12187/88

FORM 1

596277

SPRUSON & FERGUSON

COMMONWEALTH OF AUSTRALIA

PATENTS ACT 1952

APPLICATION FOR A STANDARD PATENT

LODGED AT SUB-OFFICE
25 FEB 1988
Sydney

Nissei Jushi Kogyo Kabushiki Kaisha, of 2110, Ooaza Minamijo, Sakaki-machi, Hanishina-gun, Nagano-ken, JAPAN, hereby apply for the grant of a standard patent for an invention entitled:

A Mold Clamping Device

which is described in the accompanying complete specification.

APPLICATION ACCEPTED AND AMENDMENTS ALLOWED 15-2-90

Details of basic application(s):-

Basic Applic. No:	Country:	Application Date:
62-045983	JAPAN	28 February 1987

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DATED this TWENTY FOURTH day of FEBRUARY 1988

Nissei Jushi Kogyo Kabushiki Kaisha

By: M.J. Anderson

Registered Patent Attorney

TO: THE COMMISSIONER OF PATENTS
OUR REF: 51261
S&F CODE: 63662

5845/2

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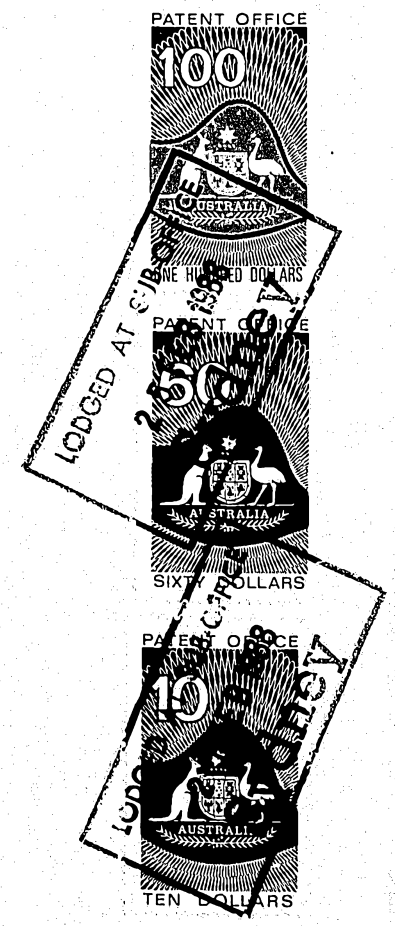

Spruson & Ferguson

AUSTRALIA
CONVENTION
STANDARD
& PETTY PATENT
DECLARATION
SFP4

COMMONWEALTH OF AUSTRALIA

THE PATENTS ACT 1952

DECLARATION IN SUPPORT OF A CONVENTION APPLICATION FOR A PATENT

In support of the Convention Application made for a patent for an invention entitled:

Title of Invention: A Mold Clamping Device

Full name(s) and address(es) of Declarant(s):

I/~~We~~ Yoshiharu SHIMA

~~of~~ c/o, Nissei Jushi Kogyo Kabushiki Kaisha
2110, Ooaza Minamijo, Sakaki-machi, Hanishina-gun, Nagano-ken, Japan

do solemnly and sincerely declare as follows:—

Full name(s) of Applicant(s):

1. ~~I am/We are the applicant(s) for the patent~~

(or, in the case of an application by a body corporate)

1. I am/~~We are~~ authorised by
Nissei Jushi Kogyo Kabushiki Kaisha

the applicant~~(s)~~ for the patent to make this declaration on its/~~their~~ behalf.

2. The basic application~~(s)~~ as defined by Section 141 of the Act was/~~were~~ made

Basic Country(ies): in Japan

Priority Date(s): on February 28, 1987

Basic Applicant(s): by Nissei Jushi Kogyo Kabushiki Kaisha

3. ~~I am/We are the actual inventor(s) of the invention referred to in the basic application(s)~~

(or where a person other than the inventor is the applicant)

Full name(s) and address(es) of inventor(s):

3. Minoru TAKADA

~~of~~ c/o, Nissei Jushi Kogyo Kabushiki Kaisha
2110, Ooaza Minamijo, Sakaki-machi, Hanishina-gun, Nagano-ken, Japan

~~(respectively)~~

is/~~are~~ the actual inventor~~(s)~~ of the invention and the facts upon which the applicant~~(s)~~ is/~~are~~ entitled to make the application are as follows:

Set out how Applicant(s) derive title from actual inventor(s) e.g. The Applicant(s) is/are the assignee(s) of the invention from the inventor(s):

The said applicant is the assignee of the actual inventor.

