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(71) Applicant(s):

Xi'an Jiaotong University
(Incorporated in China)
No. 28, Xianning West Road, Beilin District,
Xi'an City 710049, Shaanxi, China

(72) Inventor(s):

Shengdun Zhao
Jingzhou Gao
Wei Du
Fei Jiang
Zhenhao Zheng

(74) Agent and/or Address for Service:

Page White & Farrer
Bedford House, John Street, London, WC1N 2BF,
United Kingdom

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(54) Title of the Invention: Friction clutch and friction brake assembly with low inertia of driven system for mechanical press

Abstract Title: Friction clutch-brake assembly for mechanical press

(57) A friction clutch-brake assembly, for a mechanical press, having low driven system inertia. The press comprising a press body connected with a transmission system (16, fig 1) having a crankshaft (15) mounting a flywheel 4 and a clutch-brake support sleeve (14). The clutch-brake support sleeve (14) is connected to a friction clutch discs 6, 7, 8 and a friction brake discs 10, 11, 12 provided with rigid interlocking structure. The friction clutch and friction brake are actuated by a hydraulic system comprising a valve, and oil pump and pipes connected to hydraulic cylinders which, via pistons 10-6, engage and disengage the clutch-brake. The flywheel 4 is driven by driving motor and can rotate independently on the crankshaft, and the friction clutch-brake is used to control the movement and stop of the crankshaft. Clutch and brake driving discs 6, 10 are slidably mounted on bolts 5, 9 via sliding bearings 6-1, 10-1.

