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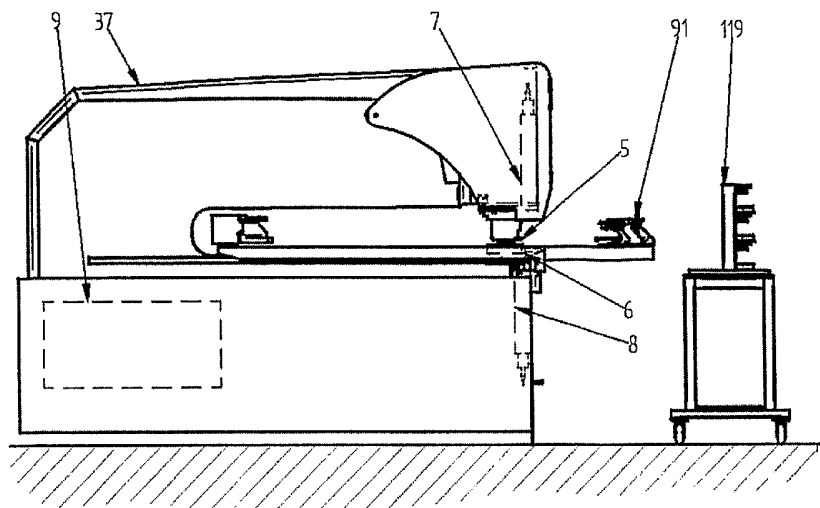
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(54) Title: PUNCH PRESS WITH UNIVERSAL ROTARY HEAD



(57) Abstract: A punch press with a universal rotary head, consisting of a frame with a drive, an upper case, composed of a slide with a punch, a basket, an attachment to the frame of the machine and the drive, a lower case, composed of a bed with a die, a base, a guiding table and a drive, a tool magazine, a loading jig, and of a control unit; the drive (7) of the upper case (5) consists of a motor (30) with a gearbox and a belt gear, which is composed of a gear wheel (56) fitted on the slide (3), a gear wheel (21) fitted on the motor (30) and a toothed belt (90); the drive (8) of the lower case (6) consists of a motor (31) with a gearbox and a belt gear, which is composed of a gear wheel (70) fitted in the bed (4), a gear wheel (84) of the motor (31) and a toothed belt (80), the rotary movement of the slide (3) with the punch (1) fitted in the upper case (5) being ensured by a drive (7) independent of the drive (8) for the rotary movement of the bed (4) with the die (2) fitted in the lower case (6); rotary movements of the slide (3) with the punch (1) and of the bed (4) with the die (2) are controlled by the control unit (9).



For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Punch press with universal rotary head**Technical Area**

The invention concerns a punch press with a universal rotary head, consisting of a frame with a drive, an upper case, composed of a slide with a punch, a basket, an attachment of the machine frame and the drive, a lower case, composed of a bed with a die, a base, a guiding table and a drive, a tool magazine, a loading jig and a control unit.

Existing State of Technology

Currently, many various designs of punch presses are known that serve for machine punching of various materials. All punch machines use a tool composed of a punch and a die.

A punch press with a frame, a punched material guide, a ram guide and punch and die clamping fitted therein with bands of punched material passing under the ram, which is punched or cut with a tool shaped to exactly copy the shape of the punching, is among the oldest known designs. Such punch press can be arranged in a line where several punch heads are lined next to each other so that it is possible to punch several shapes in a single pass of material through the punch line. One disadvantage of such a layout is its large external size. One big disadvantage is then, considering that each tool is specific and cannot be changed quickly and easily, its low production flexibility. Therefore, such punch press or punch line can be used for the production of large quantities of simple shape punchings.

The punch press described in US4,412,469 offers a more flexible production layout: the described punch has a set of tools with various punch and die shapes arranged in a carousel manner in the upper and bottom part. These tools are turned into working positions as necessary. At the same time, they can be turned while in the working position to cut openings with various punch and die turning. Turning is performed by means of stepping motors. One disadvantage of such an arrangement is the rather complicated design of the carousel and individual tool drives. Considering that turning is carried out by means of relatively complicated gear mechanisms, geometric inaccuracies are read in these gears, which results in inaccuracies in the angle turning of the punch and the die. This causes quick wear and tear of the punch and the die and inaccuracies in punched products. With a

relatively large number of gears, it is necessary to overcome big inertial masses in the gears. Inaccuracies resulting therefrom are difficult to correct by the machine control system, which results in further inaccuracies in the tool synchronism.

