(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 952 912 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
06.03.2019 Bulletin 2019/10

(21) Application number: **07013122.2**

(22) Date of filing: **04.07.2007**

(51) Int Cl.:
B22C 11/00 *(2006.01)* ***B22C 15/08*** *(2006.01)*

(54) Molding machine and molding method

Formgerät und Formverfahren

Machine de moulage et procédé de moulage

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC MT NL PL PT RO SE SI SK TR

(30) Priority: **15.01.2007 JP 2007005585**

(43) Date of publication of application:
06.08.2008 Bulletin 2008/32

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Description

FIELD OF THE INVENTION

[0001] This invention relates to a molding machine and molding method, and, more particularly, it relates to a match-plate molding machine and a molding method using a match plate.

BACKGROUND OF THE INVENTION

[0002] One example of conventional match plate molding machines for molding upper and lower molds at the same time is disclosed in WO2005/058528 A1. In this molding machine, first, a match plate is sandwiched and held between a cope flask and a drag flask. Upper and lower squeeze members are then inserted into the respective flasks through their openings opposed to the match plate such that upper and lower molding spaces are defined. The defined molding spaces are then filled with molding sand. The upper and lower squeeze members are then moved to the match plate to squeeze the molding sand within the molding spaces to mold upper and lower molds. The cope and drag flasks, which contain the corresponding upper and lower molds, are then removed from the match plate. These removing procedures are achieved with cylinders that reciprocatingly move the cope and drag flasks relative to the match plate.

[0003] The inconvenience of such a conventional molding machine is that the procedures for removing the cope and drag flasks from the match plate start when the match plate adheres to either the upper mold or the lower mold. That is, if the match plate adheres to either mold, first, the other mold (i.e., the mold that doesn't adhere to the match plate) and the corresponding flask that contains the other mold, are removed (i.e., stripped) from the match plate in unison (the first stripping). Then one mold (i.e., the mold that adheres to the match plate), and the corresponding flask that contains that one mold, are then removed from the match plate in unison (the second stripping). The first stripping is to be begun when the other mold is stationary. The second stripping should, however, be done when the moving match plate, which is moved immediately just before this point, is stopped, while the mold (the one mold) that is adhered to the match plate is still moving. Because of this, the one mold may receive a significant impact when it is removed from the match plate. Thus the second stripping may cause a defect.

[0004] Accordingly, one object of the present invention is to provide a molding machine and molding method that prevent any defect in a mold that is adhered to a match plate when it, and the corresponding flask that contains the mold, are removed from the match plate.

SUMMARY OF THE INVENTION

[0005] In one aspect of the present invention, a molding method is provided.

[0006] The method includes the steps as recited in appended independent claim 1. In another aspect of the present invention a match plate molding machine is provided, which includes the features as recited in appended independent claim 3. Preferable embodiments are respectively the subject matter of dependant claims 2 (method) or claims 4-9 (machine).

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] The foregoing and other purposes and advantages of the present invention are further clarified by the following descriptions, which refer to the accompanying drawings, in which:

Fig. 1 is a front view schematically illustrating a molding machine of the present invention;
Fig. 2 is a schematic left view of the molding machine of Fig. 1; and
Fig. 3 schematically illustrates a pressurizing fluidic unit that drives the molding machine of Figs. 1 and 2.
Fig. 4 schematically illustrates an alternative embodiment of the hydraulic power unit.

DESCRIPTION OF THE PREFERED EMBODIMENT OF THE PRESENT INVENTION

[0008] One embodiment of the match-plate molding machine of the present invention will now be explained in detail by reference to Figs. 1, 2, and 3. As shown in Figs. 1 and 2, the molding machine of the present invention includes a rotating frame 2, which is extended substantially vertically. The rotating frame 2 is pivotally mounted on a supporting shaft 1 such that it can be moved up and down in the vertical plane about the supporting shaft 1. A drag flask 4, whose sidewall has sand-filling ports, is mounted on the lower end of the rotating frame 2 via a supporting member 3. On the left side of the rotating frame 2, a pair of guide rods 5 is attached at a predetermined interval therebetween in back and front such that they extend substantially vertically. On the guide rods 5, a match plate 7 is slidably and vertically mounted via guide holders 6. Immediately above the guide holders 6 of the guide rods 5, a cope flask, whose sidewall has sand-filling ports, is slidably and vertically mounted via guide holders 8. Attached to the left side of the rotating frame 2 is the distal end of a piston rod of a downwardly facing, vertical cylinder 10.

[0009] The match plate 7 can be carried in and carried out between the cope flask 9 and the drag flask 4 by any well-known shuttle (not shown). The match plate 7 can be moved to approach and retract from the drag flask 4 by an upwardly-facing cylinder (not shown) that is mounted on the rotating frame 2, as it is extended and contracted.

