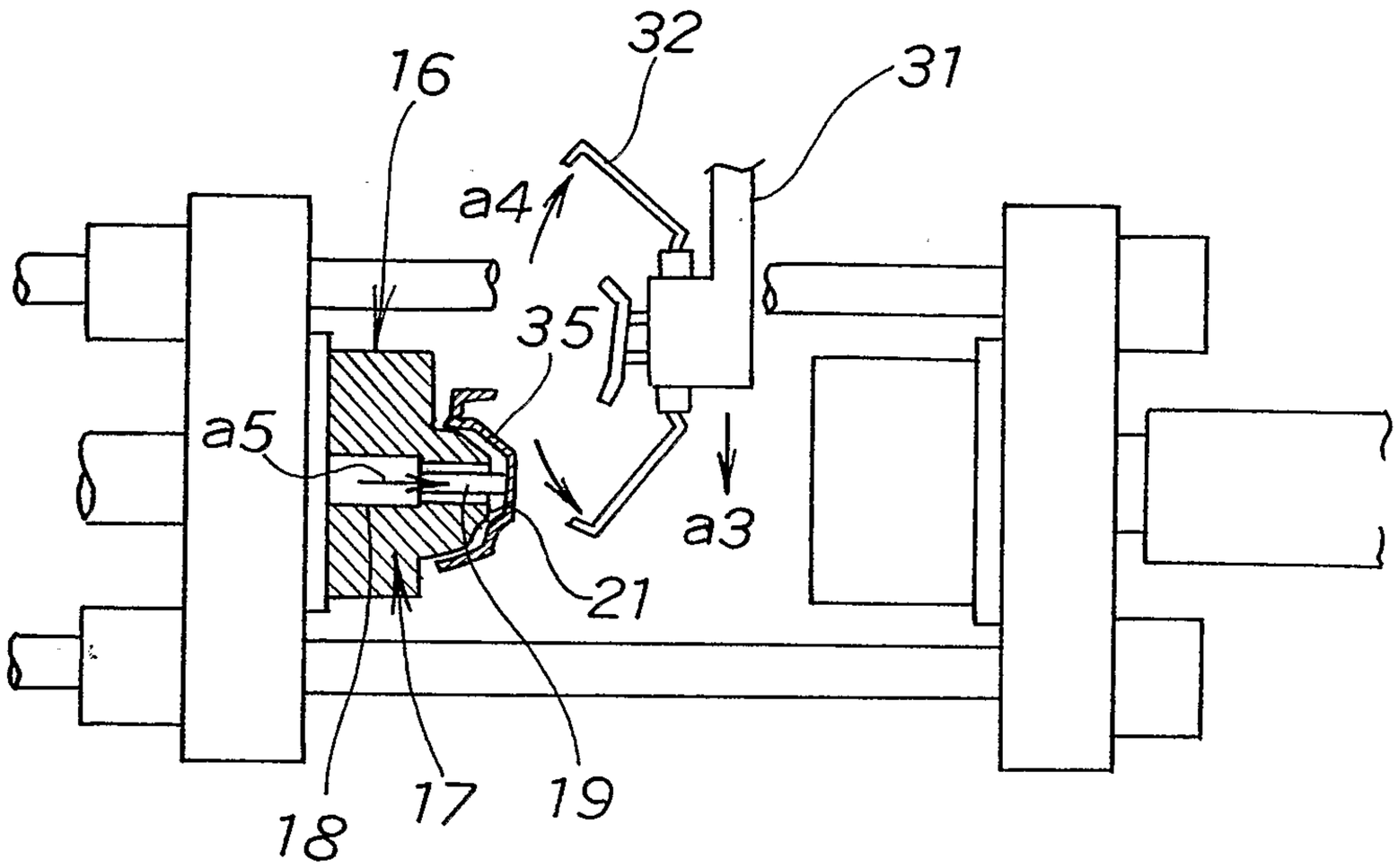


FIG.4

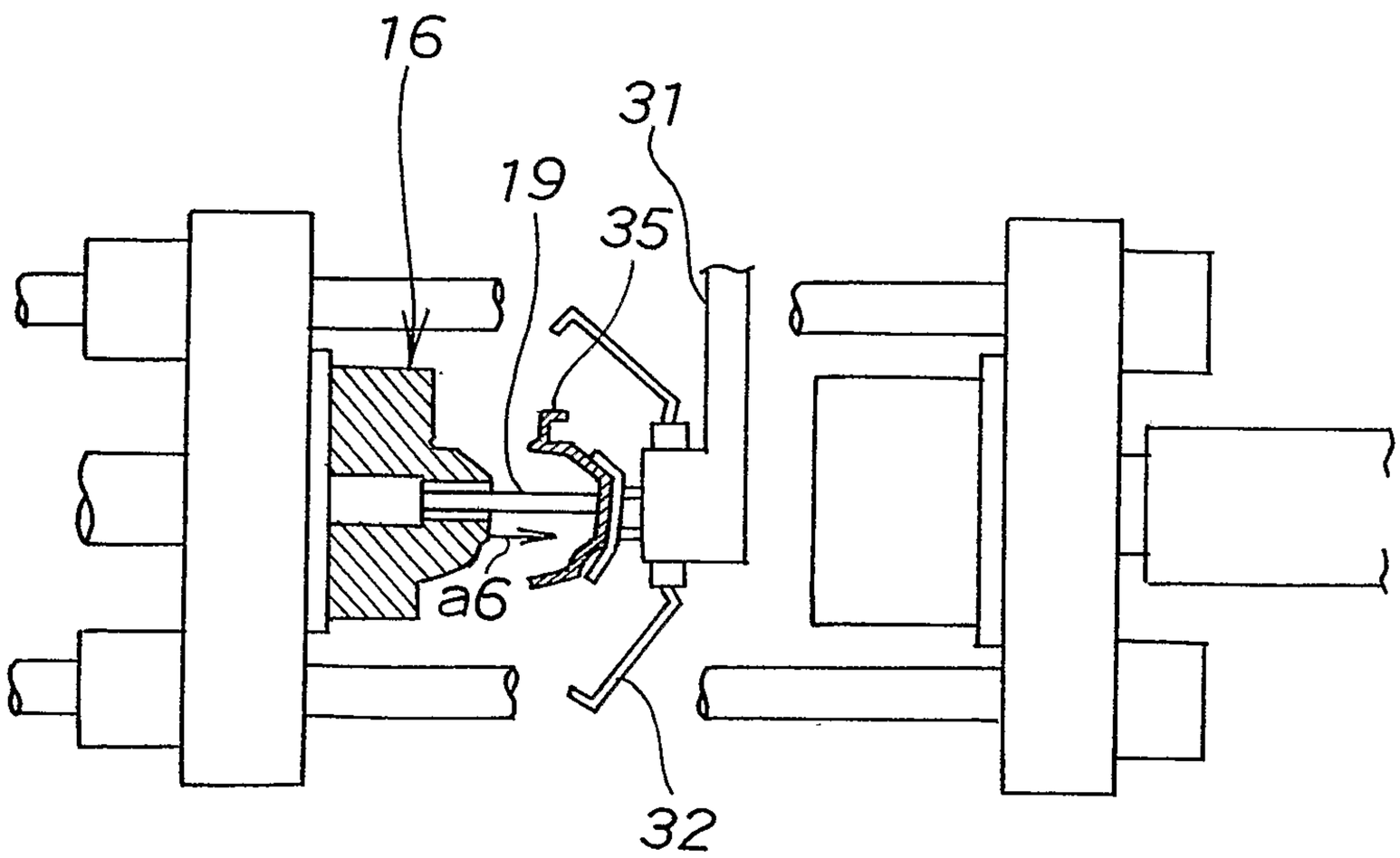


FIG.5