The US 4,869,141 describes a solution that ensures relatively precise punching of individual punchings and it is possible to operatively change the punch tool. The punch press under this patent is composed of a machine frame, which serves as a base for the work surface and where a ram head with a clamped punch above the work surface and a die under the work surface are mounted. The work surface moves in the X-Y coordinate system. The punch moves against the die along the vertical axis, which is perpendicular to the base and crosses the work surface, thus punching individual punchings.

The punch is safely clamped in the clamping system at the bottom of the ram. The die is mounted in a die holder. The bottom of the ram and the die holder are mounted so that they can rotate along their axes but at the same time they safely clench, despite their rotation.

The control of the punch and die rotary movement is mounted in the machine frame. The control consists of a drive with gears, a pair of control rods with toothed ends, one of them controlling the ram with the punch and the other the die holder. The drive is connected to one end of the control rods. The ram with the punch or the die holder is connected via gearing to the other end. A single drive controls the ram and die holder rotation. The drive along with the work surface movement is controlled by the control system, thus ensuring relatively productive manufacturing of punchings of complicated shapes using a single punch and a single die. The movement of the punch as well as the movement of the die are mechanically connected so that after being set up, the press can very precisely punch individual punchings.

The punch press is completed with a change system, which enables tools to be changed. The change system can be controlled manually or can be placed on the manipulator arm and be automatic.

The punch in the ram and the die in the holder are clamped by means of a hydraulic clamping system.

The punch press under this patent enables productive manufacturing of punchings; in addition, due to the very precise setting and mechanical coupling of rotary movement of the punch and the die, tools are subject to relatively low wear.

One disadvantage of this punch press is its relatively large design. The large number of precise mechanical parts is another disadvantage which considerably increases the price of this equipment. Considering the large quantity of mechanical parts controlling rotation, it is necessary to sufficiently dimension the rotation drive so that it overcomes inertial mass in the gear mechanism. Although inaccuracies in the mutual turning of tools do not occur with a punch press of this design, relatively big inertial masses requires the use of a well dimensioned drive unit.

Punch presses with rotary heads are usually completed with automatic tool change equipment. Currently, upon any change of the punch and the die, both parts of the tool are changed at the same time. Pairs of tools are prepared for such change in the tool magazine. If only the punched material thickness changes, the whole tool set must be changed. This is an inconvenient and uselessly expensive solution. Such change equipment, including a tool magazine, is described, for instance, in US 4719691. A relatively big disadvantage of this solution is its rather large magazine complicated in terms of design and production. This is inconvenient especially if the user needs to change many tool sets.

Tool clamping is currently solved using various hydraulic clamping systems. This rather complicates the design of the whole press. A pressurised oil medium must be led to the clamping system. This increases environmental risks of the whole equipment.

The objective of the invention is to solve and simplify the punch press design, in particular the design of the universal rotary head drive, to simplify the system of tool clamping and the related tool change system, including the tool magazine.

Essence of the Invention

The above-mentioned defects are, to a considerable extent, eliminated in a punch press with a universal rotary head, consisting of a frame with a drive, an upper case, composed of a slide with a punch, a basket, an attachment to the machine frame and a drive, a lower case, composed of a bed with a die, a base, a guiding table and a drive, a tool magazine and a loading jig, and of a control unit, whose essence lies in the fact that the upper case drive consists of a motor with a gearbox and a belt gear, which is composed of a gear wheel fitted on a slide, a gear wheel fitted on the motor and of a toothed belt; the lower case drive consists of a motor with

a gearbox and a belt gear, which is composed of a gear wheel fitted on the bed, a gear wheel of the motor and a toothed belt; the rotary movement of the slide with the punch fitted in the upper case is ensured by a drive independent of the drive for the rotary movement of the bed with the die fitted in the lower case; rotary movements of the slide with the punch and of the bed with the die are controlled by the control unit. Motors with a planetary gearbox can conveniently be used to drive the upper and lower cases.