[0010] The cope flask 9 is mounted on a cylinder 10 such that it is moved upward and downward by extending

and contracting operation of the cylinder 10 to approach and retract from the match plate 7. Mounted near the four corners of the outer periphery of the cope flask 9 are four downwardly facing hydraulic cylinders (upper pushing means) 11 for pushing away the cope flask 9 from the match plate 7. Similarly, mounted near the four corners of the outer periphery of the drag flask 4 are four, upwardly facing, air cylinders (lower pushing means) 12 for pushing away the drag flask 4 from the match plate 7.

[0011] As in Fig. 3, the molding machine is provided with a pressurizing fluidic unit 13 that supplies oil to the four hydraulic cylinders 11 and compressed air to the four air cylinders 12. The pressurizing fluidic unit 13 includes a hydraulic unit 14 having a hydraulic pump for generating the oil and a compressor 15 for generating the compressed air. The hydraulic pump of the hydraulic unit 14 is connected to an upper port and a lower port of a downwardly facing, hydraulic cylinder 16 through a directional control valve 17 and a shut-off valve 18.

[0012] On the lower end of the piston rod of the hydraulic cylinder 16, a pusher plate 19 is fixed. Below the pusher plate 19, four hydraulic pushers 21, for extruding and supplying the oil to respective upper ports of the four hydraulic cylinders 11 through four pipes 20, are provided such that their upper ends abut the pusher plate 19. Each of the hydraulic pushers 21 comprises an upwardly facing, hydraulic cylinder structure. The four pipes 20 are connected to the hydraulic pump of the hydraulic unit 14 through four respective shut-off valves 22. The respective lower ports of the four hydraulic cylinders 11 are connected to the hydraulic unit 14 through the directional control valve 17. The four air cylinders 12 are connected to the compressor 15 through a directional control valve 23.

[0013] With the foregoing molding machine, prior to the machinery state shown in Figs. 1 and 2, the match plate 7 is sandwiched and held between the cope flask 9 and the drag flask 4 at a molding station (not shown). Upper and lower squeeze members (not shown) are then inserted into the corresponding openings, which are opposed to the match plate 7, of the cope flask 9 and the drag flask 4, to define upper and lower molding spaces. The cope flask 9, the drag flask 4, the match plate 7, and their associated elements defining the molding space are then turned to their vertical positions or horizontal positions such that molding sand is blown and filled within the molding spaces through the sand-filling ports of the cope and drag flasks 9 and 4. The upper and lower squeeze members are then drivingly moved to the match plate 7 to squeeze the molding sand within the upper and lower molding spaces to make an upper mold and a lower mold at the same time. As a result, the molding machine is in the state shown in Figs. 1 and 2.

[0014] At the same time, the shut-off valve 18 is preliminarily opened to supply the oil to the lower port of the cylinder 16 and the upper ports of the four hydraulic pushers 21 to contract the cylinder 16 and to extend the four hydraulic pushers 21. The shut-off valve 18 is then closed and the four shut-off valves 22 are opened to supply the oil from the hydraulic pump of the hydraulic unit 14 to the four pipes 20, and the lower ports of the four hydraulic pushers 21. The oil from the hydraulic pump is also supplied to the upper ports of the four hydraulic cylinders 11 to contract them. The four shut-off valves 22, which are located between the four pipes 20 and the hydraulic unit 14, are then shut off.

[0015] From the state shown in Figs. 1 and 2, the cylinder 10 is extended to raise the cope flask 9, while another cylinder (not shown) is contracted to raise the match plate 7. In this case, the velocity of the cope flask 9 when it rises is preferably twice that of the match plate 7. The directional control valve 17 is then turned to extend the cylinder 16 to contract the four hydraulic pushers 21 through the pusher plate 19 to supply the oil to the upper ports of the four hydraulic cylinders 11 to extend them. At the same time, the directional control valve 23 is turned to supply the compressed air from the compressor 15 to the four air cylinders 12 to extend them. Therefore, the four hydraulic cylinders 11 push down the match plate 7, while the four air cylinders 12 are simultaneously pushed up to the match plate 7. This causes the cope and drag flasks 9 and 4, which contain upper and lower molds, to be simultaneously pushed away from the match plate 7 and each other. In contrast to the conventional two-step stripping, the cope flask 9 and the drag flask 4 are thus stripping at the same time. Therefore, this prevents an undesirable impact that may cause a defect in a mold that is involved in the conventional second stripping (stripping one flask from the match plate on which a mold that is contained within the flask is adhered).