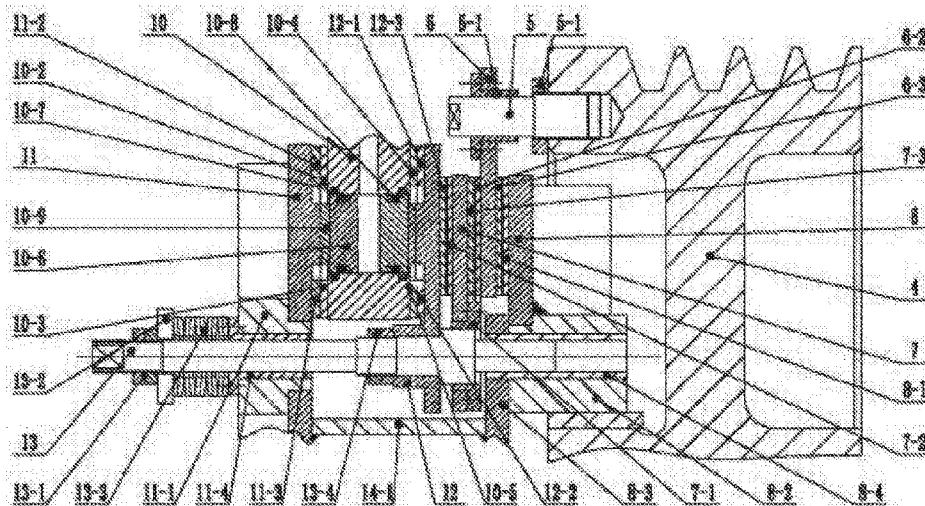


FIG.6

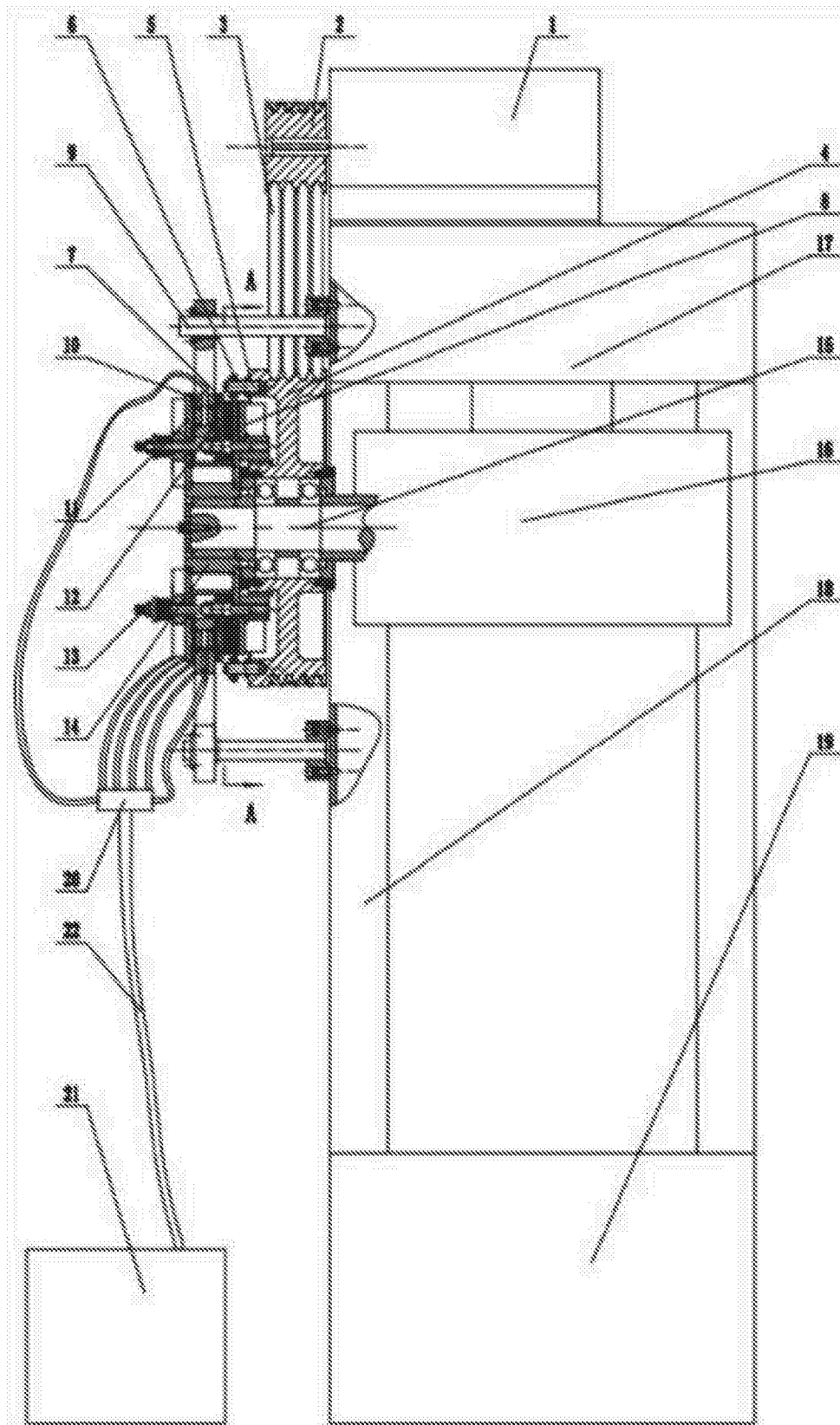


FIG.1

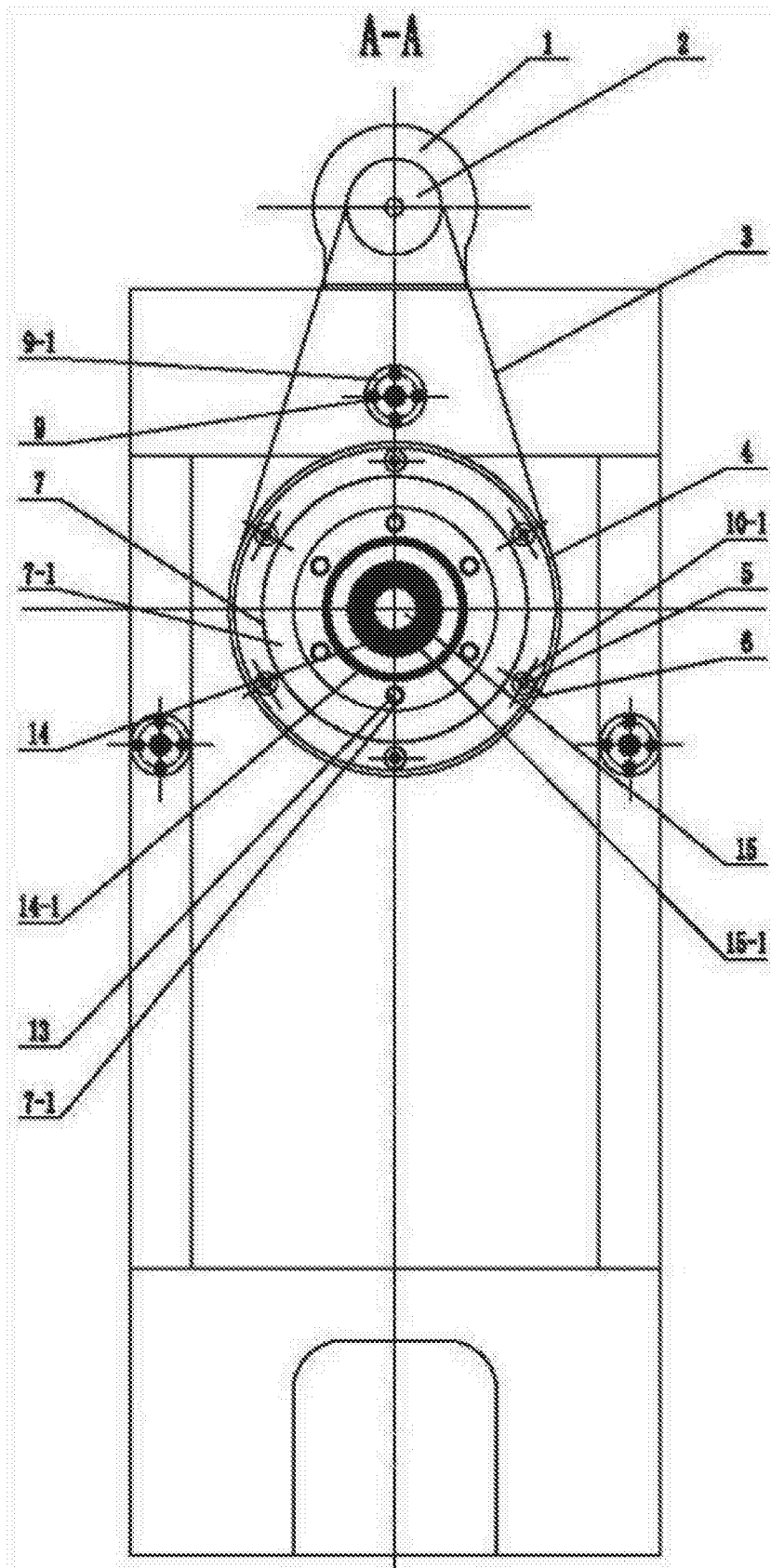


FIG.2

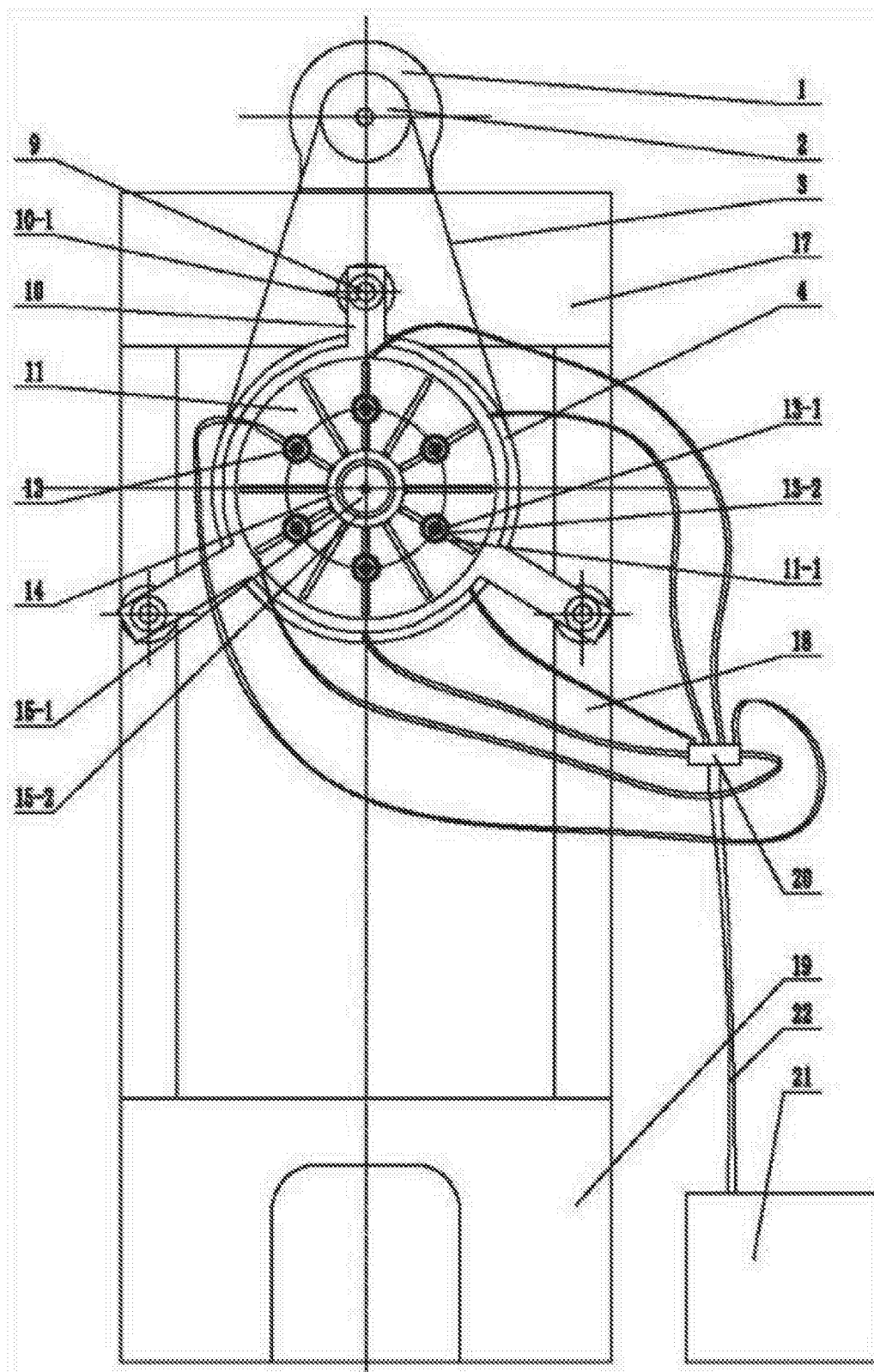


FIG.3

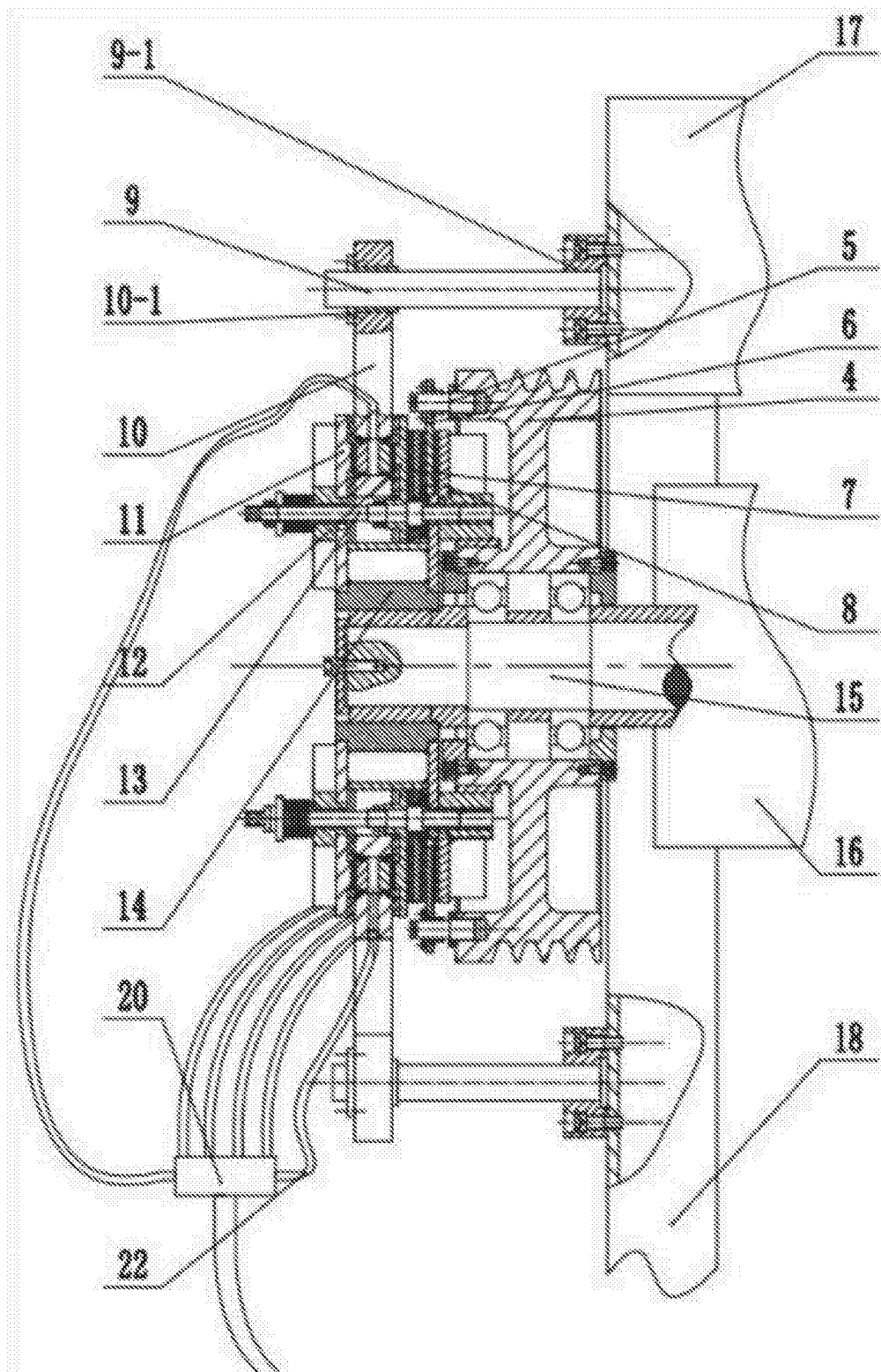


FIG.4

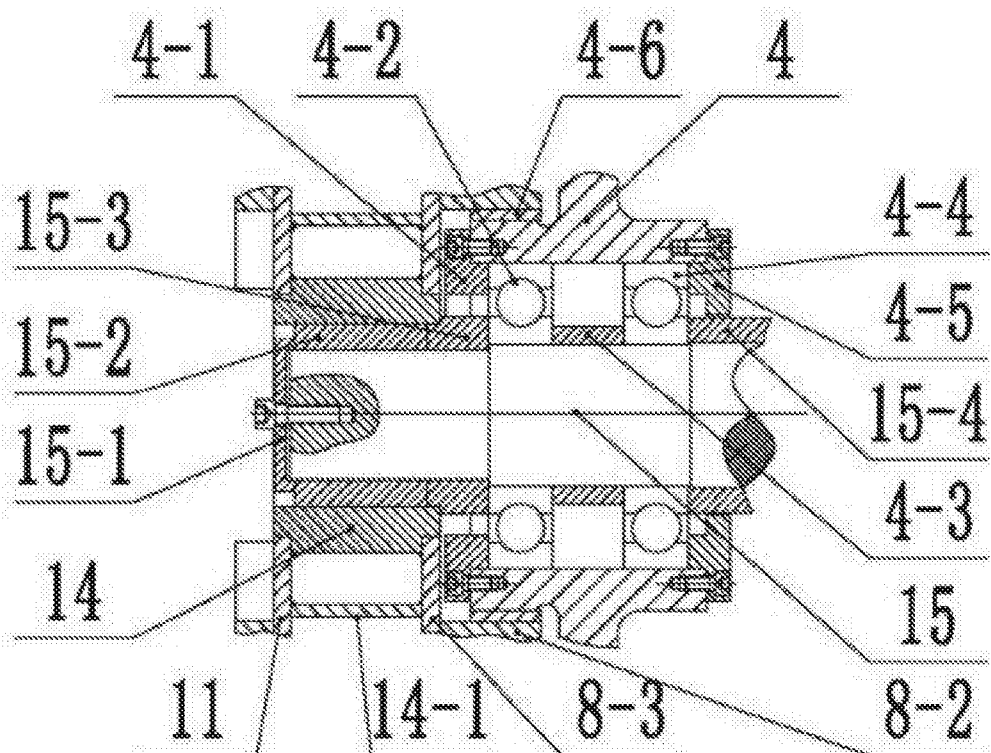


FIG.5

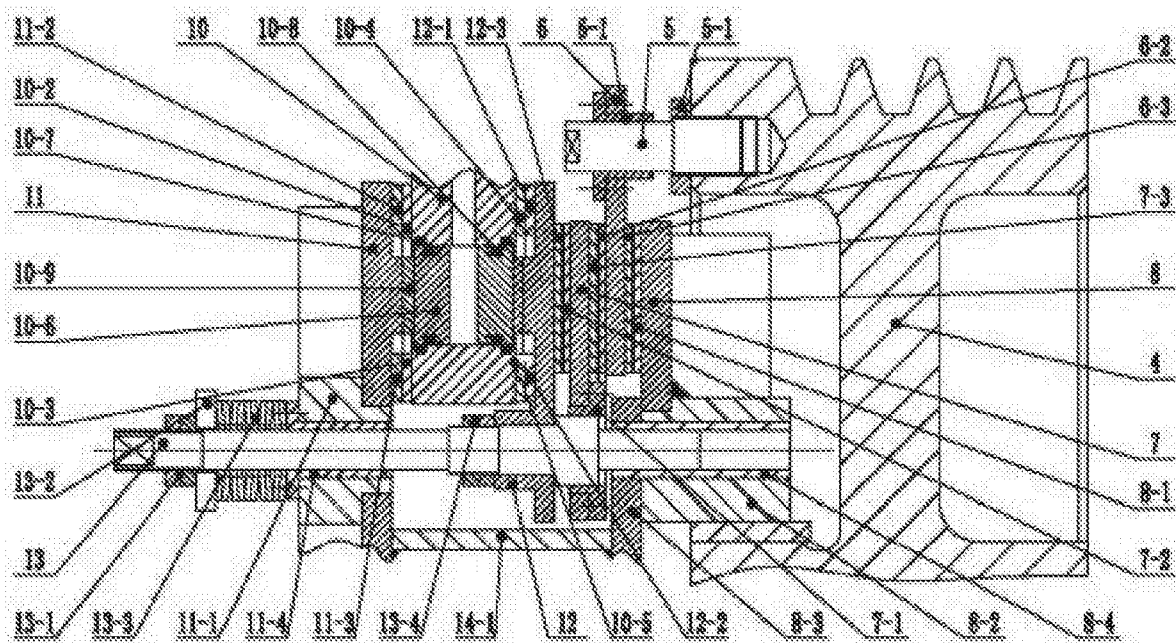


FIG.6

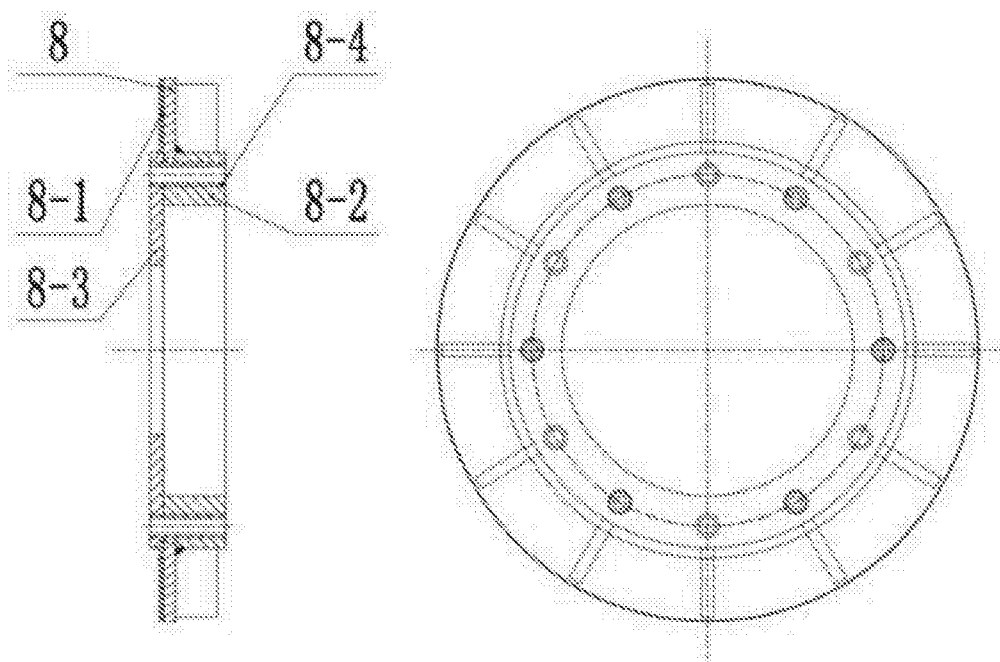


FIG. 7

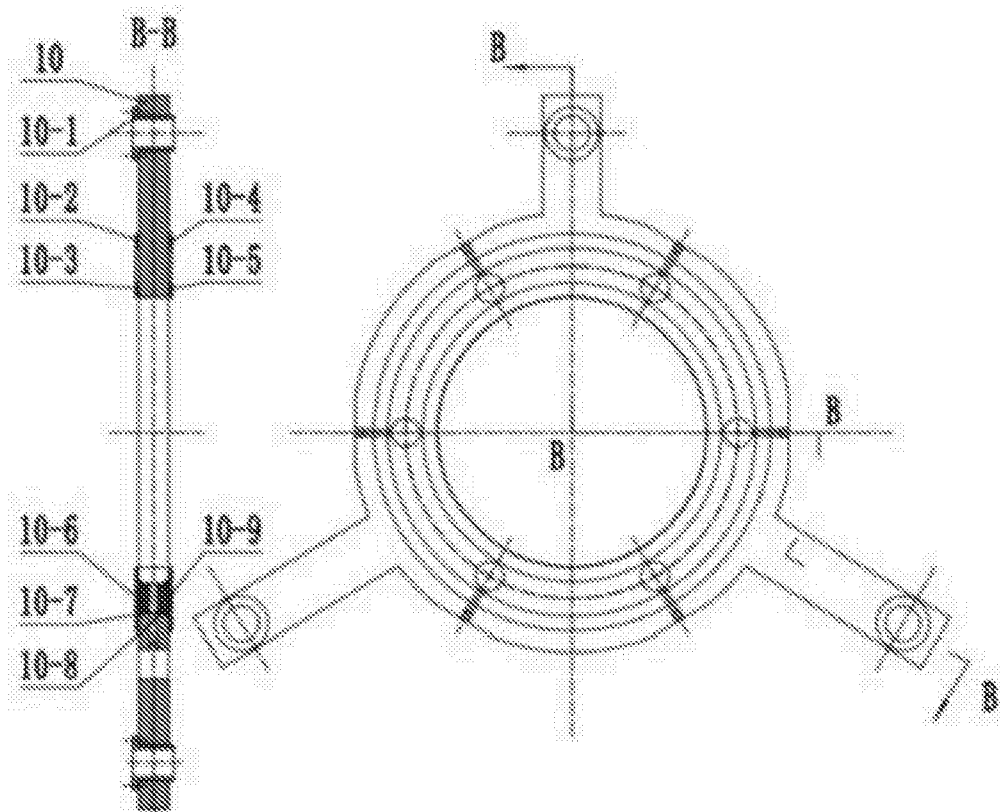


FIG. 8

FRICION CLUTCH AND FRICION BRAKE ASSEMBLY WITH LOW INERTIA OF DRIVEN SYSTEM FOR MECHANICAL PRESS

TECHNICAL FIELD

[0001] The subject disclosure belongs to the technical field of mechanical press for forging equipment, and specifically relates to a friction clutch and friction brake assembly with low inertia of driven system for a mechanical press.

BACKGROUND ART