The punch is fitted in the slide leaning against a semicircular groove created in the slide body and against a stone and at the same time it is forced against the slide and the stone by means of stops, an advantage being using a pair of stops. The stone fits the neck of the punch so that it axially holds the punch. The stops are pushed into the working position by leaning against the punch with their tapered ends. The stops are pushed into the working position by means of springs. As an option, they can be pushed using other means, for instance pneumatic or electric drives. Both the stops and the springs, or other types of drive, are fitted in grooves created in the slide face. The stops have a tapered groove in the middle of their face, which serves to guide the jig while changing the punch. To prevent turning, the punch is secured by a tongue placed on the upper surface of the clamping ring of the punch that fits the groove created in the slide body.

The die is fitted in the bed placed in the lower case being on a guide created in the bed hollow. To ensure a stable position, the die is secured by stops leaning against the die and pushing it against the bed walls. Conveniently, a couple of stops are used. The stops have bevelling on the front, which allows them to better fit on the die surface. The stops are fitted in grooves created in the bed body. The stops are forced into the working position by means of springs but they can also be forced using other means, for instance pneumatic or electric drives. The die is secured against turning by a tongue placed in the bed inner hollow wall. The bevelling on the upper surface of the stop serves to guide the jig while changing the die.

The gear wheel of the drive of the slide with the punch is fitted in a rotating set, with a sliding contact in the hollow between the case with a hub and a flange, being pressed on an insert; washers are placed on its upper and lower side firmly fixed together by means of screws placed in holes created in the insert, the position of the set being axially defined. Tongues are fixed on the inside circumference and are fitted in grooves created on the slide upper surface.

The motor of the drive with the planetary gearbox and the motor gear wheel is firmly fitted in an adjustable holder placed in a groove created in the upper surface of the flange, which is firmly fixed to the lower part of the base plate; a stone is attached to the flange lower surface, which serves as the base to lean the tightening mechanism placed on the lower surface of the holder.

The gear wheel of the drive of the bed with the die is fitted by sliding it on the sleeve placed on the hub and, at the same time, it axially leans against a hardened washer fitted on the flange which leans against the hub shoulder, being axially secured by means of a barrier attached by means of screws to the hub.

The motor of the drive with the planetary gearbox and the gear wheel of the drive of the bed with the die is attached to a holder placed in the flange, the toothed belt tension being ensured by means of a tightening mechanism composed of a tightener and a screw.

The control unit controls rotary movement of the slide with the punch so that after evaluating information on the position of the slide with the punch supplied by a sensor and information on zero pulse of the incremental rotary sensor of the drive motor, it determines the reference position of turning of the slide with the punch.

The sensor placed on the base plate monitors the edge of a target attached on the upper washer of the gear wheel.

The control unit controls rotary movement of the bed with the die so that after evaluating information on the position of the bed with the die supplied by a sensor and information on zero pulse of the incremental rotary sensor of the drive motor, it determines the reference position of turning of the bed with the die.

The sensor that detects the leading edge of the hole created in the bed is fitted in the holder attached to the flange.

To simplify jig loading while changing the punch and the die, a guiding table is attached to the flange fitted in the lower part by means of screws.

The loading jig consists of a holder, an upper part for punch change, a lower part for die change and a control mechanism.

The upper part consists of an upper stop, a right upper jaw, a left upper jaw, an upper work pushpin, a right middle jaw and a left middle jaw. The right upper jaw and the left upper jaw are firmly fitted in the upper stop, where the upper pushpin is also movably fitted. The right middle jaw and the left middle jaw rotate in the upper part on pivots. While changing the punch, the middle jaws clamp the clamping ring of

the punch by entering the grooves in the side of the clamping ring. The middle jaws are opened by means of springs and pushed into the working position by the leading edge of the control mechanism. The upper jaws release the stops in the slide and enable the punch to be loaded and removed. The upper pushpin forces the punch while it is being loaded and ensures that the punch is not pulled out of the slide.