4. The basic application~~(s)~~ referred to in paragraph 2 of this Declaration was/~~were~~ the first application~~(s)~~ made in a Convention country in respect of the invention~~(s)~~ the subject of the application.

Declared at Sakaki this 1st day of February 19 88

Yoshiharu Shima
Signature of Declarant(s)
Yoshiharu SHIMA

SFP4 To: The Commissioner of Patents 11/81

(12) PATENT ABRIDGMENT (11) Document No. AU-B-12187/88
(19) AUSTRALIAN PATENT OFFICE (10) Acceptance No. 596277

(54) Title
MOLD CLAMPING DEVICE

International Patent Classification(s)
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(56) Prior Art Documents
AU 12188/88
AU 22125/88

(57) Claim

1. A mold clamping device comprising,

a clamping cylinder slidably fitted with a clamping ram whose front end is fixed to a movable board, a mold opening piston being slidably fitted in a cylindrical chamber of clamping ram wherein,

the clamping cylinder is divided into a rear chamber and a front chamber by a large-diameter piston on section of the clamping ram;

the mold opening piston includes one end fixed on an inner rear wall of the clamping cylinder and the other end slidably positioned in the cylindrical chamber of the clamping ram;

the cylindrical chamber of the clamping ram is divided by the large-diameter piston section provided at the front end of the mold opening piston into a first chamber and a second chamber which vents to the atmosphere;

the rear, front and first chambers are connected to a hydraulic controlling device which connects the rear, front and first chambers to an oil pressure source and connects the front and first chambers to the rear chamber for high-speed mold closure, the hydraulic controlling device

further connecting the rear chamber to the oil pressure source and relieving pressure in the front and first chambers for tight clamping, and connecting the first chamber to the oil pressure source, and connecting said rear chamber to both the front chamber and an oil tank.

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FORM 10

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COMPLETE SPECIFICATION

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FOR OFFICE USE:

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Complete Specification Lodged:
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Related Art:

This document contains the amendments made under Section 49 and is correct for printing.

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Complete Specification for the invention entitled:

A Mold Clamping Device

The following statement is a full description of this invention, including the best method of performing it known to me/us

5845/3

TITLE OF THE INVENTION

A MOLD CLAMPING DEVICE

FIELD OF THE INVENTION

This invention relates to a mold clamping device preferred for injection molding machines and die casting machines.

BACKGROUND OF THE INVENTION

In the direct pressure type mold clamping devices for injection molding machines and die casting machines, it is necessary to open or close molds at a high speed for reducing the time of the molding cycle. In addition, it is also necessary to clamp molds with a large force to oppose the molding pressure.

To satisfy these antipodal operations, this particular type of mold clamping device generally has a complex structure. Further, many kinds of mold clamping devices are available.

For example, a booster-ram type mold clamping device is shown in Fig. 5. In this device, a smaller-diameter booster ram 11 is slidably fit into a larger-diameter clamping ram 10. Oil is introduced into the smaller-diameter cylinder chamber 13 of the clamping ram 10 via an oil path 12 provided in the booster ram 11 for the high-speed mold closure. Then oil is also introduced into a rear chamber 14 of the clamping ram at a negative pressure from an oil tank 16 via a prefill valve 15. After closure of the mold, a high-pressure mold clamping is conducted by closing the prefill valve 15 and introducing oil into the rear chamber 14 of the clamping ram.

However, in the above stated booster ram type mold clamping device, the rear chamber 14 of the clamping ram is at a negative

pressure with respect to the high-speed advancing of the clamping ram. Therefore, attracting force introduces oil to the rear chamber 14 from the oil tank 16 so that this requires a following problems result:

(1) The oil tank 16 requires a larger capacity than a mold clamping cylinder which is needed to prevent sucking air into the system so that the mold clamping device should be larger than necessary.