[0016] In this case, setting the velocity of the cope flask 9 when it is rising to twice that of the match plate 7 results in there being a sufficient space in which the cope and drag flasks 9,4 can be simultaneously pushed away from the match plate 7 and each other, in the following step.

[0017] While the molding machine and molding method of the present invention have been described with respect to the preferred embodiment, it is to be understood that the invention is intended to cover all of the various modifications and variations that can be included within the spirit and scope of the appended claims. Accordingly, the arrangements and operations of the match-plate molding machine for which the present invention can be applied are not limited to those described and shown herein. For example, the match plate, the cope flask, and the drag flask may rotate after the match plate is held between the cope and drag flasks. Alternatively, the match plate may be held between the cope flask and the drag flask after the flasks are rotated. Therefore, the timing of holding the match plate and rotating the flasks does not limit the present invention. The resulting upper and lower molds that are made by the molding machine and molding method of the present invention may be tight-flask molds or flaskless molds.

[0018] Further, the hydraulic power unit 13 of the molding machine of the present invention is not limited to its

embodiment shown in Fig. 3. The hydraulic power unit 13 of Fig. 3 may be replaced with, e.g., the alternative hydraulic power unit 13A of Fig. 4. The alternative hydraulic power unit 13A of Fig. 4 differs from the foregoing hydraulic power unit 13 of Fig. 3 in that the hydraulic cylinder 16 and the shut-off valve 18 are eliminated, while the upper ports of the hydraulic pushers 21 are connected to the directional control valve 17. Because the other elements of the alternative hydraulic power unit 13A of Fig. 4 are the same as those that are denoted by the same numbers of the hydraulic power unit 13 of Fig. 3, their explanations are omitted.

[0019] The operation of the molding machine that employs the alternative hydraulic power unit 13A will now be explained. First, the molding machine makes the upper and lower molds at the same time, in the same manner as in the foregoing embodiment. As a result, the molding machine is thus in the state shown in Figs. 1 and 2. The four shut-off valves are then opened to supply the oil to the four pipes 20 and the lower ports of the four hydraulic pushers 21. The oil is also supplied to the upper ports of the four cylinders 11, to contract them. The four shut-off valves are then closed to shut off the fluid communication between the four pipes 20 and the hydraulic unit 14.

[0020] From the state shown in Figs. 1 and 2, the cylinder 10 is then extended to raise the cope flask, while the other cylinder (not shown) is contracted to raise the match plate 7. In this case the velocity of the cope flask 9 when it rises is preferably twice that of the match plate 7. The directional control valve 17 is then turned to contract the hydraulic pushers 21 through the pusher plate 19 to supply the oil to the upper ports of the four hydraulic cylinders 11, to extend them. At the same time, the directional control valve 23 is turned to supply the compressed air from the compressor 15 to the four air cylinders 12 to extend them. Therefore, the four hydraulic cylinders 11 push down the match plate 7, while the four air cylinders 12 push up the match plate 7. This causes the cope flask 9 and the drag flask 4, which contain the upper and lower molds, to be simultaneously pushed away from the match plate 7 and pushed away relative to each other. The cope flask 9 and the drag flask 4 are thus stripped at the same time, the same as in the foregoing embodiment.

Claims

1. A molding method comprising steps of: holding a match plate between a cope flask and a drag flask; inserting an upper squeeze member and a lower squeeze member into openings of said cope and drag flasks, which are opposed to said match plate, to define an upper molding space and a lower molding spaces, respectively; filling said defined molding spaces with molding sand; and forcing said upper and lower squeeze members toward the match plate to squeeze said molding sand within said upper and lower molding spaces to make an upper mold and a lower mold at the same time;
said method being **characterized in that**:
when the flasks are stationary, upper pushing means push down the match plate and lower pushing means are simultaneously pushed up to the match plate such that said cope and drag flasks including said upper and lower molds are pushed away from said match plate at the same time.

2. The method of claim 1, wherein the velocity at which said cope flask is separated from said drag flask is twice that when said match plate is separated from said drag flask, and wherein the velocity at which said cope flask is separated from said match plate is the same as that when said drag flask is separated from said match plate.

3. A molding machine comprising: a cope flask and a drag flask; a match plate to be held between said cope and drag flasks; an upper squeeze member and a lower squeeze member that are insertable into openings of said cope and drag flasks, which are opposed to said match plate; means for filling molding sand within an upper molding space that is defined by said cope flask, said match plate, and said upper squeeze member, and a lower molding space that is defined by said drag flask, said match plate, and said lower squeeze member; compacting means for forcing said upper and lower squeeze members toward the match plate to squeeze said molding sand within said upper and lower molding spaces to mold an upper mold and a lower mold at the same time:
said machine being **characterized in that**:
upper pushing means and lower pushing means are mounted on both the cope flask and the drag flask, wherein the upper pushing means are adapted to push down the match plate and the lower pushing means are adapted to be simultaneously pushed up to the match plate such that, in response of the flasks being stationary, the upper and the lower pushing means push away said cope and drag flasks including said upper and lower molds from said match plate at the same time.

