

(19)



(11)

EP 3 470 146 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:
19.08.2020 Bulletin 2020/34

(51) Int Cl.:
B21C 23/21 (2006.01)

(21) Application number: **18199519.2**

(22) Date of filing: **10.10.2018**

(54) DIRECT MECHANICALLY-OPERATED EXTRUSION PRESS

DIREKT MECHANISCH-ANGETRIEBENE STRANGPRESSE

PRESSE D'EXTRUSION DIRECTEMENT ET MÉCANIQUEMENT ACTIONNÉE

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR**

(30) Priority: **12.10.2017 IT 201700115300**

(43) Date of publication of application:
17.04.2019 Bulletin 2019/16

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Description

[0001] The present invention relates to a direct mechanically-operated extrusion press for metal materials, with a punch according to the preamble of claim 1 (see e.g. US 2012/244239 A1).

[0002] Extrusion presses able to produce extruded metal products typically comprise a punch able to press a metal billet in a die.

[0003] Said punch is integral with a cylinder, the translation of which occurs by pressurizing a hydraulic fluid.

[0004] The cylinder is a single-effect cylinder and consists of a piston and a sleeve. The introduction of pressurized fluid into the rear part of the sleeve causes the advancement of the piston and therefore of the punch, which presses the billet into the die.

[0005] The fluid is pressurized by hydraulic pumps and once introduced into the chamber of the sleeve, said pressure turns into force.

[0006] Disadvantageously, a hydraulic system causes a series of problems due to the complexity of the system, including the classical problems of all hydraulic machines, such as the leakage problem affecting the hydraulic fluid, the periodic replacement thereof, the recovery and disposal thereof, as well as the increased maintenance labor required to maintain the efficiency of a complex hydraulic system in which the assembly of valves, solenoid valves, fluid filters, air filters, pipes, proportional boards, etc. requires an increased maintenance expertise. Considering that the maximum pressure required to generate the extrusion force normally varies from 25 to 30 MPa, the hydraulic circuit is susceptible of stresses from continuous cycles induced by cyclical increases and decreases of the hydraulic pressure. Additionally, the problem of flammability of the fluid also exists, because the spontaneous combustion is triggered if it comes into contact with the hot metal (which generally is at 500°C). In such a case, certain users may use delayed flammability fluid.

[0007] US-2015/0040635 describes a hybrid system which combines a hydraulic system like that described above, with an electric system with electric motors which operate pinions engaging racks which help the translation of the cylinder but which are not capable of generating all the force required to perform the plastic deformation of the metal, i.e. the extrusion. Given that this solution consists of a dual or hybrid system, it is doubly complex and in any case the problem of the circulation of the fluid, the cooling thereof, the filtering and periodic replacement thereof due to its deterioration remains, with all the associated and costly scheduled and corrective maintenance operations. In this solution, the main force generated for the extrusion is created by pumps which pressurize a hydraulic fluid.

[0008] WO-2016056276 shows an extrusion press electrically driven by drums about which cables are wound. A transverse head integral with the extrusion punch is moved by a pulley. Electric motors cause the

winding/unwinding of the cables. The use of cables and large drums results in a significant volume, in addition to the wear to which said components are subjected. Moreover, given that the cables are susceptible of twisting and natural extension (elasticity of the metal) thereof, they do not allow a positioning accuracy under load which also may reach 50MN of force. Moreover, the more the punch moves towards the die, the less the force resulting from this system, up to reaching zero. This is a limitation which is difficult to be overcome. This application is applicable only to presses having limited extrusion force due to the increased forces involved.

[0009] JP-2016043370 also includes the use of drums and cables for pushing the punch. Said cables are fixed at one end to a body with which the cylinder supporting the punch is integral. Therefore, said cables feed the punch towards the die. As in the above-mentioned document, the Japanese patent also suggests the use of cables as pushing means, i.e. elements subjected to wear and which are cumbersome and with a push which is not very controllable.