[0002] A mechanical press is often subjected to short-term peak loads, and the slider thereof needs to frequently move and stop during forging and punching operations, so the transmission system of the mechanical press is often provided with a flywheel with large inertia, and the energy of the forging operation mainly comes from the output of the rotational kinetic energy of the flywheel. Mainly for the above two reasons, and to facilitate the operation of adjustment of molds to workers and to ensure safety of workers, the mechanical press is basically provided with a clutch and a brake, which are heart components of the mechanical press, to control the movement and stop of the operation mechanism of the press. The reliability, safety and convenience of operation and maintenance of the mechanical press are closely related to the clutch and brake.

[0003] There are many types of clutches and brakes, and a universal mechanical press generally uses either rigid clutch and brake or friction clutch and friction brake, where the rigid clutch is used only in small-sized presses (typically with a nominal pressure below 1000kN) and is often used with a belt brake; the rigid clutch has many disadvantages, thus belongs to a to-be-eliminated structural form of clutch.

[0004] The friction clutch and the friction brake have better structures and are generally applied to large-sized and medium-sized presses. The friction clutch and the friction brake have the following advantages: the transmitted torque and the generated braking torque are large, the operation is stable, no impact exists, the engagement is stable, they can work at a high rotating speed, the sliders can enable the clutch to operate at any position, the adjustment of mold is convenient, and certain safety function can be realized by the sliding between the friction plates when being overloaded. Friction clutches and friction brakes can be classified, according to the environment that the friction pair involve, into dry type (in air) and wet type (in liquid).