(2) A high-speed advancing movement will be unstable due to introducing oil into the rear chamber 14 of the clamping cylinder from the oil tank 16 by sucking. The oil path provided between the oil tank 16 and the rear chamber 14 of the clamping cylinder and the prefill valve 15 should be of a large-diameter to reduce fluid resistance.

(3) On switching to a tight clamping, a shock often occurs because the oil pressure in the rear chamber 14 is changed from a negative pressure to a high pressure very quickly. Thus, the time of the molding cycle is longer because rising pressure requires much time.

There is a mold clamping device disclosed in the Japanese Provisional Publication 53-42248 which comprises, a clamping piston which is slidably fit in a clamping cylinder, a clamping ram of the same diameter and high-speed advancing cylinder are provided on the front and rear faces of the clamping piston, an oil path is provided which can be opened or closed and connects the front and rear chambers of the clamping cylinder, and a small-diameter booster ram is slidably fit into the high-speed advancing cylinder.

In this clamping device, moving the clamping ram at a high

speed by introducing oil into the high-speed advancing cylinder from the booster ram, does not create the problems stated above because the oil travels from the front chamber to the rear chamber without negative pressure in the rear chamber by connection chambers provided on the front and rear sides of the clamping piston. However, with the structure of this device, the total length of the device should be more than twice as long as the clamping stroke so that the device should be large, heavy and expensive.

OBJECTS OF THE PRESENT INVENTION

It is the object of the present invention to overcome or substantially ameliorate the above disadvantages.

There is disclosed herein a mold clamping device comprising,

a clamping cylinder slidably fitted with a clamping ram whose front end is fixed to a movable board, a mold opening piston being slidably fitted in a cylindrical chamber of clamping ram wherein,

the clamping cylinder is divided into a rear chamber and a front chamber by a large-diameter piston on section of the clamping ram;

the mold opening piston includes one end fixed on an inner rear wall of the clamping cylinder and the other end slidably positioned in the cylindrical chamber of the clamping ram;

the cylindrical chamber of the clamping ram is divided by the large-diameter piston section provided at the front end of the mold opening piston into a first chamber and a second chamber which vents to the atmosphere;

the rear, front and first chambers are connected to a hydraulic controlling device which connects the rear, front and first chambers to an oil pressure source and connects the front and first chambers to the rear chamber for high-speed mold closure, the hydraulic controlling device further connecting the rear chamber to the oil pressure source and relieving pressure in the front and first chambers for tight clamping, and connecting the first chamber to the oil pressure source, and connecting said rear chamber to both the front chamber and an oil tank.

Note that, preferably, the effective pressure receiving area of the first chamber Y is designed to be equal to the cross sectional area of the cylindrical section of the clamping ram.

The high-speed mold closure occurs by pressure working on the cross section of the cylindrical clamping ram when oil is introduced into the rear, front and first chambers W, X and Y. Following the advancing of the clamping ram, the oil in the front and first chambers X and Y is introduced into the rear chamber W so that the high-speed mold closure is available, at that time the rear chamber W is not at negative pressure.

The tight clamping occurs by pressure working to the effective pressure receiving area of the rear chamber W when pressure in the rear chamber W is increased and pressure in the front and first chambers X and Y are reduced. Upon reducing pressure in the front and first chambers X and Y, this tight clamping may be quickly executed.

The mold opening occurs by pressure working to the effective pressure receiving area of the first chamber when the oil is introduced into the first chamber Y. Following the retracting of the clamping ram, the oil in the rear chamber W may be introduced back into the front chamber X and the rest may be discharged to the oil tank.

When the effective pressure receiving area of the first chamber

Y and the cross-sectional area of the cylindrical section of the clamping ram is the same area, the quantity of the oil introduced from an oil pressure source during a high-speed mold closure may be ~~is~~ the same as the quantity of the oil introduced therefrom during a high speed mold opening so that speed of mold opening is approximately equal to the speed of closure dependent on constant oil outflow from the oil pressure source.

Therefore, according to this invention, the quantity of the oil provided from the oil pressure source may be a portion of the capacity of the clamping cylinder in the clamping and opening mold, the high speed operation is available in spite of a small outflow from the oil pressure source.