[0010] It is worth noting that the force required for the extrusion *per se* (the force by which the plastic deformation of the billet occurs, namely the extrusion) is always generated, even in the hybrid systems described, by the pressurization of the fluid and never by the electric motors directly connected to the punch. The mechanically/electrically-operated part is designed to serve auxiliary functions only, never the main one, i.e. the force of extrusion.

[0011] It is the object of the present invention to provide an extrusion press in which the extrusion force is generated by mechanical means only, without the interposition of pressurized hydraulic means.

[0012] It is a further object of the present invention to ensure, by said mechanical means, at least the same push as the known systems, with less maintenance expenses and energy consumption.

[0013] It is a still further object for said mechanical means to be slightly or not subjected to wear so as to limit the unexpected production stops and the subsequent losses due to production stops.

[0014] According to the invention, said and further objects are achieved by an extrusion press as defined in claim 1.

[0015] Advantageously, the push of the punch is caused by one or more electric motors directly mechanically connected to the punch by a screw-nut screw system, without the aid of cylinders and/or hydraulic pistons which generate by themselves the extrusion force required.

[0016] The screw-nut screw extrusion system allows reduced energy costs.

[0017] These and other features of the present invention will become more apparent from the following detailed description of an exemplary practical embodiment thereof, shown by way of non-limitative example in the accompanying drawings, in which:

figure 1 shows a partially cross-sectional side view of an extrusion press according to the present invention;

figure 2 shows a sectional view according to line II-II in figure 1;

figure 3 shows a block of the sectional view in figure 2;

figure 4 shows a body of the sectional view in figure 2;

figure 5 shows a cylinder of the sectional view in figure 2.

[0018] An extrusion press 1 able to transform a metal billet profile by plastic deformation (extrusion) comprises a punch 2 able to push the billet through a die 3.

[0019] The billet is supported and guided by a container 4 which limits the expansion thereof during the push through the die and is placed between the punch and the die and guides the billet towards the die.

[0020] Punch 2 is integral with a screw 5 (see circle A in figure 1 in which the threading of screw 5 is depicted on enlarged scale).

[0021] Screw 5 engages a nut screw 6 which substantially is an annular-shaped body with an inner threaded surface.

[0022] Said nut screw 6 is driven to rotation about an axis E of screw 5 by one or more electric motors mechanically connected thereto. Figure 1 depicts an annular-shaped electric motor 7 alone.

[0023] Said electric motor 7 comprises a rotor 71 integral with the nut screw 6 and a stator 72 integral with a base 8 by a block 9.

[0024] The nut screw 6 includes a cylindrical outer surface 64 able to slide on a cylindrical inner surface 91 of a cylindrical cavity 93 of block 9.

[0025] An interstice 94 is provided between said cylindrical outer surface 64 and said cylindrical inner surface 91, which is able to accommodate lubricating fluid to facilitate the sliding of body 6 in block 9.

[0026] Body 6 further comprises an annular portion 65 (figure 1) which abuts against block 9, like a portion of rotor 71, thus axially blocking the body 6.

[0027] The extrusion press 1 further comprises a shear 10 able to separate the non-extruded end portion of the billet (referred to as a discard) after the extrusion, such as described in International Patent Application WO-2017103828, for example.

[0028] A cylindrical bar 11 connects the container 4 of the billet with block 9. Such a connection is made by a screw and a nut screw and is electrically operated. The electrically driven screw-nut screw function aims at moving the billet container 4 along axis E.

[0029] Moreover, the extrusion press 1 preferably but not necessarily comprises a lubrication unit able to insert lubricating fluid between screw 5 and nut screw 6 in order to limit the friction and thus the energy expenditure of the electric motor 7.

[0030] With regard to the operation, motor 7 rotates the nut screw 6, which allows the translation of screw 5

along axis E due to the engagement thereof.