4. The molding machine of claim 3, wherein a said upper pushing means is a hydraulic cylinder that is extended by supplying an oil therein, and wherein said lower pushing means is a hydraulic cylinder that has a force for extruding the oil that is less that that of said upper pushing means, or an air cylinder that is extended by the compressed air, or an elastic means that is extended by an elastic member.

5. The molding machine of claim 3 or 4, wherein said cope and drag flasks have sand-filling ports on their

sidewalls.

6. The molding machine of claim 3 or 4, wherein said drag flask is mounted on a rotating frame that is upwardly and downwardly rotated in a vertical plane, and wherein said cope flask is mounted on said rotating frame such that said cope flask can approach and retract from said drag flask.

7. The molding machine of claim 3 or 4, wherein said molding machine further comprises a shuttle for carrying in and carrying out said match plate between said cope and drag flasks.

8. The molding machine of claim 3 or 4, wherein said molding machine further comprises a mechanism that enables said match plate to approach and retract from the drag flask.

9. The molding machine of claim 3 or 4, wherein the resulting molds are tight-flask molds or flaskless molds.

Patentansprüche

1. Formverfahren, die Schritte umfassend: Halten einer Formplatte zwischen einem oberen Formkasten und einem unteren Formkasten; Einsetzen eines oberen Quetschelements und eines unteren Quetschelements in Öffnungen des oberen und unteren Formkastens, die der Formplatte gegenüberliegen, um einen oberen Formraum beziehungsweise einen unteren Formraum zu definieren; Füllen der definierten Formräume mit Formsand; und Drängen des oberen und unteren Quetschelements in Richtung der Formplatte, um den Formsand innerhalb des oberen und unteren Formraums zusammenzudrücken, um gleichzeitig eine obere Form und eine untere Form herzustellen;
wobei das Verfahren **dadurch gekennzeichnet ist, dass**:
wenn die Formkästen stationär sind, obere Drückmittel die Formplatte nach unten drücken und gleichzeitig untere Drückmittel nach oben an die Formplatte gedrückt werden, sodass der obere und untere Formkastenmit der oberen und der unteren Form gleichzeitig von der Formplatte weggedrückt werden.

2. Verfahren nach Anspruch 1, wobei die Geschwindigkeit, mit der der obere Formkasten von dem unteren Formkasten getrennt werden, doppelt so hoch ist wie die, wenn die Formplatte von dem unteren Formkasten getrennt wird, und wobei die Geschwindigkeit, mit der der oberen Formkasten von der Formplatte getrennt wird, die gleiche ist wie die, wenn der untere Formkasten von der Formplatte getrennt wird.

3. Formgerät, umfassend: einen oberen Formkasten und einen unteren Formkasten; eine Formplatte, die zwischen dem oberen und dem unteren Formkasten gehalten werden soll; ein oberes Quetschelement und ein unteres Quetschelement, die in Öffnungen des oberen und des unteren Formkastens einsetzbar sind, die der Anpassungsplatte gegenüberliegen; Mittel zum Einfüllen von Formsand in einen oberen Formraum, der durch den oberen Formkasten, die Formplatte und das obere Quetschelement definiert ist, und einen unteren Formraum, der durch den unteren Formkasten, die Formplatte und das untere Quetschelement definiert ist; Verdichtungsmittel zum Drängen des oberen und unteren Quetschelements in Richtung auf die Formplatte, um den Formsand in dem oberen und unteren Formraum zusammenzudrücken, um gleichzeitig eine obere Form und eine untere Form zu formen:
wobei das Gerät **dadurch gekennzeichnet ist, dass**:
obere Drückmittel und untere Drückmittel sowohl an dem oberen Formkasten als auch an dem unteren Formkasten montiert sind, wobei die oberen Drückmittel dazu eingerichtet sind, die Formplatte nach unten drücken, und die unteren Drückmittel dazu eingerichtet sind, gleichzeitig nach oben bis zur Formplatte gedrückt zu werden, sodass die oberen und unteren Drückmittel als Reaktion darauf, dass die Formkästen stationär sind, die oberen und unteren Drückmittel den oberen und unteren Formkasten, die die obere und untere Form umfassen, gleichzeitig von der Formplatte wegdrücken.