Especially during a tight clamping, the operation can be quickly changed to tight clamping by only reducing the pressure in the front and first chambers X and Y. Additionally, there is no need to provide a sucking tank or a prefill valve as required in conventional devices. The total length can be reduced to be half of the conventional mold clamping devices which have a clamping ram and a high-speed advancing cylinder with the same diameters provided on the front and rear faces of the clamping piston. The mold clamping device of this invention has a high speed efficiency and a high reliability, and can be a simplified structure, which is compact in size and manufactured at a reduced marketing cost, and so on.

Moreover, if the effective pressure receiving area of the first chamber Y and the cross-sectional area of the cylindrical section of the clamping ram are substantially equal, the quantity of the oil provided at the mold opening is approximately equal to the quantity at mold clamping so that standardization can be

achieved in designing oil circuits and selecting structural parts. Thus design, manufacturing and control can be easily conducted.

BRIEF DESCRIPTION OF DRAWINGS

A preferred form of the present invention will now be described by way of example with reference to the accompanying drawings, wherein:

Fig. 1 shows a cross-sectional view during changing to the high-speed mold closure status from mold opening status;

Fig. 2 shows a cross-sectional view during the tight clamping status;

Fig. 3 shows a cross-sectional view during the status of changing to a mold opening;

Fig. 4 shows a cross-sectional view of taken on line IV - IV of Fig. 1; and

Fig. 5 shows an approximate cross-sectional view of a conventional booster ram type mold clamping device.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Now preferred embodiments of this invention will be described with reference to accompanying drawings.

In Figs. 1 to 3, a movable board 20 is guided to and way from a fixed board 21 by a tie bar, not shown, which is bridged between the fixed board 21 and a clamping cylinder 22.

In the opposite faces of the movable board 20 and the fixed board 21, there are provided a movable mold 23 and a fixed mold 24.

On a base (not shown) located to the rear of the fixed

board 21, a conventional injection machine 25 is provided and is movable to and away from the fixed mold 24.

A clamping ram 26 having a front end connected to the rear face of the movable board 20 is slidably fit into a clamping cylinder 22. The inner space of the clamping cylinder 22 is divided into a rear chamber W and a front chamber X by the large-diameter piston section of the clamping ram 26. The large-diameter piston section is provided at the rear end of the clamping ram 26.

A mold opening piston 27 having a rear end is fixed on the inner rear wall of the clamping cylinder 22 is slidably fit into the clamping ram 26. The inner space of the clamping ram 26 is divided into a chamber Y and a chamber Z by the large-diameter piston section provided at the front end of the mold opening piston 27. The chamber Z is connected to the atmosphere by rear of an air path 28.

Oil is introduced into or discharged from the chambers W and X via a port opened on the wall face of the clamping cylinder 22. The oil is also introduced into or discharged from the chamber Y via an oil path bored on the opening piston 27 whose one end is opened at the rear end of the opening piston and the other end is opened on the outer face of the opening piston in the chamber Y.

Because the large-diameter piston section of the clamping ram 26 is provided at a rear end thereof, and the large-diameter piston section is provided at the opening piston 27, the total length of the device including clamping cylinder is shortened as shown in Fig. 1.

The effective pressure receiving area S1 (the area of the

piston section of the opening piston 27 minus the cross sectional area of the rod section of the opening piston) is designed to be substantially equal to the cross sectional area of the cylindrical section of the clamping ram.

Note that, the effective pressure receiving area of the chamber X (the area of the piston section of the clamping ram 26 minus the cross-sectional area of the clamping ram) is defined as S3.

The chambers W and Y are connected to an oil pump 40 and an oil tank 32 via a three-position switching valve 31 which is bridged between an oil path 30 connected to the chamber W and an oil path 29 connected to the chamber Y.

The three-position switching valve 31 switches the oil paths 29 and 30 to one of the following three positions:

a position for connecting both the chambers W and Y to the oil pump 40 (shown in Fig. 1);

a position for connecting only the chamber W to the oil pump 40, and for connecting the chamber Y to the oil tank 32 (shown in Fig. 2); and

a position for connecting only the chamber Y to the oil pump 40, and for connecting the chamber W to the oil tank 32 (shown in Fig. 3).