A lower plate is firmly attached to the lower part where a circular cut is made. In the lower part, the lower pushpin is movably fitted and an arm is fitted on the pivot controlled by the control mechanism. The lower pushpin pushes the die while it is being loaded and ensures that the die is not pulled out of the bed.

The control mechanism consists of a control, a tongue, an arresting screw, pushpins and forcing springs where the control pushes the middle jaws into the working position by means of leading edges via the pushpins; the arresting screw fixed in the control pushes the arm into the working position via a set screw, the stopping of the control in the working position being ensured by the tapered part of the tongue.

If tools are changed manually, the holder is terminated with a handle.

If tools are loaded automatically, the holder is attached to the handling equipment and the control mechanism independently controls the upper part, which serves to clamp the punch, and the lower part, which serves to clamp the die.

The tool magazine is arranged in the following way: 1 to 3 dies with different sizes of cutting clearance are assigned to one punch.

The overall layout of the punch press with a universal rotary head has numerous advantages compared to the existing status. The system of drives, whose movement is controlled by the control system, is totally unique. Since the drives are independent of each other, the mutual mechanical interconnection of the upper and lower case drives, which in the past was solved by complicated gear mechanisms, is thus not necessary. This considerably simplifies the whole design. Concurrently, it enables the total input of the whole punch press to be reduced. By removing complicated gear mechanisms, the operation of the machine will also become more precise since inertial masses acting in the entire system of head rotation drive will be significantly reduced. Another very important advantage is the simplification of the punch and die clamping, which enables not only a fast change of tools but also very precise clamping of the tool. Considering the fact that clamping uses only mechanical clamping elements, problems related to the supply of a pressurised oil medium are

eliminated, which significantly simplifies the whole design. To use the tool magazine where more dies with different sizes of cutting clearance are assigned to one punch is economically very convenient as well. This enables great space savings by reducing the size of the tool magazine, important tooling cost reduction and in particular, time savings upon tool change and preparation.

Due to all the above-mentioned modifications, the price of the whole punch press is reduced substantially, power consumption being lower as well. This also increases the use value of the punch press to a considerable extent. Although the new design represents an inseparable whole, it is possible to independently use the design of the drive of the punch and the die, tool clamping with the loading jig and the tool magazine arrangement. The new drive of the punch and the die with a new system of tool clamping and a new loading jig can also be installed on punch presses that have been designed for non-rotating tools. Considering the fact that these punch presses usually belong to lower price categories, their use value will increase, against a minimum price increase, by using the above. This will also enable manufacturing costs related to these machines to be reduced.

List of Figures in the Drawing

The invention will further be explained by means of the enclosed drawings representing the following: fig. 1 punch press with the description of basic parts, fig. 2 universal rotary head in section, fig. 3 tool magazine, fig. 4 upper case in section, fig. 5 upper case viewed from the ground plan, fig. 6 lower case in section, fig. 7 ground floor view of the upper case, fig. 6 lower case section, fig. 7 ground floor view of the lower case, fig. 8 punch clamping mechanism in section, fig. 9 schema of the control mechanism of the loading jig, and fig. 10 loading jig in section.

Technical Design Examples

The punch press with a universal rotary head consists of a frame 37 with a drive, an upper case 5, a lower case 6, a tool magazine 119, a loading jig 91 and a control unit 9.

The upper case 5 is composed of an attachment to the frame 37 of the machine, a slide 3, a punch 1, a basket 34 and a drive 7. The lower case 6 is composed of a base 35, a bed 4 with a die 2, a guiding table 36 and a drive 8.

The drive 7 of the upper case 5 consists of a motor 30 with a planetary gearbox and a belt gear, which is composed of a gear wheel 56 fitted on a slide 3, a gear wheel 21 fitted on the motor 30 and a toothed belt 90. The drive 8 of the lower case 6 consists of a motor 31 with a planetary gearbox and a belt gear, which is composed of a gear wheel 70 fitted on a bed 4, a gear wheel 84 of the motor 31 and a toothed belt 80.