4. Formgerät nach Anspruch 3, wobei ein solches oberes Drückmittel ein Hydraulikzylinder ist, der durch Zuführen eines Öls in denselben ausgefahren wird, und wobei das untere Drückmittel ein Hydraulikzylinder ist, der eine Kraft zum Ausstoßen des Öls aufweist, die geringer ist als die des oberen Drückmittels, oder ein Luftzylinder, der durch Druckluft ausgefahren wird, oder ein elastisches Mittel, das durch ein elastisches Element ausgefahren wird.

5. Formgerät nach Anspruch 3 oder 4, wobei der obere und der untere Formkasten an ihren Seitenwänden Sandeinfüllöffnungen aufweisen.

6. Formgerät nach Anspruch 3 oder 4, wobei der untere Formkasten auf einem Drehrahmen montiert ist, der in einer vertikalen Ebene nach oben und unten gedreht wird, und wobei der obere Formkasten auf dem Drehrahmen so montiert ist, dass sich der obere Formkasten dem unteren Formkasten annähern und sich von ihm zurückziehen kann.

7. Formgerät nach Anspruch 3 oder 4, wobei das Form-

gerät ferner einen Shuttle zum Einführen und Herausführen der Formplatte zwischen dem oberen und dem unteren Formkasten umfasst.

8. Formgerät nach Anspruch 3 oder 4, wobei das Formgerät ferner einen Mechanismus umfasst, der es der Formplatte ermöglicht, sich dem unteren Formkasten anzunähern und sich von ihm zurückzuziehen.

9. Formgerät nach Anspruch 3 oder 4, wobei die entstehenden Formen Kastenformen oder kastenlose Formen sind.

Revendications

1. Procédé de moulage comprenant les étapes consistant à : maintenir une plaque d'appariement entre un châssis supérieur et un châssis inférieur ; insérer un élément de compression supérieur et un élément de compression inférieur dans les ouvertures desdits châssis supérieur et inférieur, qui sont opposés à ladite plaque d'appariement, pour définir un espace de moulage supérieur et un espace de moulage inférieur, respectivement ; remplir lesdits espaces de moulage définis par du sable de moulage ; et forcer lesdits éléments de compression supérieur et inférieur vers la plaque d'appariement pour compresser ledit sable de moulage à l'intérieur desdits espaces de moulage supérieur et inférieur afin de réaliser un moule supérieur et un moule inférieur en même temps ;
ledit procédé étant **caractérisé en ce que** :
lorsque les châssis sont fixes, des moyens de poussée supérieurs poussent vers le bas la plaque d'appariement et des moyens de poussée inférieurs sont simultanément poussés vers le haut vers la plaque d'appariement de telle sorte que lesdits châssis supérieur et inférieur comprenant lesdits moules supérieur et inférieur soient poussés à distance de ladite plaque d'appariement en même temps.

2. Procédé selon la revendication 1, dans lequel la vitesse à laquelle ledit châssis supérieur est séparé dudit châssis inférieur est deux fois celle lorsque ladite plaque d'appariement est séparée dudit châssis inférieur, et la vitesse à laquelle ledit châssis supérieur est séparé de ladite plaque d'appariement étant la même que celle lorsque ledit châssis inférieur est séparé de ladite plaque d'appariement.

3. Machine de moulage comprenant : un châssis supérieur et un châssis inférieur ; une plaque d'appariement à maintenir entre lesdits châssis supérieur et inférieur ; un élément de compression supérieur et un élément de compression inférieur qui peuvent être insérés dans les ouvertures desdits châssis supérieur et inférieur, qui sont opposés à ladite plaque d'appariement ; des moyens de remplir de sable de moulage l'intérieur d'un espace de moulage supérieur qui est défini par ledit châssis supérieur, ladite plaque d'appariement, et ledit élément de compression supérieur, et un espace de moulage inférieur qui est défini par ledit châssis inférieur, ladite plaque d'appariement et ledit élément de compression inférieur ; des moyens de compactage pour forcer lesdits éléments de compression supérieur et inférieur vers la plaque d'appariement pour compresser ledit sable de moulage à l'intérieur desdits espaces de moulage supérieur et inférieur afin de mouler un moule supérieur et un moule inférieur en même temps :
ladite machine étant **caractérisée en ce que** :
les moyens de poussée supérieurs et les moyens de poussée inférieurs sont montés à la fois sur le châssis supérieur et le châssis inférieur, les moyens de poussée supérieurs étant adaptés pour pousser vers le bas la plaque d'appariement et les moyens de poussée inférieurs étant adaptés pour être poussés simultanément vers le haut vers la plaque d'appariement de telle sorte que, en réponse aux châssis qui sont fixes, les moyens de poussée supérieurs et inférieurs poussent à distance lesdits châssis supérieur et inférieur comprenant lesdits moulages supérieur et inférieur de ladite plaque d'appariement en même temps.