The chambers W and X are connected with each other by an oil path 33 branched from the oil path 30 and a switching valve 34 provided in the oil path 33.

The oil paths 29 and 33 are connected by an oil path 36 having a switching valve 35 in substantially the middle thereof.

A switching valve 37 is provided midway of the oil path connecting the oil pump 40 and the three-position switching

valve 31. The switching valve 37 shuts the oil flow to prevent opening or clamping of the mold unnecessarily. Upon receiving a clamping or opening signal, then the switching valve 37 releases the oil flow.

Note that, the above system included a three-position switching valve 31, switching valves 34, 35 and 37 controlled to switch to prescribed positions automatically by a control means (not shown) of the injection molding machine, etc. and storing control programs.

Next, the action of the device will be described.

The high-speed mold closure;

The three-position switching valve 31, and switching valves 34, 35 and 37 are set at the position shown in Fig. 1. The chambers W, X and Y are connected to the oil pump 40 and then the chambers are pressurized. The pressure working in the chamber W is the value of multiply the area S1+S2+S3 shown in Fig. 4 by the oil pressure P (=S1 P+S2 P+S3 P). But the component pressure S1 P is countervailed by the pressure in the chamber Y and the component pressure S3 P is countervailed by the pressure in the chamber X so that the clamping ram 26 is advanced by the component pressure S2 P. Following an advancement of the clamping ram 26, the oil in the chamber X is introduced into the chamber W via the oil path 33, switching valve 34 and the oil path 30, and the oil in the chamber Y is also introduced into the chamber W via the oil path 29, the three-position switching valve 31 and the oil path 30.

Therefore, the oil quantity supplied to the chamber W from the oil pump 40 may be the quantity corresponding to the quantity multiplying the cross-sectional area S2 by the travelling length

of the clamping ram so that the high speed mold closure can be supplied with oil independently of the capacity of the chamber W, and the chamber W will not be at a negative pressure.

The tight clamping;

In the high-speed mold closure, oil outflow from the oil pump 40 is reduced slightly before completing mold closure, then the molds are closed with low speed and low pressure (S2 P). The three-position switching valve 31, switching valves 34 and 35 are changed to the position shown in Fig. 2 by the signal indicating completion of the high-speed mold closure.

The chamber W is connected to the oil pump 40 and is pressurized as described before but the chambers X and Y are connected to the oil tank 32 to relieve pressure so that component pressure S1 P and S3 P forcing against pressure in the chamber W disappears, then the pressure working to the clamping ram 26 is quickly the value of S1 P+S2 P+S3 P. Therefore, the tight clamping can be executed, and the switching valve 37 is switched to the position of oil shut to maintain a tight clamping status.

Mold opening;

In the tight clamping status, the following steps are executed. They are, the injection machine 25 comes into contact with the fixed mold 24, resin melt is injected into the molding mold, and the resin melt is cooled, and solidificated. After the above stated molding steps, a mold opening signal is generated, then thethree-position switching valve 31, the switching valves 34, 35 and 37 are switched to the positions shown in Fig. 3, and the oil outflow from the oil pump 40 is reduced. Therefore, the oil is introduced into the chamber Y via the three-position

switching valve 31 then initial mold opening is executed by the component pressure S1 P. After the molded product is ejected from the molding mold, the oil outflow is increased, and high-speed mold opening is executed. Slightly before the stop mold opening, the oil outflow is reduced again to slow down the speed of mold opening. Upon reaching the prescribed position, the oil outflow reduces to zero and the mold opening stops. After completing the mold opening, the molded product can be taken out.

Discharged oil from the chamber W following retracting the clamping ram 26 is introduced into the chamber X via the oil path 30, the switching valve 34 and the oil path 33, and the rest of the oil is returned to the oil tank 32.

In the above embodiment, we explained a mold clamping device for an injection molding machine, but the mold clamping device, of course, can be used for die casting machines and similar machines.

Additionally, the hydraulic controlling device including the three-position switching valve 31, the switching valves 34, 35, 37, etc. is not restricted by the above embodiment.

Now, we explained the invention in detail, this invention is not restricted by the above stated embodiment. Modifications, of course, can be executed without deviation from the spirit of the invention.