[0005] An existing universal mechanical press uses compressed air as power sources for engaging and disengaging the clutch and braking and separating the brake, and both the clutch and the brake are arranged on the same shaft. This is currently the most widely used driving and structural arrangement for the existing universal mechanical press, called as pneumatic friction clutch and pneumatic friction brake (PFC & PFB).

[0006] When the mechanical press does not operate, the whole mechanical press is usually in a power-off state, and air supplied to the outside of the mechanical press is not pressurized, so that there is no air pressure in the slider balance cylinder of the mechanical press to balance the dead weight that makes the slider falling down. Therefore, a pneumatic friction brake (PFB) of the mechanical press usually uses an air pressure disengagement friction pair, and a spring presses the PFB friction pair to generate

mechanical braking, so that the slider is prevented from falling down and is braked at an upper dead point.

[0007] Before a friction pair of a pneumatic friction clutch of a mechanical press is engaged, a brake must be released firstly, and the driven system is not braked; before the pneumatic friction brake brakes, the friction pair of the clutch should be separated firstly, that is to say, the actions of the mechanical press should be coordinated with each other, the sequential actions between the friction pair and the mechanical press are realized by an interlocking control system, and in order to ensure correct interlocking actions between the clutch and the brake, a gas valve interlocking mode or a rigid interlocking mode is usually used at home and abroad, wherein the rigid interlocking mode has reliable operation, simple operation system and quick action.

[0008] The pneumatic friction clutch-friction brake widely used in the industrial practice of the existing mechanical press has the following defects:

[0009] (1) the cylinder for transmitting torque engaged with the clutch rotates synchronously with the crankshaft, so that a driven system comprises a driven part of the cylinder piston, thus the rotational inertia J_c of the driven system is increased, the clutch is poor in motion sensitivity. When the clutch is engaged, the friction work on the surface

of the friction material is in direct proportion to the rotational inertia J_c , so that $J_c \omega_m^2 / 2$ is increased, the friction material of the clutch is excessively heated, the abrasion of the friction material is increased, and the service life is shortened.

[0010] (2) The driving source of engaging and braking of the clutch and the brake adopts a compressed air driving mode. However, generating compressed air by using the air compressor involves low energy conversion rate, the noise of the air compressor is large, causing the noise pollution of a workshop; and compared with a hydraulic pump system, the air compressor occupies a large area and has complex pipelines.

[0011] (3) During the engaging and braking process of the clutch and the brake, if compressible air is adopted for driving, then the engagement process of the clutch and the braking process of the brake are slow in action, which can easily cause the faults of congestion or brake failure for the clutch and the brake; also, adopting the pneumatic driving mode results in up to 110dB(A) of noise in the air intake and exhaust process during the operation of the clutch and the brake, which cause a serious environmental pollution, and physical and psychological health damage of workers.

[0012] (4) The cylinder of clutch will rotate along with the crankshaft, thus a rotary joint (swivel joint) must be used to introduce compressed air into the central hole of the crankshaft, then into the clutch cylinder through the rotary sealing, which requires seals in multiple locations in the compressed air transmission path, and requires punching in the middle of the crankshaft, thereby making the structure complex, the air leakage large, and the energy utilization rate low.

[0013] (5) The clutch and the brake are arranged between the flywheel and the body of press, thus the heat generated by friction cannot be dissipated timely, and the flywheel must be removed during maintenance, disassembly, and replacement of the friction material, so that the period of maintenance is long and the maintenance is inconvenient.

SUMMARY

[0014] In order to overcome the defects of the prior art, the present disclosure aims to provide a friction clutch and friction brake assembly with low inertia of driven system for a mechanical press, wherein the small-sized hydraulic cylinder does not move along with the crankshaft, the crankshaft does not need a processing central air hole. The friction clutch and friction brake assembly has the advantages of low rotational inertia of the driven system, small frictional heating, good heat dissipation effect, high energy utilization rate, compact structure, coordinated action, simplicity and convenience in operation, convenience in maintenance, low noise pollution and the like.

[0015] In order to achieve the purpose, the present disclosure adopts the following technical scheme:

[0016] A friction clutch and friction brake assembly with low inertia of driven system for a mechanical press includes a press body, wherein the press body is connected with a transmission system composed of a crankshaft 15 and accessories of the crankshaft; a flywheel 4 and a clutch-brake support sleeve 14 are mounted on the crankshaft 15, and the clutch-brake support sleeve 14 is connected with the friction clutch and the friction brake, the friction clutch and the friction brake are provided with a rigid interlocking structure, the friction clutch and the friction brake are connected with a hydraulic pipeline system, the flywheel 4 is driven to move by a driving motor 1, the flywheel 4 can be rotatable independently on the crankshaft 15, and the friction clutch and friction brake are configured for controlling the movement and stop of the crankshaft 15.

[0017] The friction clutch comprises a clutch driving disc 6, a clutch first driven disc 7 arranged on one side of the clutch driving disc and a clutch second driven disc 8 arranged on the other side of the clutch driving disc; first bearings 6-1 is installed in a circumferential array of through holes arranged on a clutch driving disc 6, the clutch driving disc 6 is connected with first bolts 5 through the first bearings 6-1, the clutch driving disc 6 can be slidable on the first bolts 5, and the first bolts 5 are fixedly arranged on a flywheel 4; the clutch second driven disc 8 is in contact with the flywheel 4 through a second bearing 4-6 and is rotatable, the friction clutch and the flywheel are integrated into one piece.

[0018] The friction brake comprises a brake driving disc 10, a brake first driven disc 11 and a brake second driven disc 12; more than three small-sized hydraulic cylinders are reserved on the brake driving disc 10, and each small-sized hydraulic cylinder is provided with two hydraulic pistons 10-6; the brake driving disc 10 is connected with a second bolt 9 through a third bearing 10-1, the brake driving disc 10 can be slidable on the second bolt 9, and the second bolt 9 is fixedly connected with an upper lateral beam 17 or a upright post 18.

[0019] An oil pump 21 delivers hydraulic medium into the small-sized hydraulic cylinders to push the hydraulic pistons 10-6 to move, and is regulated by a hydraulic valve switch 20.

[0020] The interlocking structure of the friction clutch and friction brake comprises: the brake first driven disc 11 is connected with one ends of a clutch-brake support sleeve 14 and one end of a third sleeve 14-1, a clutch connecting plate 8-3 is connected with the other end of the clutch-brake disc support sleeve 14 and the other end of the third sleeve

14-1, so that the brake first driven disc 11 is fixedly connected with the clutch connecting plate 8-3, and a friction clutch and a friction brake are integrated into one piece; the friction clutch and the friction brake are rigidly interlocked through a guiding connection shaft 13, a second sleeve 11-1 of a brake first driven disc 11 is connected with the guiding connection shaft 13 through a fourth bearing 11-4, and the brake first driven disc 11 can be slidable on the guiding connection shaft 13; the brake second driven disc 12 is connected with the guiding connection shaft 13 and is fixedly connected with the step of the guiding connection shaft 13 through a second round nut 13-4; the clutch first driven disc 7 is connected with the guiding connection shaft 13 through fifth bearings 7-1 installed on a circumferential array of through holes of the clutch first driven disc 7, and the clutch first driven disc 7 can be slidable on the guiding connection shaft 13; a first sleeve 8-2 and a clutch connecting plate 8-3 of a clutch second driven disc 8 are connected with the guiding connection shaft 13 through sixth bearings 8-4 installed on the circumferential array of through holes on the clutch connecting plate 8-3, and the clutch second driven disc 8 can be slidable on the guiding connection shaft 13; the guiding connection shaft 13 is axially fixed through a brake spring 13-3, a baffle 13-2 and a first round nut 13-1; the clutch-brake support sleeve 14 is fixedly connected with the crankshaft 15 by an expansion sleeve 15-2.