4. Machine de moulage selon la revendication 3, dans lequel un dit moyen de poussée supérieur est un cylindre hydraulique qui est étendu par apport d'une huile à l'intérieur de celui-ci, et dans lequel ledit moyen de poussée inférieur est un cylindre hydraulique qui a une force pour extraire l'huile qui est inférieure à celle dudit moyen de poussée supérieur, ou un cylindre d'air qui est étendu par l'air compressé, ou un moyen élastique qui est étendu par un élément élastique.

5. Machine de moulage selon la revendication 3 ou 4, dans lequel lesdits châssis supérieur et inférieur ont des orifices de remplissage de sable sur leurs parois latérales.

6. Machine de moulage selon la revendication 3 ou 4, dans lequel ledit châssis inférieur est monté sur un cadre rotatif qui est tourné vers le haut et vers le bas dans un plan vertical, et ledit châssis inférieur étant monté sur ledit cadre rotatif de telle sorte que ledit châssis inférieur peut s'approcher et se rétracter à partir dudit châssis inférieur.

7. Machine de moulage selon la revendication 3 ou 4, dans lequel ladite machine de moulage comprend en outre une navette pour acheminer à l'intérieur et acheminer à l'extérieur de ladite plaque d'appariement entre lesdits châssis supérieur et inférieur.

8. Machine de moulage selon la revendication 3 ou 4, dans lequel ladite machine de moulage comprend en outre un mécanisme qui permet à ladite plaque d'appariement de s'approcher et de se rétracter à partir du châssis inférieur.

9. Machine de moulage selon la revendication 3 ou 4, dans lequel les moules résultants sont des moules à châssis étanche ou des moules sans châssis.