[0031] During the extrusion, the nut screw 6 rotates so as to cause the displacement of screw 5, and therefore of punch 2, towards the container 4 in which the billet is accommodated (to the right, looking at figure 1).

[0032] Once in contact with the billet, punch 2 pushes the billet through die 3, thus causing the plastic extruded deformation thereof, i.e. generating a profiled element.

[0033] Once the extrusion has been complete, motor 7 reverses the rotation of the nut screw 6, causing screw 5, and therefore punch 2, to retract, thus returning to a configuration like that depicted in figure 1.

[0034] Advantageously, the push of punch 2 is caused by an electric motor which directly converts the driving torque thereof into axial force by screw-nut screw motion transmission means without the aid of hydraulic means, i.e. the possible pressurization of hydraulic means does not generate any force which contributes to the required extrusion force.

[0035] Preferably, there are between 40 and 60, even more preferably 50 threads engaged in the engagement of screw 5 and nut screw 6.

[0036] Preferably, the surface engaged in said engagement is between 1 m² and 1.5 m², even more preferably about 1.38 m².

[0037] The aforesaid sizes cause a specific load ranging between 1 and 1.5 kg per square millimeter, preferably of 1.3 kg per square millimeter.

[0038] The maximum feeding speed of cylinder 5 preferably is between 25 and 35 mm/second, preferably 30 mm/second, with a rotation speed preferably being between 25 and 35 revolutions per minute, preferably 27 revolutions per minute corresponding to 0.45 revolutions per second.

[0039] The return speed of the cylinder obviously is greater (without a load), preferably between 550 and 650 mm/second, preferably 600 mm/second, with a rotation speed preferably between 800 and 1000 revolutions per minute, preferably 900 revolutions per minute corresponding to 15 revolutions per second.

[0040] Alternatively, instead of motor 7, there may be a toothed crown on which two or more planetary motors are engaged, the purpose of which is the rotation of the aforesaid crown directly fixed to the nut screw 6.

[0041] Advantageously, the screw-nut screw extrusion system allows a reduced volume of the press, increased cleaning, lower maintenance costs and reduced energy costs.

[0042] The push generated by this mechanical system is sufficient for the extrusion of any metal material without the interposition of a compressed fluid and of the complex hydraulic circuits required therein.

[0043] Alternatively, it may be provided that the nut screw 6 translates along axis E with the punch 2 integral therewith, and the screw 5 rotates, thus feeding and pushing the punch forwards, with which it is integral.

[0044] The same above-described screw-nut screw pushing system is also applicable with horizontal screws

(e.g. four in number), with which respective nut screws are engaged, which move a vertical plate with which the punch is integral, along axis E. This includes the possibility for the nut screws to rotate-translate on the screws, or alternatively for the screws to rotate in order to feed the nut screws which are integral with the vertical plate.

Claims

1. An extrusion press (1) of a metal billet, comprising a die (3), a punch (2) able to push the billet through the die (3) and a container (4) of the billet upstream of the die (3),
characterized in that it comprises a screw (5) which the punch (2) is integral to, able to engage with a nut screw (6) comprised in the extrusion press (1), at least one electric motor (7) driving the reciprocal movement of the screw (5) and of the nut screw (6) thus causing the translation of the punch (2) in the extrusion direction.
2. An extrusion press (1) according to claim 1, **characterized in that** the nut screw (6) is driven to rotate about an axis (E) of the screw (5), corresponding to the translation direction of the screw (5) itself, by said at least one electric motor (7).
3. An extrusion press (1) according to claim 1, **characterized in that** the nut screw (6) is fixed and the screw (5) is driven to rotate about an axis (E) of the screw (5), corresponding to the translation direction of the screw (5), at least by said at least one electric motor (7).
4. An extrusion press (1) according to claim 1, **characterized in that** it comprises a plurality of horizontal screws (5) which respective nut screws (6) engage with, thus causing the translation in the extrusion direction of a vertical plate which the punch (2) is integral to.
5. An extrusion press (1) according to any one of the preceding claims, **characterized in that** it comprises a lubrication unit able to insert lubricating fluid between the screw (5) and the nut screw (6).
6. An extrusion press (1) according to claim 2, **characterized in that** said at least one electric motor (7) comprises a rotor (71) integral with the nut screw (6), and a stator (72) integral with a base (8).
7. An extrusion press (1) according to claim 2, **characterized in that** said at least one electric motor (7) comprises planetary motors able to engage with a crown integral to the nut screw (6).
8. An extrusion press (1) according to claim 6 or claim