[0021] The friction clutch, the friction brake, and the flywheel 4 are structurally integrated into one piece, and are located on the outer side of the press body, wherein the friction brake is located on the outermost side, the friction clutch is located in the middle, and the flywheel 4 is located near the press body.

[0022] Compared with the existing friction clutch and friction brake, the present disclosure has the following advantages:

[0023] (1) the driving oil cylinder for torque transmission engaged with the clutch does not rotate synchronously with the crankshaft, so that the driven system does not comprise driven parts such as oil cylinders, pistons and the like, thus the rotational inertia J_c of the driven system is greatly reduced, the action sensitivity of the clutch is improved, when the clutch is engaged, the friction work on the surface of a friction material is related to

the rotational inertia J_c , so that $J_c \omega_m^2 / 2$ is greatly reduced, the calorific value of the friction material of the clutch is reduced, the abrasion of the friction material is slowed down, and the service life is prolonged.

[0024] (2) The driving source of engaging and braking of the clutch and the brake adopts a hydraulic transmission mode, and its transmission energy utilization and load stability are significantly higher than those of pneumatic transmission, and the supply of the hydraulic pressure energy can be achieved by directly equipping a hydraulic pump station on the press. Thus the pipeline is simple, the occupied area is small, and no high-noise pneumatic compressor is required, which makes the engagement of clutch and the braking of the brake sensitive, the noise low, the vibration small, and the use and maintenance convenient.

[0025] (3) During the engagement and braking processes of the clutch and the brake a hydraulic transmission driving mode is adopted, so that the engagement process of the clutch and the braking process of the brake are stable in terms of action and strong in

terms of action responsiveness, and the faults of congestion or brake failure and the like caused by the clutch and the brake are greatly avoided; a hydraulic mode is adopted, so that the phenomena of noise pollution, environmental pollution and the like are avoided in the working process of the clutch and the brake, and the physical and psychological health of workers is protected to a certain extent.

[0026] (4) The action sources of the clutch and the brake do not move along with the crankshaft, thus there is no need to machine the center air hole in the crankshaft, a rotary joint does not need to be adopted, and the structure is simple, the strength and the rigidity of the crankshaft are improved, the transmission path of the hydraulic medium is short, the leakage amount is reduced, and the energy utilization rate is improved.

[0027] (5) The friction clutch-friction brake is integrally arranged at the outer side of the flywheel and the outer side of the machine body and at one end of the crankshaft, the brake is arranged at the outermost side, thus the clutch and brake has good heat dissipation, the working condition is greatly improved, the flywheel does not need to be disassembled when replacing wearing parts such as a sealing ring and friction materials, and the like, and the maintenance is convenient.

BRIEF DESCRIPTION OF THE DRAWINGS

[0028] Fig. 1 is a front view of the present disclosure.

[0029] Fig. 2 is a left side view of fig. 1.

[0030] Fig. 3 is a sectional view taken along the line A-A of Fig. 1.

[0031] Fig. 4 is a partial view of Fig. 1.

[0032] Fig. 5 is a partial view of mounting positions of parts on the crankshaft 15 of Fig. 4.

[0033] Fig. 6 is a partial view of mounting positions of parts on the guiding connection shaft 13 of Fig. 3.

[0034] Fig. 7 is a schematic view of an assembling structure of the second driven disc 8 of the clutch and mounting parts thereof.

[0035] Fig. 8 is a schematic view of the assembling structure of the brake driving disk 10 and its related parts.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0036] The disclosure is described in detail below with reference to the accompanying drawings and embodiments.

[0037] Referring to Figs. 1, 2 and 3, the friction clutch and friction brake assembly with low inertia of driven system for the mechanical press comprises a press body formed by an upper lateral beam 17, a upright post 18 and a base 19 connected to one another, wherein the press body is connected with a transmission system 16 composed of a crankshaft 15 and accessories of the crankshaft, and a hydraulic pipeline system composed of a hydraulic valve switch 20, an oil pump 21, an oil pipe 22 and the like; the friction clutch, the friction brake and a flywheel 4 are structurally integrated into one piece and are positioned on the outer side of the press body, wherein the friction brake is positioned on the outermost side, the friction clutch is positioned in the middle, and the flywheel 4 is positioned near the press body, the friction clutch and the friction brake

being provided with an interlocking structure; the upper lateral beam 17 is provided with a driving motor 1, the driving motor 1 drives a small belt wheel 2 to move through a key, and the small belt wheel 2 drives the flywheel 4 to move through the belt 3.

[0038] Referring to Figs. 4 and 5, a flywheel 4 and a clutch-brake support sleeve 14 are mounted on the crankshaft 15, the flywheel 4 is fixedly connected with a clutch driving disc 6, and the crankshaft 15 is connected with the flywheel 4 through a seventh bearing 4-2 and an eighth bearing 4-4; the crankshaft 15 is fixedly connected with the clutch-brake support sleeve 14 through an expansion sleeve 15-2; the flywheel 4 is axially positioned on the crankshaft 15 through a fourth sleeve 15-4; the clutch-brake support sleeve 14 is axially positioned on the crankshaft 15 through a fifth sleeve 15-3; the clutch-brake support sleeve 14 is axially fixed by a first end cap 15-1.

[0039] A second end cap 4-1 is arranged on one side of the flywheel 4 and a third end cap 4-5 is arranged on the other side of the flywheel 4, the positions of the outer diameters of the seventh bearing 4-2 and the eighth bearing 4-4 are fixed by the second end cap 4-1 and the third end cap 4-5, and the positions of the inner diameters of the seventh bearing 4-2 and the eighth bearing 4-4 are fixed by a sixth sleeve 4-3.

[0040] Referring to Figs. 2, 3, 4, 6, and 7, the friction clutch includes a clutch driving disc 6, a clutch first driven disc 7 arranged on one side of the clutch driving disc 6 and a clutch second driven disc 8 arranged on the other side of the clutch driving disc 6; a first bearing 6-1 is installed in a circumferential array of six through holes arranged on a clutch driving disc 6, the clutch driving disc 6 is connected with a first bolt 5 through the first bearing 6-1, the clutch driving disc 6 can be slidable on the first bolt 5, and the first bolt 5 is fixedly arranged on the flywheel 4;

[0041] Twelve rib plates are arranged on one side of a clutch second driven disc 8, the clutch second driven disc 8 is connected with a first sleeve 8-2, the end of the first sleeve 8-2 is fixedly connected with a clutch connecting plate 8-3, a circumferential array of through holes is formed in the clutch connecting plate 8-3, and a sixth bearing 8-4 is arranged on the through holes; the clutch second driven disc 8 is in contact with the flywheel 4 through the second bearing 4-6 and is rotatable, the friction clutch and the flywheel 4 are integrated into one piece.

[0042] Referring to Fig. 6, a first friction disc 6-2 is bonded to one side of the clutch driving disc 6 and a second friction disc 6-3 is bonded to the other side of the clutch driving disc 6; a third friction disk 7-2 is bonded on one side of the clutch first driven disk 7 and a fourth friction disk 7-3 is bonded on the other side of the clutch first driven disk 7; a fifth friction disk 8-1 is bonded on one side of the clutch second driven disk 8; the first friction disk 6-2 and the fourth friction disk 7-3 form a friction pair; the second friction disk 6-3 and the fifth friction disk 8-1 form a friction pair.