Fig. 1

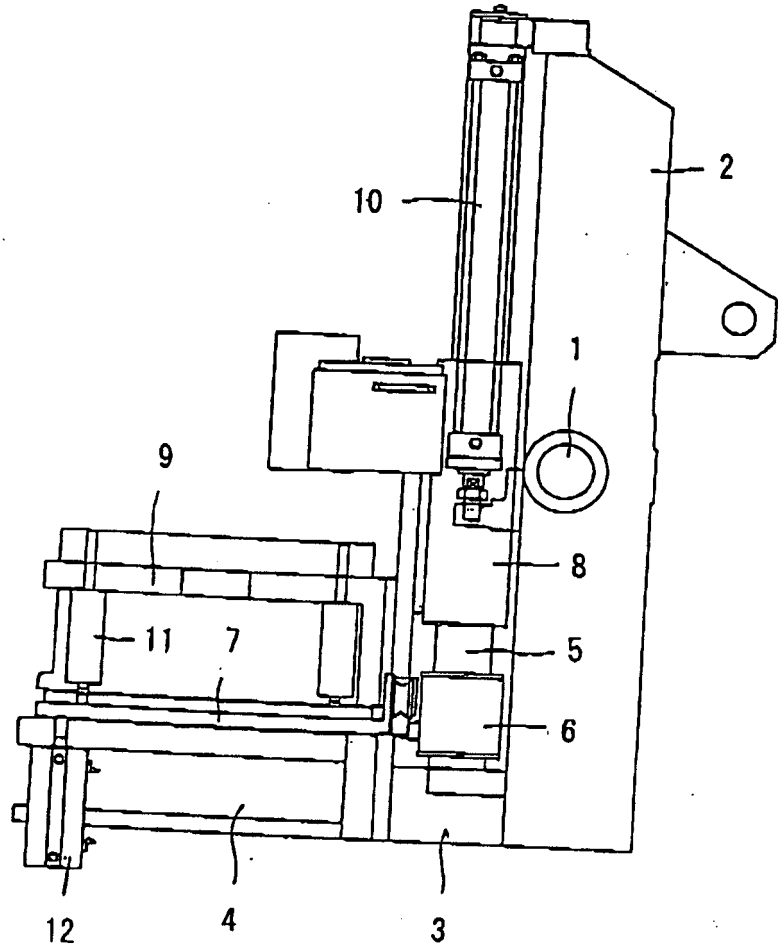


Fig. 2

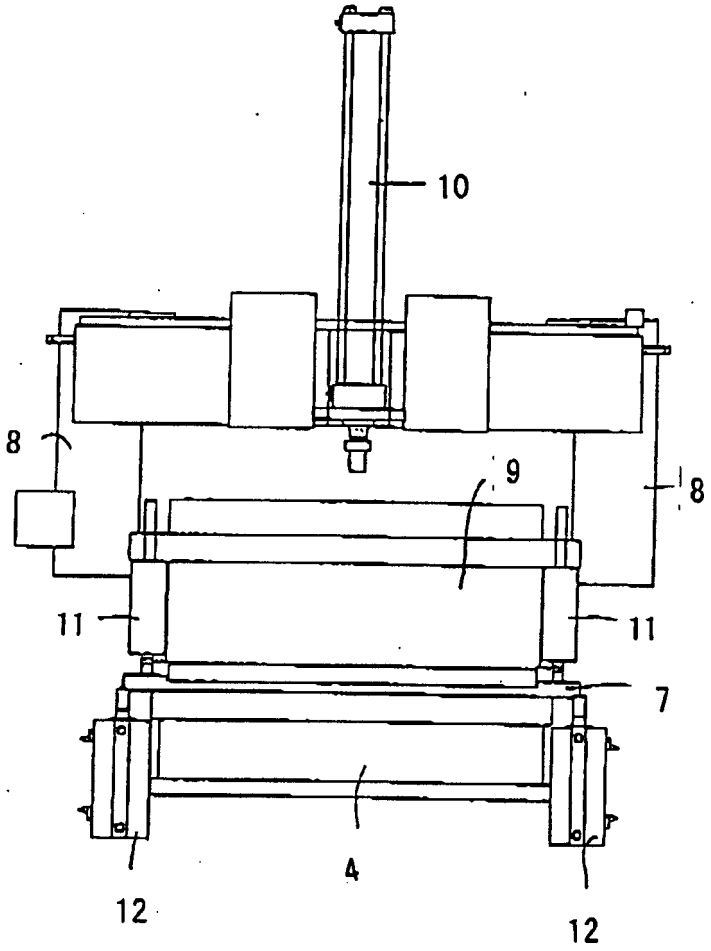


Fig. 3

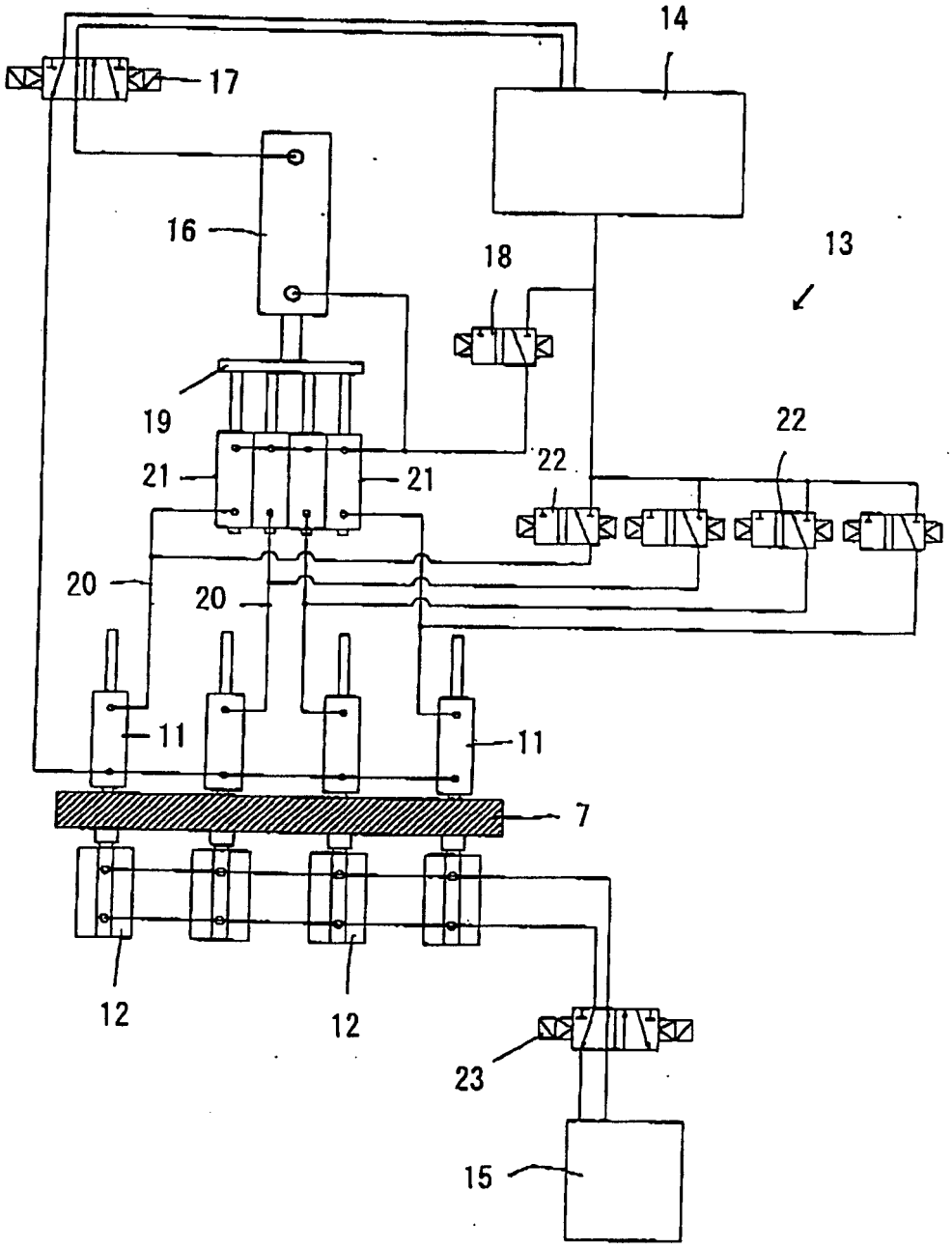