7, **characterized in that** it comprises a block (9) which provides a cylindrical inner surface (91) of a cylindrical cavity (93) on which a cylindrical outer surface (64) of the nut screw (6) slides.

9. An extrusion press (1) according to claim 8, **characterized in that** an interstice (94) is provided between said cylindrical outer surface (64) and said cylindrical inner surface (91), able to accommodate lubricating fluid to facilitate the sliding of the nut screw (6) in the block (9).

Patentansprüche

1. Strangpresse (1) für einen Metallstrang, aufweisend ein Werkzeug (3), einen Stempel (2), der den Strang durch das Werkzeug (3) drücken kann, und einen Behälter (4) für den Strang stromaufwärts von dem Werkzeug (3),
dadurch gekennzeichnet sie eine Gewindespindel (5) aufweist, mit der der Stempel (2) einstückig ausgebildet ist und die mit einer in der Strangpresse (1) vorhandenen Spindelmutter (6) zusammenwirken kann;
wobei mindestens ein Elektromotor (7) für die antriebsmäßige Hin- und Herbewegung der Gewindespindel (5) und der Spindelmutter (6) sorgt und dadurch die Translationsbewegung des Stempels (2) in der Strangpressrichtung veranlasst wird.
2. Strangpresse (1) nach Anspruch 1,
dadurch gekennzeichnet, dass die Spindelmutter (6) durch den mindestens einen Elektromotor (7) derart angetrieben wird, dass sie sich um eine Achse (E) der Gewindespindel (5) rotationsmäßig bewegt, die der Translationsrichtung der Gewindespindel (5) selbst entspricht.
3. Strangpresse (1) nach Anspruch 1,
dadurch gekennzeichnet, dass die Spindelmutter (6) fixiert ist und die Gewindespindel (5) durch den mindestens einen Elektromotor (7) derart angetrieben wird, dass sie sich um eine Achse (E) der Gewindespindel (5) rotationsmäßig bewegt, die der Translationsrichtung der Gewindespindel (5) entspricht.
4. Strangpresse (1) nach Anspruch 1,
dadurch gekennzeichnet, dass sie eine Mehrzahl von horizontalen Gewindespindeln (5) aufweist, mit denen jeweilige Spindelmutter (6) zusammenwirken, und dadurch die Translationsbewegung einer vertikalen Platte, mit der der Stempel (2) einstückig ausgebildet ist, in der Strangpressrichtung veranlasst wird.
5. Strangpresse (1) nach einem der vorhergehenden

Ansprüche,

dadurch gekennzeichnet, dass sie eine Schmier-einheit aufweist, die dazu ausgebildet ist, Schmier-fluid zwischen die Gewindespindel (5) und die Spin-delmutter (6) einzubringen.