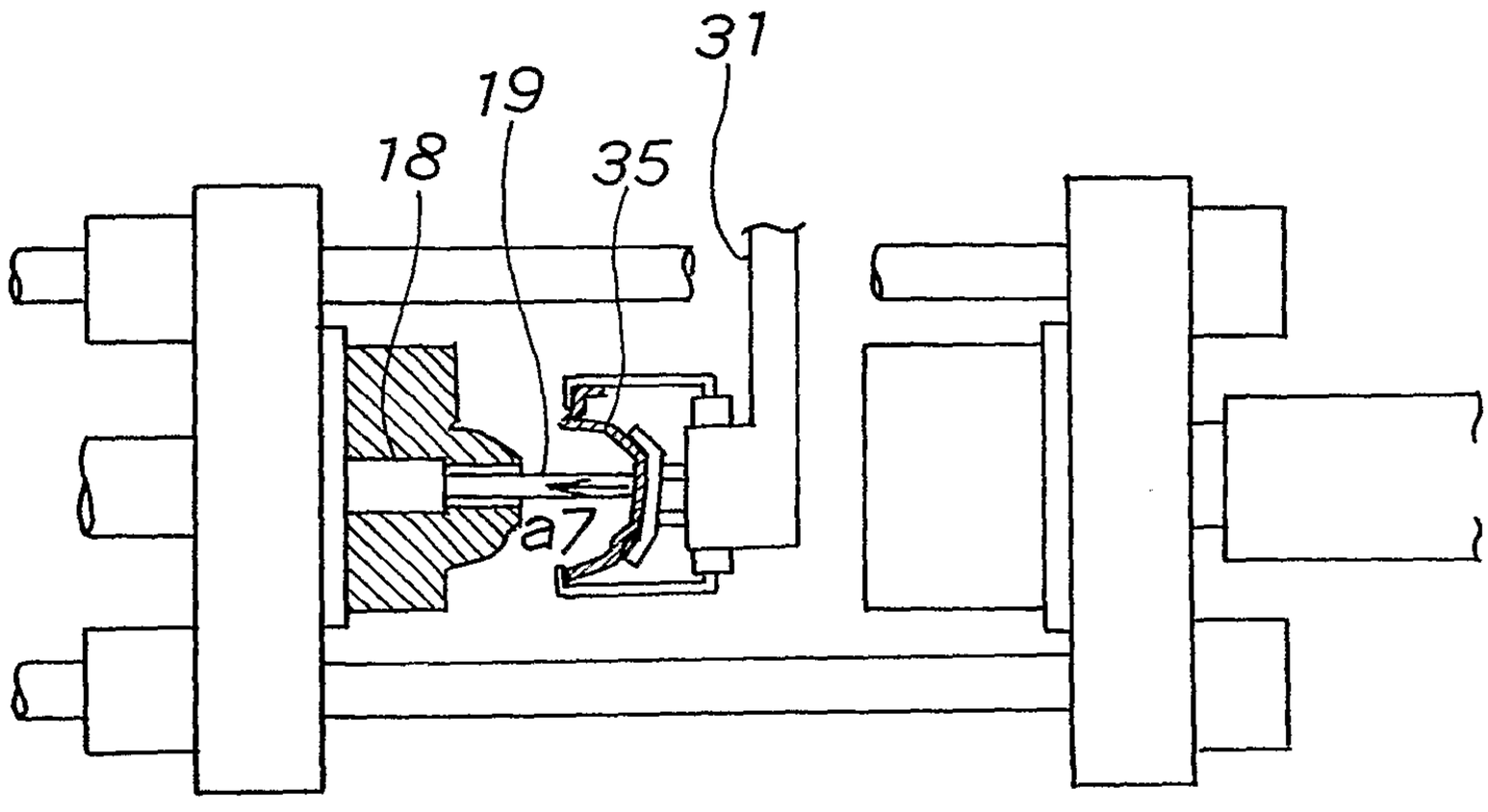
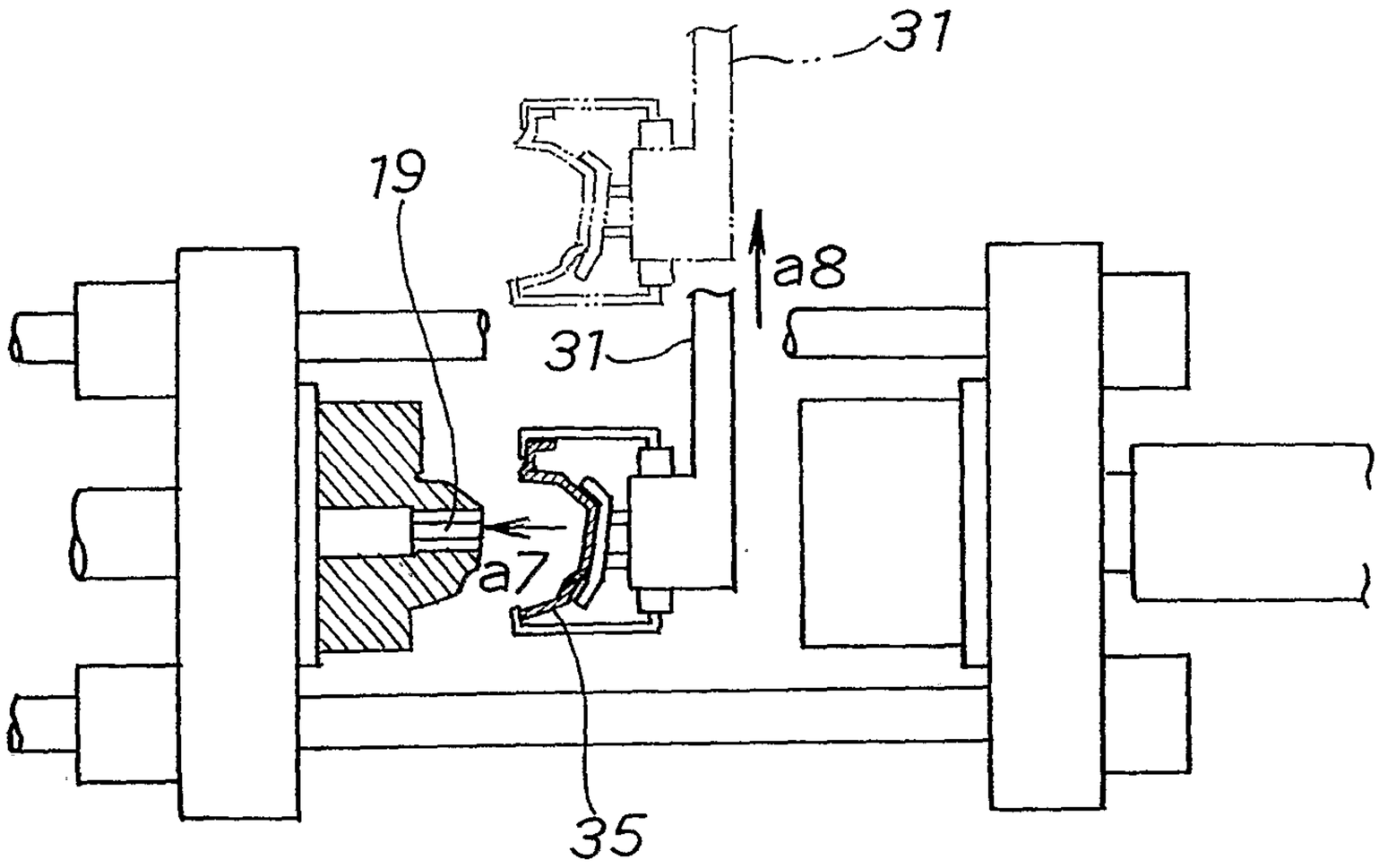


FIG.6



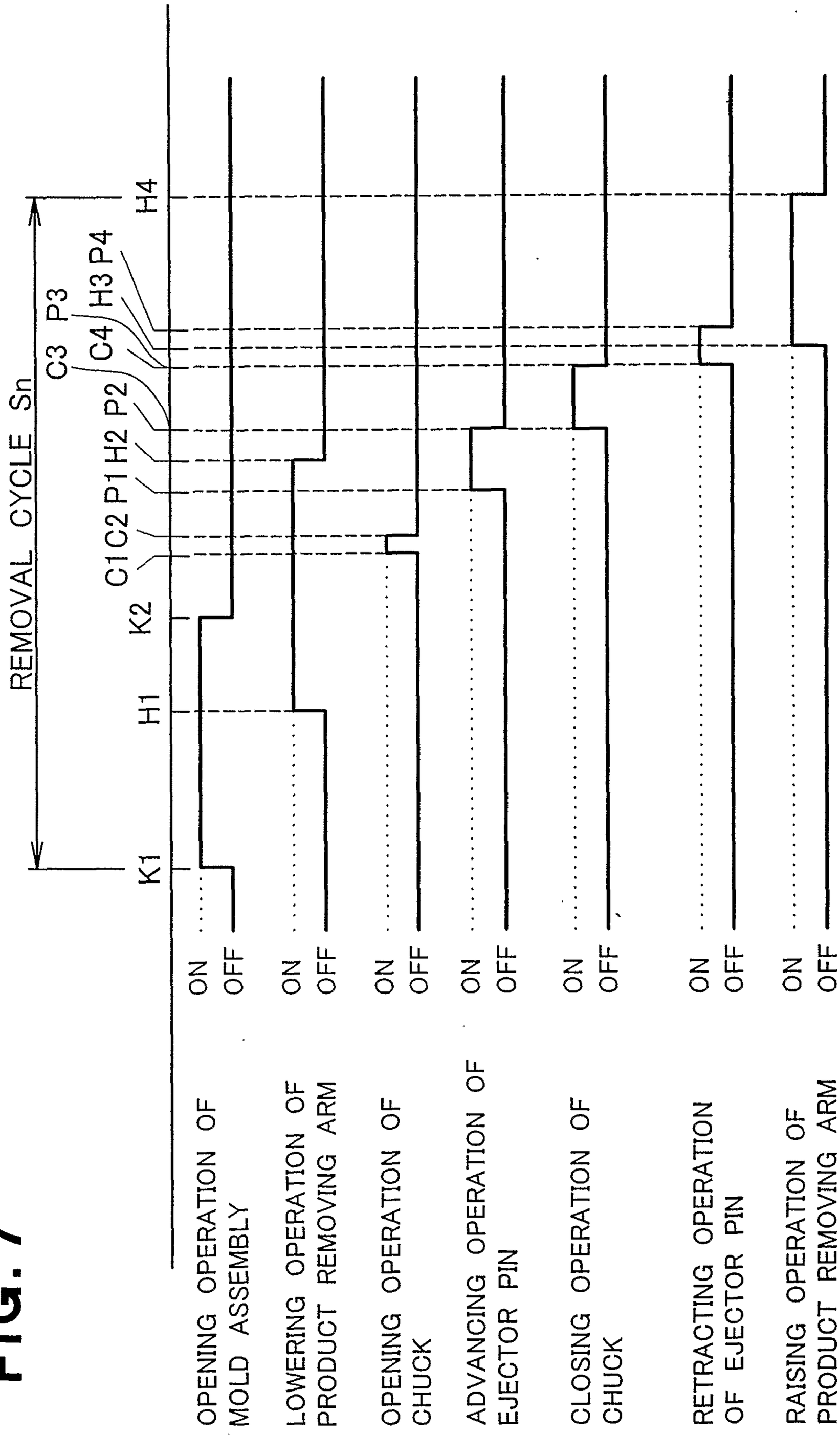