[0043] Referring to Figs. 2, 3, 4, 6 and 8, the friction brake includes a brake driving disc 10, a brake first driven disc 11 and a brake second driven disc 12; six small-sized hydraulic cylinders are reserved on the brake driving disc 10, dust-proof sealing rings 10-7 are mounted on the edges of the small-sized hydraulic cylinders, each small-sized hydraulic cylinder is equipped with two hydraulic pistons 10-6, hydraulic sealing rings 10-8 are installed on the hydraulic pistons 10-6, and self-lubricating guiding plates 10-9 are installed on the outer faces of the hydraulic pistons 10-6; the oil pump 21 delivers a

hydraulic medium to the six small-sized hydraulic cylinders of the brake driving disc 10 through an oil pipe 22 to push the hydraulic pistons 10-6 to move, and the hydraulic medium is regulated through the hydraulic valve switch 20; the brake driving disc 10 is connected with the second bolt 9 through a third bearing 10-1, the brake driving disc 10 can be slidable on the second bolt 9, and the second bolt 9 is fixedly connected with the upper lateral beam 17 or the upright post 18 through a flange limiting sleeve 9-1.

[0044] A sixth friction disk 10-2, a seventh friction disk 10-3, an eighth friction disk 10-4 and a ninth friction disk 10-5 of the brake driving disk are respectively bonded on two sides of the brake driving disk 10; a second sleeve 11-1 is installed on the circumferential array of six through holes of the brake first driven disc 11, the second sleeve 11-1 is provided with a fourth bearing 11-4, and a tenth friction disk 11-2 and an eleventh friction disk 11-3 are bonded on one side of the brake first driven plate 11; a twelfth friction disk 12-1, a thirteenth small friction disk 12-2 and a fourteenth friction disk 12-3 are respectively bonded to two sides of a brake second driven disk 12; the fourteenth friction disk 12-3 and the third friction disk 7-2 form a friction pair; the twelfth friction disk 12-1, the thirteenth small friction disk 12-2, the eighth friction disk 10-4 and the ninth small friction disk 10-5 form a friction pair; the sixth friction disk 10-2, the seventh friction disk 10-3, the tenth friction disk 11-2 and the eleventh friction disk 11-3 form a friction pair.

[0045] Referring to Figs. 2, 3, 4 and 5, the interlocking structure of the friction clutch and friction brake includes: the brake first driven disc 11 is welded with the clutch-brake support sleeve 14 and the third sleeve 14-1, the clutch connecting plate 8-3 is welded with the clutch-brake support sleeve 14 and the third sleeve 14-1, so that the brake first driven disc 11 is fixedly connected with the clutch connecting plate 8-3, and the friction clutch and the friction brake are integrated into one piece;

[0046] The friction clutch and the friction brake are rigidly interlocked through a guiding connection shaft 13, a second sleeve 11-1 of a first driven disc 11 of the brake is connected with the guiding connection shaft 13 through a fourth bearing 11-4, and the brake first driven disc 11 can be slidable on the guiding connection shaft 13; the brake disc second driven disc 12 is connected with the guiding connection shaft 13 and fixedly connected with the step of the guiding connection shaft 13 through a second round nut 13-4; the clutch first driven disc 7 is connected with the guiding connection shaft 13 through a fifth bearing 7-1 installed on the circumferential array of through holes of the clutch first driven disc 7, and the clutch first driven disc 7 can be slidable on the guiding connection shaft 13; a first sleeve 8-2 and a clutch connecting plate 8-3 of a clutch second driven disc 8 are connected with a guiding connection shaft 13 through a sixth bearing 8-4, and the clutch second driven disc 8 can be slidable on the guiding connection shaft 13; the guiding connection shaft 13 is axially fixed through a brake spring 13-3, a baffle 13-2 and a first round nut 13-1; the clutch-brake support sleeve 14 is fixedly connected with the crankshaft 15 by means of an expansion sleeve 15-2.

[0047] The guiding connection shaft 13 is sequentially connected with a first round nut 13-1, a spring baffle 13-2, a compression spring 13-3, a fourth bearing 11-4, a second round nut 13-4, a brake second driven disc 12, a fifth bearing 7-1 and a sixth bearing 8-4 from left to right.

[0048] Referring to Figs. 4, 5 and 6, a brake first driven disc 11 is welded with the left end of the clutch-brake support sleeve 14, a clutch connecting plate 8-3 is welded with the right end of the clutch-brake support sleeve, the clutch connecting plate 8-3 is connected with the first sleeve 8-2 through bolts, the first sleeve 8-2 is welded with the clutch second driven disc 8, and therefore, the brake first driven disc 11 is fixedly connected with the clutch second driven disc 8 and is reinforced by welding a third sleeve 14-1, and the friction clutch and the friction brake are integrated into one piece.

[0049] Referring to Fig. 4, six first bearings 6-1 installed in the circumferential array of the clutch driving disc 6 connect the friction clutch with the flywheel 4 together through six first bolts 5 fixedly installed on the flywheel 4 and distributed in a circumferential array, and the clutch driving disc 6 can move on the first bolts 5, and the first bolts 5 are prevented from loosening by the third round nut 5-1; a first sleeve 8-2 on the clutch second driven disc 8 is in contact with a second bearing 4-6 mounted on the flywheel 4.

[0050] Referring to Figs. 2, 3 and 4, three third bearings 10-1 of a brake driving disc 10 of the friction brake connect the brake driving disc 10 with the press body through one second bolt 9 fixed on the upper lateral beam 17 of the body and two second bolts 9 fixed on an upright post 18 of the body, wherein the brake driving disc 10 can move on the second bolts 9, and the positions of the second bolts 9 are fixed through a limiting flange 9-1.

[0051] The working principle of the present disclosure is as follows:

[0052] During the working stroke of the mechanical press, the friction brake is disengaged, and then the friction clutch is engaged; hydraulic medium in an oil pump 21 is injected into a small piston cylinder in a brake driving disc 10 of the friction brake at high pressure through an oil pipe 22 and a hydraulic valve switch 20, firstly, the hydraulic medium pushes two pistons 10-6 to move away from each other, a brake spring 13-3 is compressed, a friction pair between a brake first driven disc 11 and the brake driving disc 10 is forced to be disengaged, a friction pair between a brake second driven disc 12 and the brake driving disc 10 is disengaged, and then they are released; secondly, the pistons 10-6 still continue to move away from each other to push the brake second driven disc 12, so that the friction pair between the clutch first driven disc 7 and the clutch driving disc 6 is forced to be engaged, the friction pair between the clutch driving disc 6 and the clutch second driven disc 8 is engaged and pressed, and the clutch is engaged; finally, the rotational motion of the flywheel 4 is transmitted to the clutch first driven disc 7 and the clutch second driven disc 8 through the clutch driving disc 6 by using the friction force generated by the friction pair in the friction clutch, so as to drive the friction clutch and friction brake assembly to rotate, and the rotational motion is transmitted to the crankshaft 15 through the clutch-brake support sleeve 14 and the expansion sleeve 15-2, so as to drive the crankshaft 15 and the flywheel 4 to rotate at the same speed.