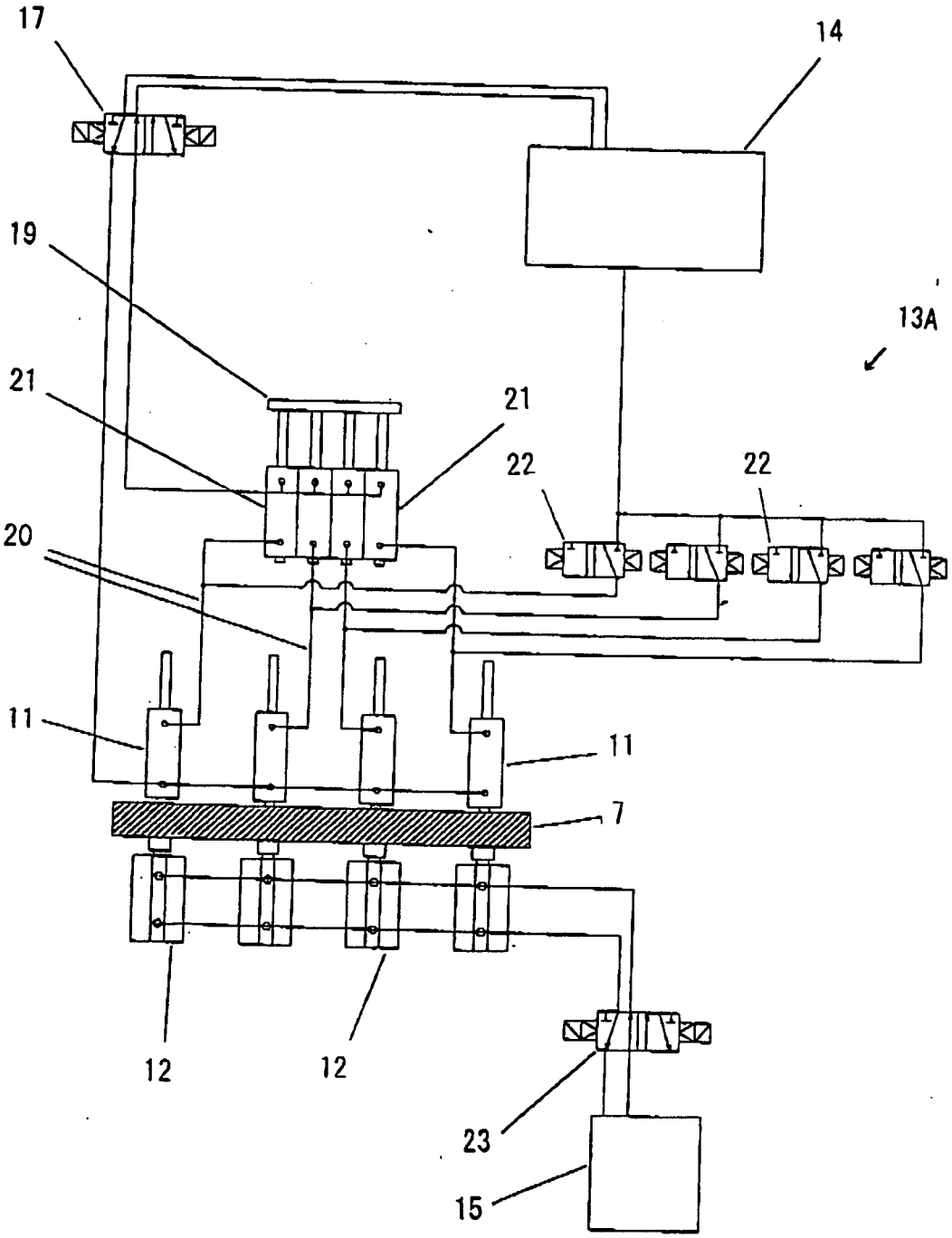


Fig. 4



REFERENCES CITED IN THE DESCRIPTION

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