H4
P4
H3
C4
P3
C3
P2
H2
C2
P1
C1
K2
H1
K1
REMOVAL CYCLE Sn
ON
OFF
ON
OFF
ON
OFF
ON
OFF
ON
OFF
ON
OFF
ON
OFF
OPENING OPERATION OF MOLD ASSEMBLY
LOWERING OPERATION OF PRODUCT REMOVING ARM
OPENING OPERATION OF CHUCK
ADVANCING OPERATION OF EJECTOR PIN
CLOSING OPERATION OF CHUCK
RETRACTING OPERATION OF EJECTOR PIN
RAISING OPERATION OF PRODUCT REMOVING ARM

FIG. 7

FIG.8
(PRIOR ART)

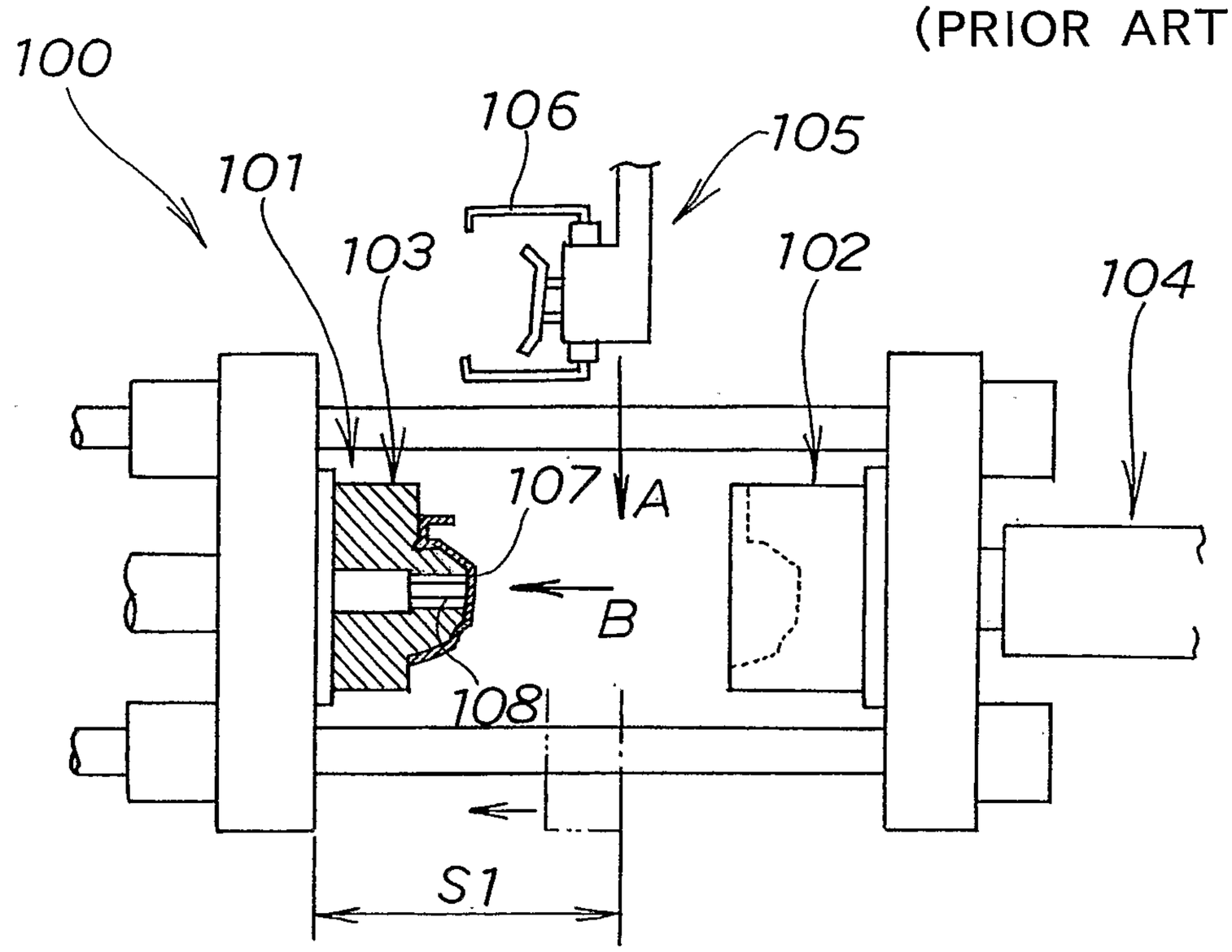