The claims defining the invention are as follows:

1. A mold clamping device comprising,

a clamping cylinder slidably fitted with a clamping ram whose front end is fixed to a movable board, a mold opening piston being slidably fitted in a cylindrical chamber of clamping ram wherein,

the clamping cylinder is divided into a rear chamber and a front chamber by a large-diameter piston on section of the clamping ram;

the mold opening piston includes one end fixed on an inner rear wall of the clamping cylinder and the other end slidably positioned in the cylindrical chamber of the clamping ram;

the cylindrical chamber of the clamping ram is divided by the large-diameter piston section provided at the front end of the mold opening piston into a first chamber and a second chamber which vents to the atmosphere;

the rear, front and first chambers are connected to a hydraulic controlling device which connects the rear, front and first chambers to an oil pressure source and connects the front and first chambers to the rear chamber for high-speed mold closure, the hydraulic controlling device further connecting the rear chamber to the oil pressure source and relieving pressure in the front and first chambers for tight clamping, and connecting the first chamber to the oil pressure source, and connecting said rear chamber to both the front chamber and an oil tank.

2. A mold clamping device according to claim 1 wherein, an effective pressure receiving area of the first chamber is designed to be substantially equal to the cross-sectional area of the cylindrical section of the clamping ram which can slidably fit within the large-diameter piston section provided at the front end of the mold opening piston.

3. A mold clamping device according to claim 1 or 2 wherein, the large-diameter piston section for driving the inner space of the clamping cylinder into the rear and front chambers is provided at the rear end of the clamping ram.

4. A mold clamping device according to claim 1, 2 or 3 wherein, the hydraulic controlling device includes a three-position switching valve for bridging between an oil path connected to the rear chamber and an oil path operatively connected to the first chamber, a switching valve is provided in an oil path which branches from the oil path connected to the rear

chamber to connect the rear chamber to the front chamber, and a switching valve is operatively provided in the oil path for branching the oil path connected to the first chamber, and connects the first chamber to the front chamber; and the three-pistion switching valve switches positions for connecting both the rear and first chambers to an oil pump, for connecting only the rear chamber to the oil pump and connecting the first chamber to the oil tank, and for connecting only the first chamber to the oil pump and connecting the rear chamber to the oil tank.

5. A mold clamping device according to claim 4 wherein, the oil path operatively connected to the first chamber is bored in the mold opening piston and includes one end opened at the rear end of the mold opening piston and the other end opened on the outer face of the mold opening piston located in the first chamber.

6. A mold clamping device substantially as hereinbefore described with reference to Figs. 1 to 4 of the accompanying drawings.