6. Strangpresse (1) nach Anspruch 2,
dadurch gekennzeichnet, dass der mindestens ei-ne Elektromotor (7) einen Rotor (71) aufweist, der mit der Spindelmutter (6) einstückig ausgebildet ist, sowie einen Stator (72) aufweist, der mit einer Basis (8) einstückig ausgebildet ist.
7. Strangpresse (1) nach Anspruch 2,
dadurch gekennzeichnet, dass der mindestens ei-ne Elektromotor (7) Planetenmotoren aufweist, die dazu ausgebildet sind, mit einer Krone zusammen-zuwirken, die mit der Spindelmutter (6) einstückig ausgebildet ist.
8. Strangpresse (1) nach Anspruch 6 oder Anspruch 7,
dadurch gekennzeichnet, dass sie einen Block (9) aufweist, der eine zylindrische Innenfläche (91) ei-nes zylindrischen Hohlraums (93) bereitstellt, auf der eine zylindrische Außenfläche (64) der Spindelmut-ter (6) gleitend verschiebbar ist.
9. Strangpresse (1) nach Anspruch 8,
dadurch gekennzeichnet, dass zwischen der zy-lindrischen Außenfläche (64) und der zylindrischen Innenfläche (91) ein Zwischenraum (94) vorhanden ist, der Schmierfluid aufnehmen kann, um die Gleit-bewegung der Spindelmutter (6) in dem Block (9) zu erleichtern.

Revendications

1. Presse à filer (1) pour billette métallique, comprenant une filière (3), un poinçon (2) apte à pousser la billette à travers la filière (3) et un contenant (4) de la billette en amont de la filière (3),
caractérisée en ce qu'elle comprend une vis (5) avec laquelle le poinçon (2) fait corps, apte à coo-pérer avec un écrou (6) compris dans la presse à filer (1),
au moins un moteur électrique (7) commandant le mouvement alternatif de la vis (5) et de l'écrou (6) de manière à provoquer la translation du poinçon (2) dans le sens d'extrusion.
2. Presse à filer (1) selon la revendication 1, **caracté-risée en ce que** l'écrou (6) est entraîné pour tourner autour d'un axe (E) de la vis (5), correspondant à la direction de translation de la vis (5) elle-même, par ledit au moins un moteur électrique (7).
3. Presse à filer (1) selon la revendication 1, **caracté-**

risée en ce que l'écrou (6) est fixe et la vis (5) est entraînée pour tourner autour d'un axe (E) de la vis (5), correspondant à la direction de translation de la vis (5), au moins par ledit au moins un moteur élec-trique (7).

4. Presse à filer (1) selon la revendication 1, **caracté-risée en ce qu'elle** comprend une pluralité de vis horizontales (5) avec laquelle coopèrent des écrous respectifs (6), de manière à provoquer la translation, dans le sens d'extrusion, d'une plaque verticale avec laquelle le poinçon (2) fait corps.
5. Presse à filer (1) selon l'une quelconque des reven-dications précédentes, **caractérisée en ce qu'elle** comprend une unité de lubrification apte à introduire du fluide lubrifiant entre la vis (5) et l'écrou (6).
6. Presse à filer (1) selon la revendication 2, **caracté-risée en ce que** ledit au moins un moteur électrique (7) comprend un rotor (71) faisant corps avec l'écrou (6) et un stator (72) faisant corps avec une base (8).
7. Presse à filer (1) selon la revendication 2, **caracté-risée en ce que** ledit au moins un moteur électrique (7) comprend des moteurs planétaires aptes à entrer en prise avec une couronne faisant corps avec l'écrou (6).
8. Presse à filer (1) selon la revendication 6 ou la re-vendication 7, **caractérisée en ce qu'elle** comprend un bloc (9) qui procure une surface intérieure cylin-drique (91) de cavité cylindrique (93) sur laquelle coulisse une surface extérieure cylindrique (64) de l'écrou (6).
9. Presse à filer (1) selon la revendication 8, **caracté-risée en ce qu'est** ménagé entre ladite surface ex-térieure cylindrique (64) et ladite surface intérieure cylindrique (91) un interstice (94) apte à accueillir du fluide lubrifiant pour faciliter le coulisement de l'écrou (6) dans le bloc (9).