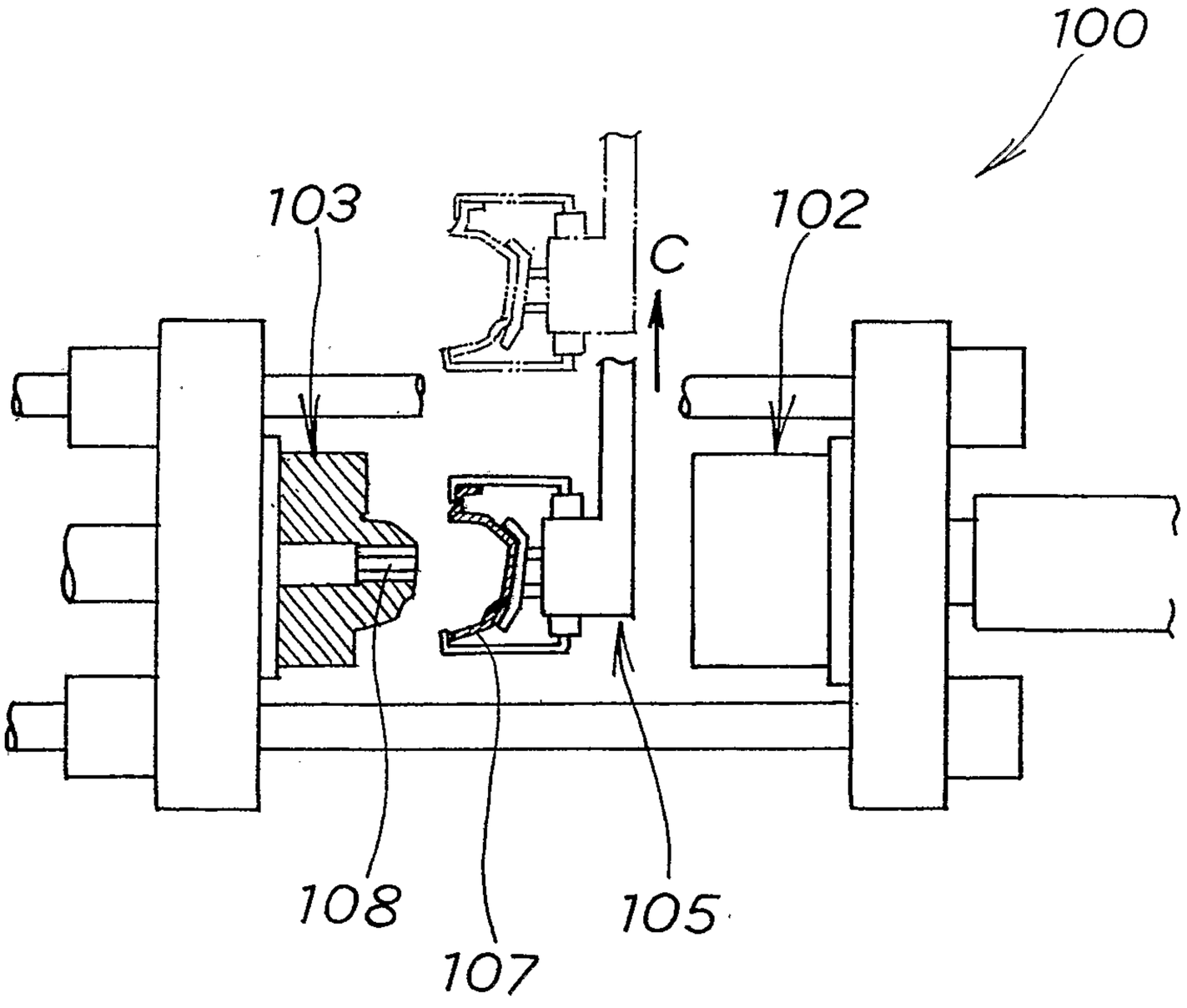


FIG.9
(PRIOR ART)



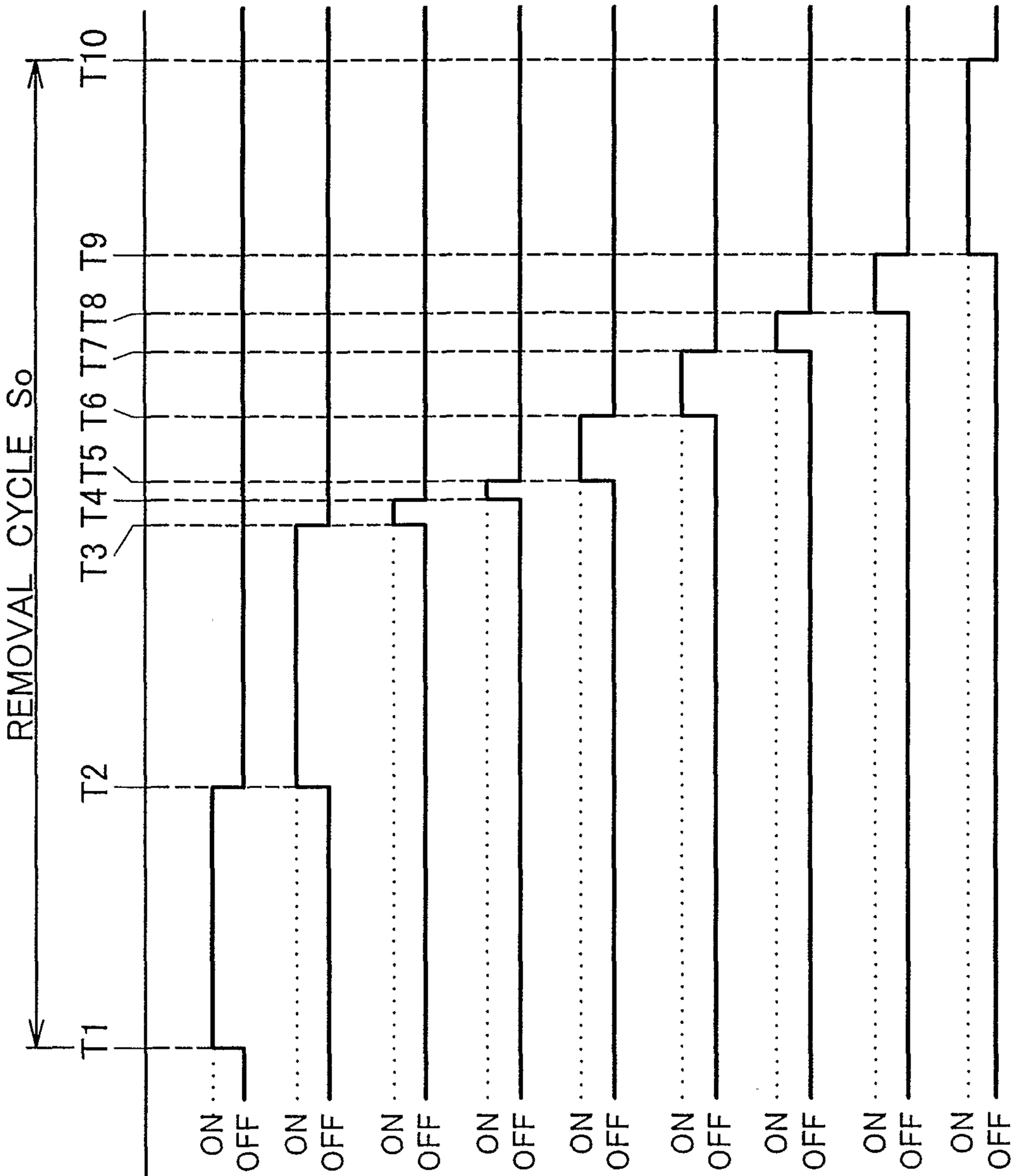