DATED this EIGHTEENTH day of JANUARY 1990
Nessei Jushi Kogyo Kabushiki Kaisha

Patent Attorneys for the Applicant
SPRUSON & FERGUSON

FIG.1

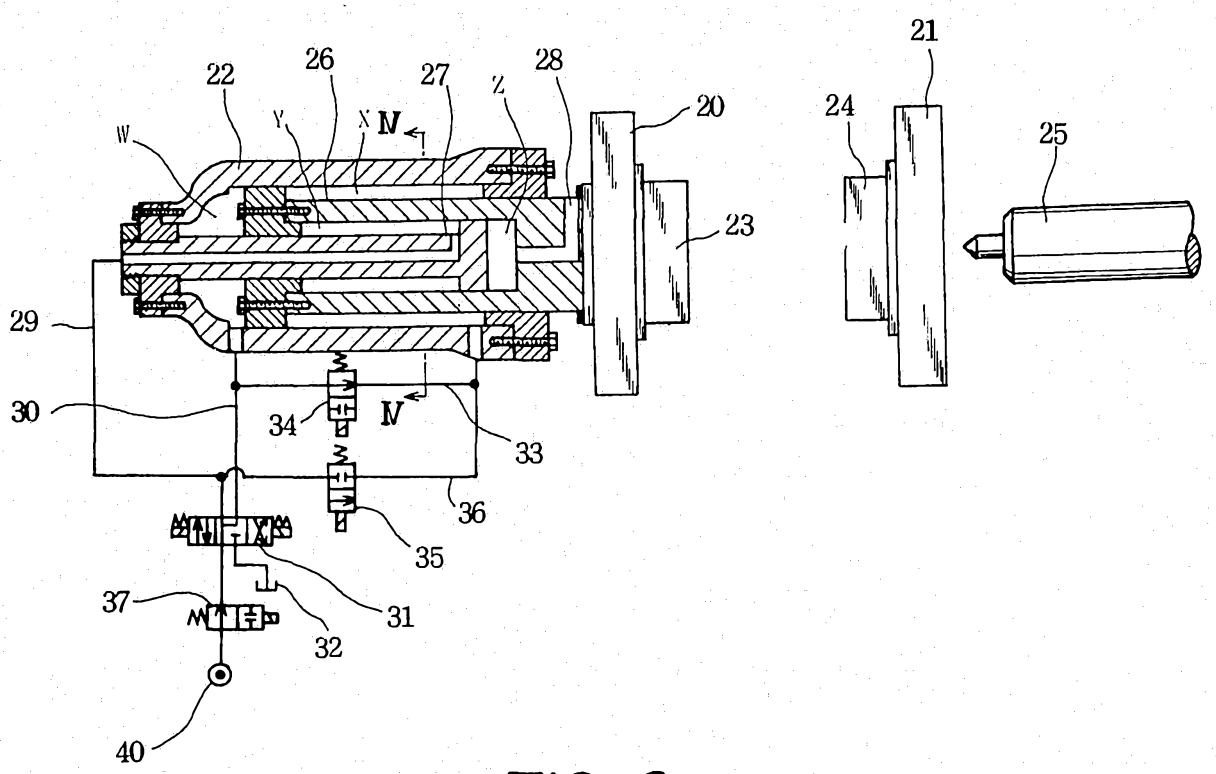
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FIG.2

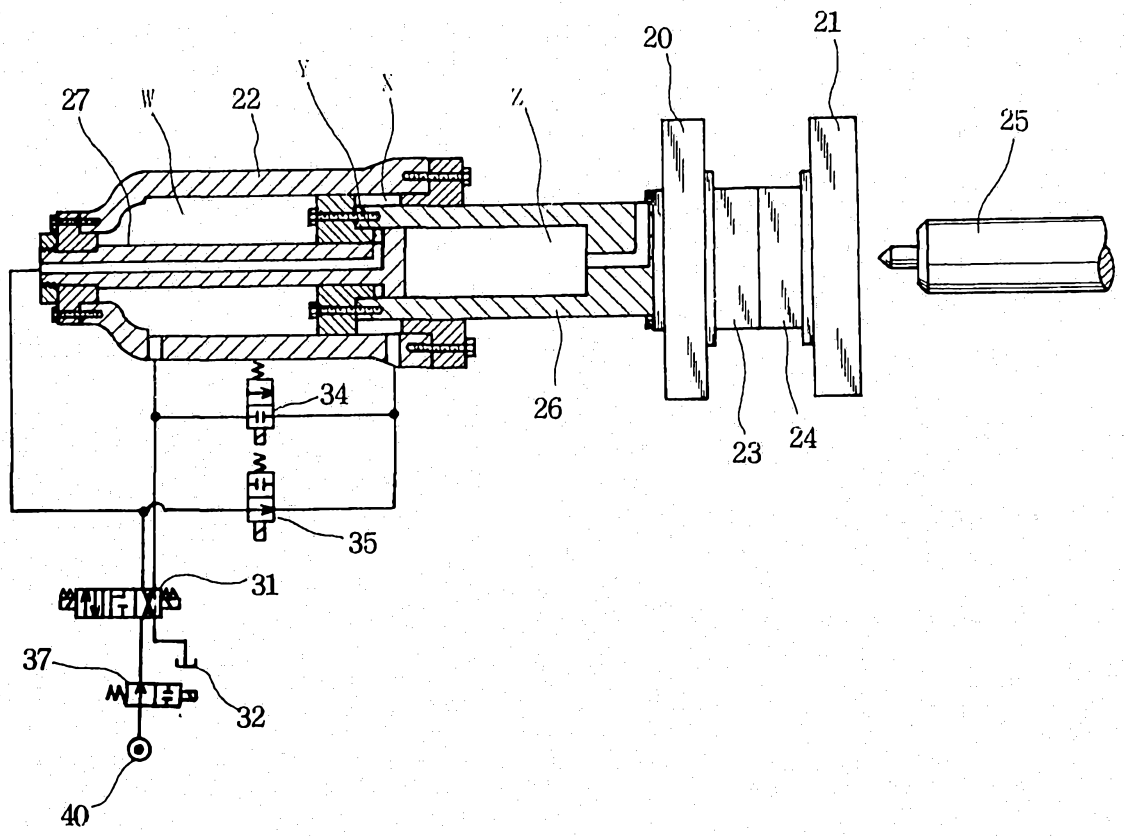
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FIG. 3