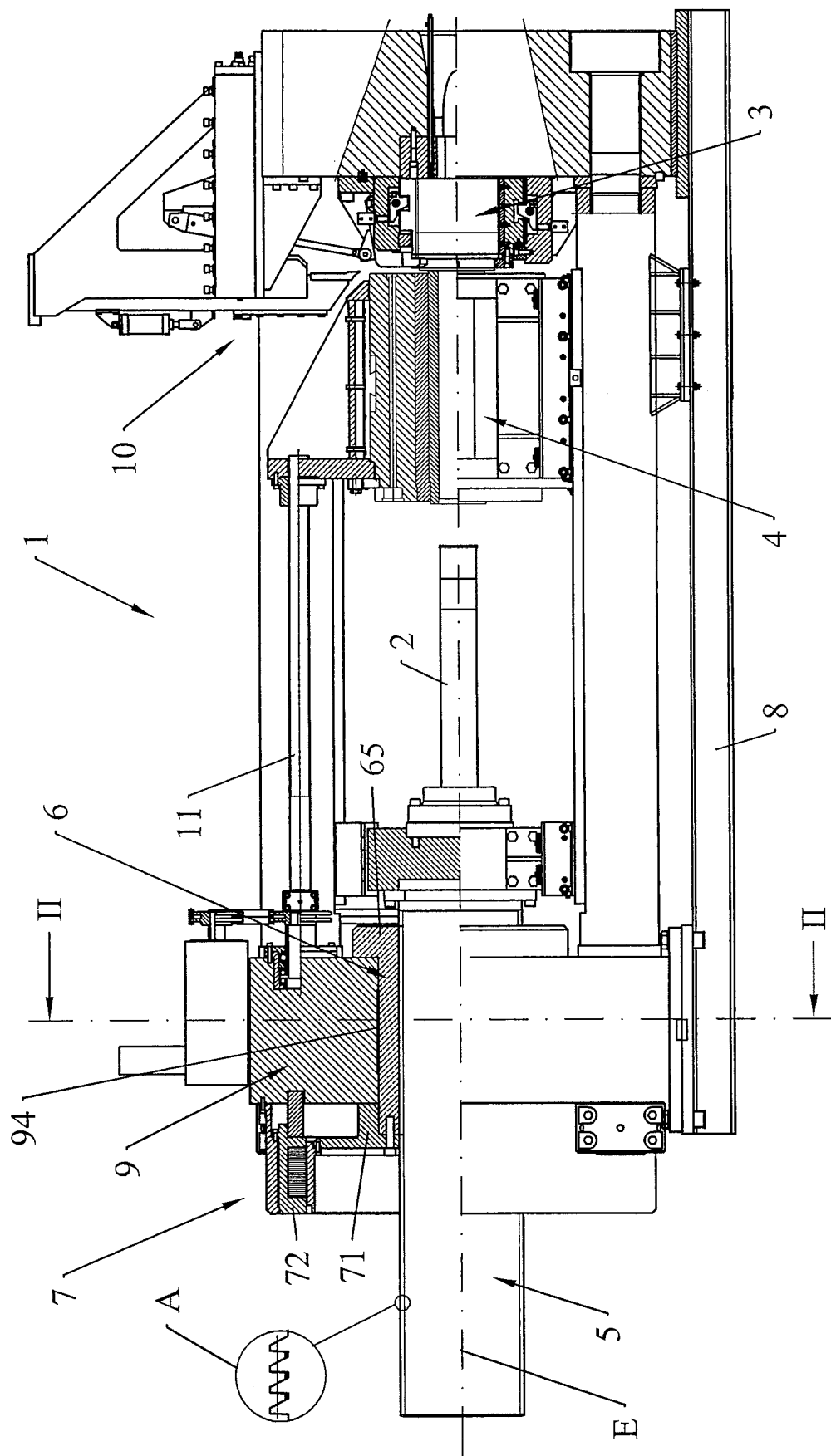


FIG.1

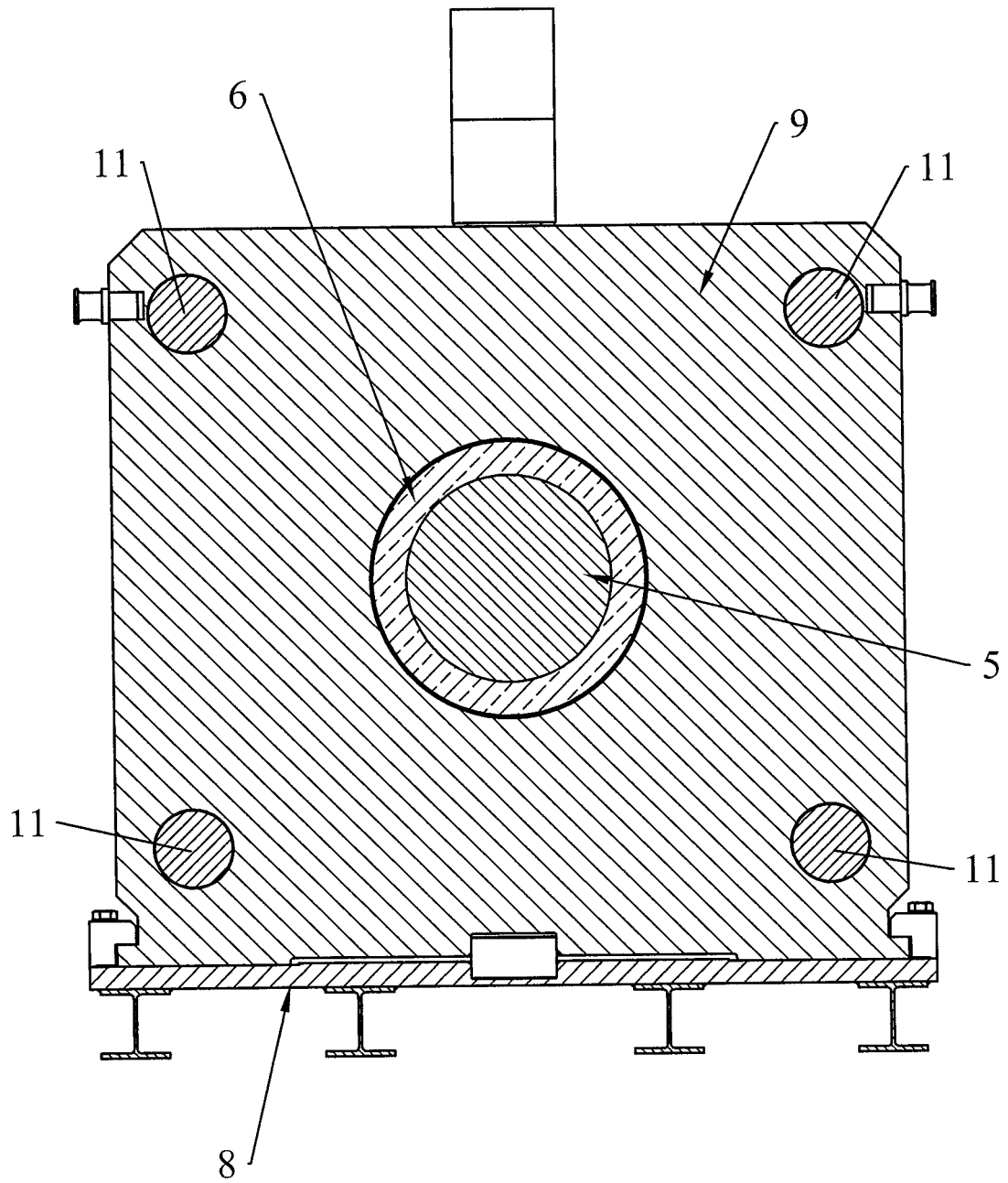


FIG.2