[0053] After the mechanical press has finished working, the friction clutch is disengaged, and then the friction brake is engaged; the oil pump 21 is turned off, the hydraulic medium is no longer supplied and injected to the small piston cylinder of the brake driving disc 10 anymore, the hydraulic medium is gradually recovered into the oil pump 21, and at the moment, the braking spring 13-3 provides braking force; under the condition that the engagement force provided by hydraulic pressure is not available, the elastic deformation

of the brake first driven disc 11 is gradually recovered, the compression amount of the brake spring 13-3 is gradually reduced, the length of the brake spring 13-3 is gradually extended, the guiding connection shaft 13 is pushed to gradually move leftwards, and the second driven disc 12 of the brake is driven to also gradually move leftwards, and then the pistons 10-6 are forced to move toward each other; in the process, the friction pair between the brake second driven disc 12 and the clutch first driven disc 7 is disengaged firstly, and then the friction pair between the clutch first driven disc 7 and the clutch driving disc 6 is disengaged, the friction pair between the clutch driving disc 6 and the clutch second driven disc 8 is disengaged, and the clutch is disengaged completely; after the clutch is completely disengaged, the compression amount of the brake spring 13-3 is still continuously reduced, the length of the brake spring 13-3 is still gradually extended, the guiding connection shaft 13 is continuously pushed to gradually move leftwards, the brake second driven disc 12 is driven to continuously and gradually move leftwards, then the pistons 10-6 are forced to move toward each other, here, the friction pair between the brake second driven disc 12 and the brake driving disc 10 is firstly engaged, the friction pair between the brake driving disc 10 and the first driven disc 11 is engaged and pressed afterward, the friction pair of the brake is completely engaged, and the crankshaft realizes braking.

WHAT IS CLAIMED IS:

1. A friction clutch and friction brake assembly with low inertia of driven system for a mechanical press, comprising a press body, wherein, the press body is connected with a transmission system composed of a crankshaft (15) and accessories of the crankshaft; a flywheel (4) and a clutch-brake support sleeve (14) are mounted on the crankshaft (15), and the clutch-brake support sleeve (14) is connected with a friction clutch and a friction brake; the friction clutch and the friction brake are provided with a rigid interlocking structure, the friction clutch and the friction brake are connected with a hydraulic piping system; the flywheel (4) is driven to move by a driving motor (1), the flywheel (4) is rotatable independently on the crankshaft (15), and the friction clutch and friction brake are configured to control movement and stop of the crankshaft (15).

2. The friction clutch and friction brake assembly with low inertia of driven system for a mechanical press according to claim 1, wherein, the friction clutch comprises a clutch driving disc (6), a clutch first driven disc (7) arranged on one side of the clutch driving disc and a clutch second driven disc (8) arranged on another side of the clutch driving disc; first bearings (6-1) are installed in a circumferential array of through holes arranged on the clutch driving disc (6), the clutch driving disc (6) is connected with first bolts (5) through the first bearings (6-1), and the clutch driving disc (6) is slidable on the first bolts (5), the first bolts (5) are fixedly arranged on the flywheel (4); the clutch second driven disc (8) is in contact with the flywheel (4) through a second bearing (4-6) and is rotatable, and the friction clutch and the flywheel (4) are integrated into one piece.

3. The friction clutch and friction brake assembly with low inertia of driven system for a mechanical press according to claim 2, wherein, the friction brake comprises a brake driving disc (10), a brake first driven disc (11), and a brake second driven disc (12); more than three small-sized hydraulic cylinders are reserved on the brake driving disc (10), each small-sized hydraulic cylinder is provided with two hydraulic pistons (10-6); the brake driving disc (10) is connected with a second bolt (9) through a third bearing (10-1), and the brake driving disc (10) is slidable on the second bolt (9), and the second bolt (9) is fixedly connected with an upper lateral beam (17) or a upright post (18).

4. The friction clutch and friction brake assembly with low inertia of driven system for a mechanical press according to claim 3, wherein, an oil pump (21) delivers hydraulic medium into the small-sized hydraulic cylinders to push the hydraulic pistons (10-6) to move and is regulated by a hydraulic valve switch (20).

5. The friction clutch and friction brake assembly with low inertia of driven system for a mechanical press according to claim 3, wherein, the interlocking structure of the friction clutch and the friction brake comprises: the brake first driven disc (11) is connected with one end of the clutch-brake support sleeve (14) and one end of a third sleeve (14-1), and a clutch connecting plate (8-3) is connected with another end of the clutch-brake support sleeve (14) and another end of the third sleeve (14-1), so that the brake first driven disc (11) is fixedly connected with the clutch connecting plate (8-3), and the friction clutch and the friction brake are integrated into one piece; the friction clutch and the friction brake are rigidly interlocked through a guiding connection shaft (13), a second sleeve (11-1) of the brake first driven disc (11) is connected with the

guiding connection shaft (13) through a fourth bearing (11-4), and the brake first driven disc (11) is slidable on the guiding connection shaft (13); the brake second driven disc (12) is connected with the guiding connection shaft (13) and is fixedly connected with a step of the guiding connection shaft (13) through a second round nut (13-4); the clutch first driven disc (7) is connected with the guiding connection shaft (13) through fifth bearings (7-1) installed on the circumferential array of through holes of the clutch first driven disc (7), and the clutch first driven disc (7) is slidable on the guiding connection shaft (13); a first sleeve (8-2) and a clutch connecting plate (8-3) of the clutch second driven disc (8) are connected with the guiding connection shaft (13) through sixth bearings (8-4) installed on the circumferential array of through holes on the clutch connecting plate (8-3), and the clutch second driven disc (8) is slidable on the guiding connection shaft (13); the guiding connection shaft (13) is axially fixed through a brake spring (13-3), a baffle (13-2), and a first round nut (13-1); the clutch-brake support sleeve (14) is fixedly connected with the crankshaft (15) by an expansion sleeve (15-2).

6. The friction clutch and friction brake assembly with low inertia of driven system for a mechanical press according to claim 1, wherein, the friction clutch, the friction brake and the flywheel (4) are structurally integrated into one piece and are located on an outer side of the press body, wherein the friction brake is located on the outermost side, the friction clutch is located in the middle and the flywheel (4) is located near the press body.



Application No: GB2205044.7

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Claims searched: 1 to 6

Date of search: 19 October 2022

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X,Y	X: 1 and 6; Y: 2 to 5	CN 201310583 Y (YANGZHOU METALFORMING MACH GR) see figures and EPODOC abstract.
X,Y	X: 1 and 6; Y: 2 to 5	GB 2337017 A (MINSTER MACHINE CO) see figures and, for example, lines 11 to 14, page 1 and line 20, page 9 to line 10, page 10.
X,Y	X: 1 and 6; Y: 2 to 5	GB 1262640 A (TAYLOR) see figures and, especially, lines 15 to 66, page 2.
X,Y	X: 1 and 6; Y: 2 to 5	US 2180218 A (WISSMAN) see figures and, in particular, lines 28 to 32 and lines 15 to 26, page 1.
X,Y	X: 1 and 6; Y: 2 to 5	US 2636581 A (BITLER) see figures and, for example, lines 4 to 10, column 7.
Y	2 to 5	CN 204004090 U (WUXI INST TECHNOLOGY) see figures and EPODOC abstract.
Y	2 to 5	CN 202690841 U (WUXI INST TECHNOLOGY) see figures and EPODOC abstract.
Y	2 to 5	CN 202628899 U (SHANGHAI YUYI MACHINERY CL LTD) see figures and EPODOC abstract.
Y	2 to 5	CN 213006755 U (QUZHOU DEMAIKE PREC MACHINERY CO LTD) see figures and EPODOC abstract.

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.



Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^X :

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Worldwide search of patent documents classified in the following areas of the IPC

B30B; F16D

The following online and other databases have been used in the preparation of this search report

WPI, EPODOC

International Classification:

Subclass	Subgroup	Valid From
F16D	0067/04	01/01/2006
B30B	0015/10	01/01/2006
B30B	0015/12	01/01/2006