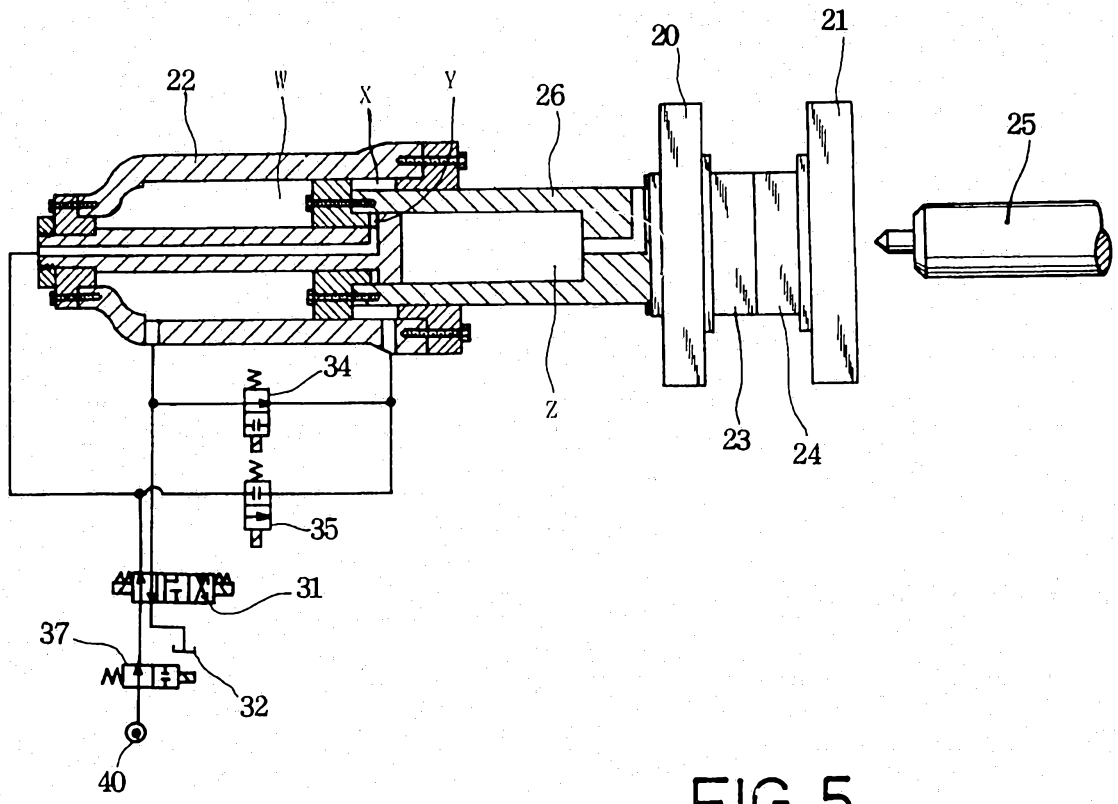

FIG. 4

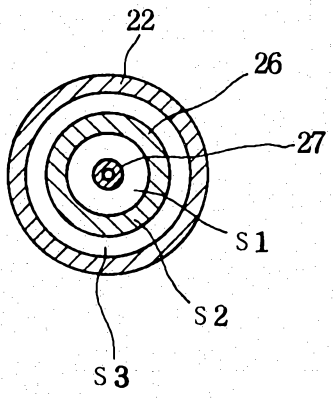

FIG. 5