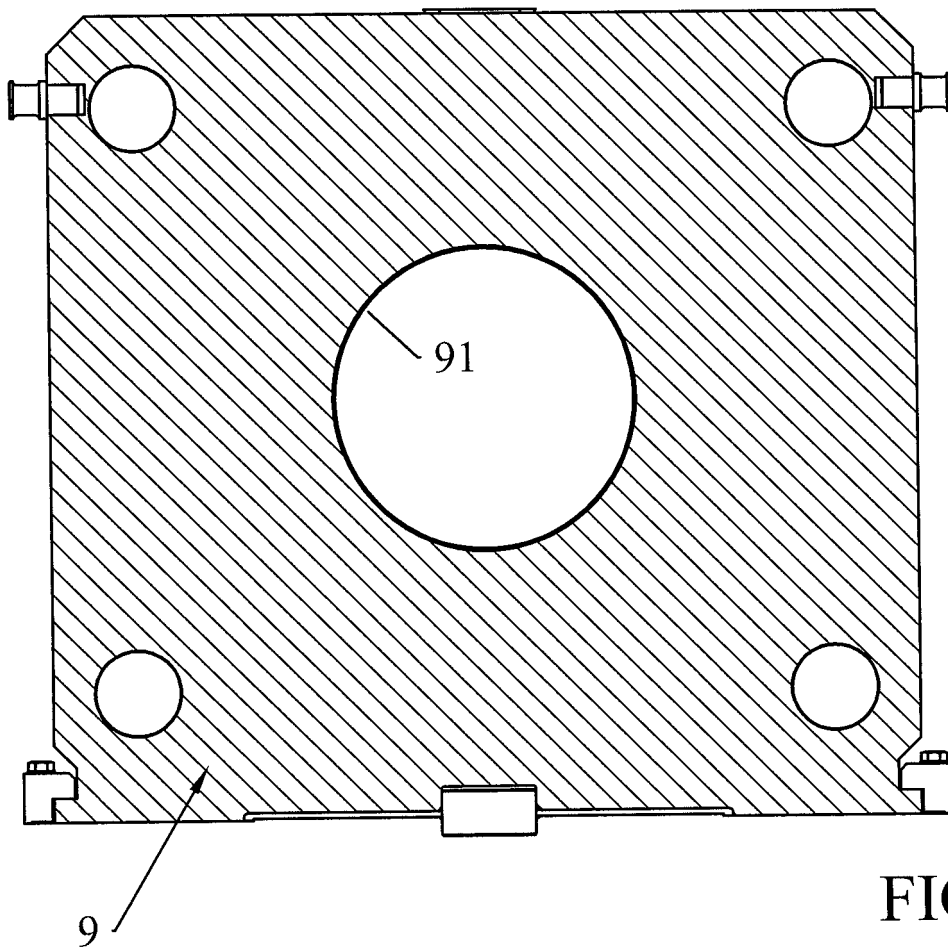


FIG. 3

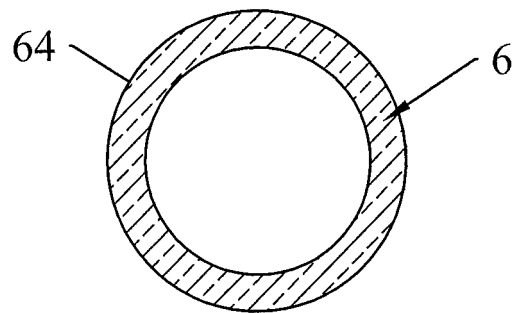


FIG. 4

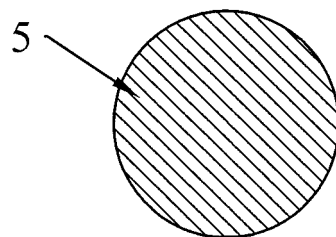


FIG. 5

REFERENCES CITED IN THE DESCRIPTION

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