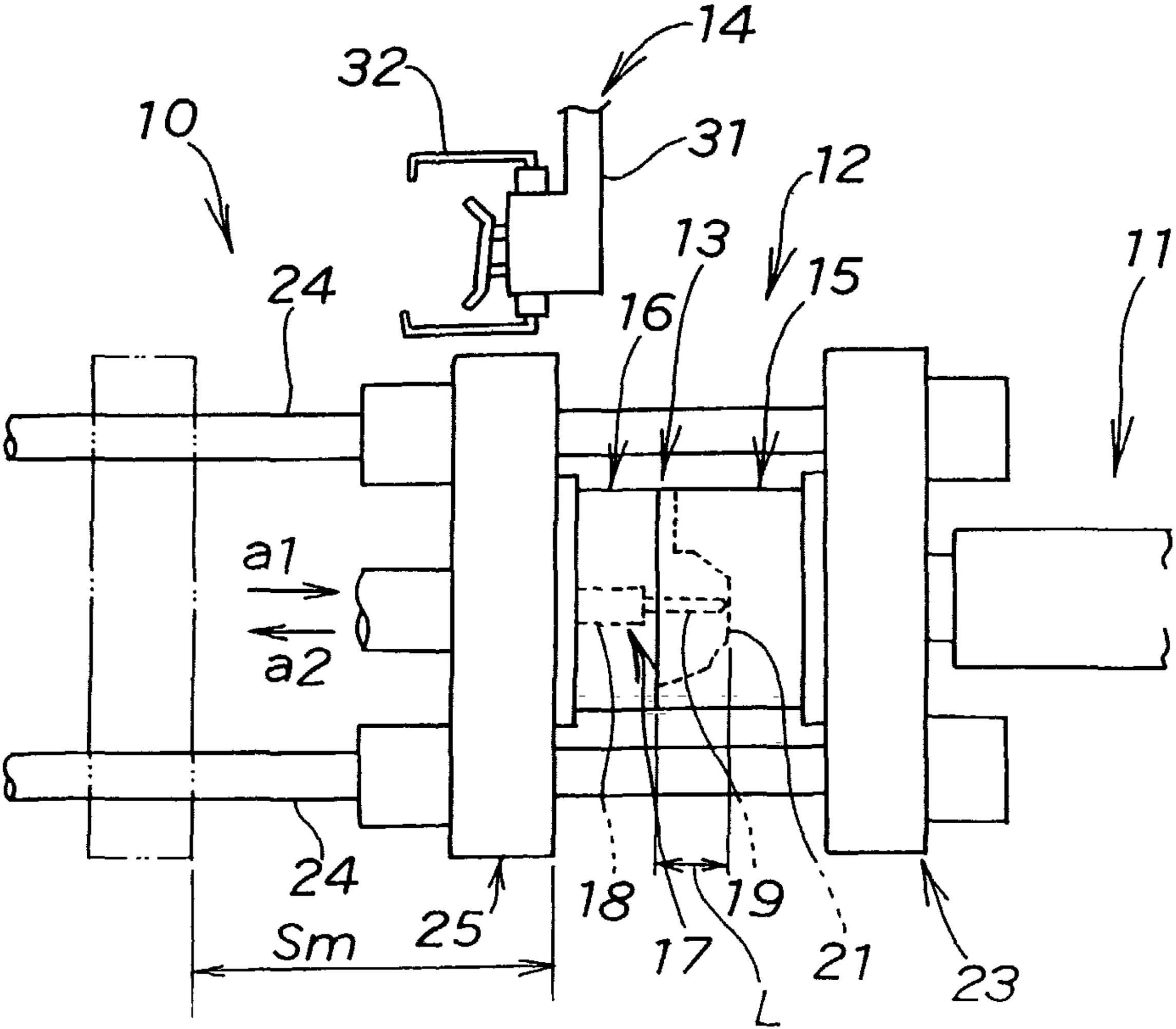


FIG.10
(PRIOR ART)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