The turning of the punch 1 and the die 2 is ensured by the drives 7, 8, which are controlled by a control unit 9 of the machine. The rotary movement of the slide 3 with the punch 1 fitted in the upper case 5 is ensured by the drive 7 independent of the drive 8 for the rotary movement of the bed 4 with the die 2 fitted in the lower case 6, rotary movements of the slide 3 with the punch 1 and of the bed with the die 2 being controlled by the control unit 9.

The control unit 9, after evaluating information on the position of the slide 3 with the punch 1 supplied by a sensor 32 and information on zero pulse of the incremental rotary sensor of the drive motor 7, determines the reference position of turning of the slide 3 with the punch 1 and controls the rotary movement of the slide 3 with the punch 1.

The control unit 9, after evaluating information on the position of the bed 4 with the die 2 supplied by a sensor 33 and information on zero pulse of the incremental rotary sensor of the drive motor 8, determines the reference position of turning of the bed 4 with the die 2 and controls the rotary movement of the bed 4 with the die 2.

The upper case 5 is composed of an attachment to the machine frame 37, a slide 3, a punch 1, a basket 34 and a drive 7.

The upper case 5 is attached to the machine as follows: the basket 34 is attached to the machine frame 37 and the slide 3 is attached to a hydraulic cylinder 38.

The basket 34 is attached to the machine frame 37 by means of a base plate 39: the base plate 39 is firmly attached by means of screws 40 to a prism 41 and an adapter 42. To ensure the mutual position, the base plate 39 and the prism 41 are pegged together. The prism 41 is firmly attached, using tongues and screws, to the

upper part of the machine frame 37. The adapter 42 is firmly fitted in the hollow of the upper part of the machine frame 37. To ensure the mutual position, the prism 41 and the upper part of the machine frame 37 are pegged together.

The slide 3 is attached to the hydraulic cylinder 38 by being screwed on a pivot 43, which is fitted by sliding it between a plate 44, a sensor holder 45 and the hydraulic cylinder 38, so that the pivot 43 and the slide 3 can freely rotate.

A system of air and lubricant distribution is conducted to the plate 44, air and lubricants being led from the plate 44 via a check ring 46 to the slide 3.

The check ring 46 is pressed into the upper part of the slide 3 that fits the pivot shoulder 43, defining the depth of the pivot 43 screwing; at the same time, channels 47 are created here for the distribution of air and lubricants.

The basket 34 is a part of the upper case that is fixed, does not rotate and serves to guide the slide 3 with the punch 1 and to fit the drive for the rotary movement of the slide 3.

The basket 34 is attached to the machine frame 37 by means of the base plate 39. The base plate 39 also carries a sensor 32 placed in a holder 48 that detects the leading edge of a target 49 and by means of zero pulse of the incremental rotary sensor of the motor drive 7, it determines the reference position of turning of the slide 3 with the punch 1. A flange 50 is firmly attached to the bottom of the base plate 39. An adjustable holder 52 of the drive 7 is fitted in a groove 51 created in the upper surface of the flange 50. The drive 7 is firmly fitted in the holder 52 of the drive 7. A stone 53 is attached to the lower surface of the flange 50, which serves as the base to lean a tightening mechanism 54 placed on the lower surface of the holder 52 of the drive 7 designed to precisely set the position of the holder 52 of the drive 7.

The gear wheel set 56 is fitted in the hollow between the case 55 with a hub and the flange 50; the gear wheel 56 is pressed on an insert 57 of the gear wheel 56 and washers 58 of the gear wheel 56 are placed on its upper and lower side. The washers 58 are fixed together by means of screws 59 placed in holes created in the insert 57 of the wheel. There are tongues 60 on the inside circumference of the insert 57 of the gear wheel 56 that are fitted in grooves 61 created in the external surface of the slide 3. The tongues 60 enable the rotary movement ensured by the drive 7 to be transmitted to the rotary movement of the slide 3. The gear wheel set 56 rotates, with a sliding contact, in the hollow between the case 55 with a hub and the

flange 50. There is a toothed belt 90 on the gear wheel 56. A target 49 is attached to the upper washer 58 of the gear wheel 56 whose edge is monitored by the sensor 32 placed on the base plate 39. The gear wheel set 56 is axially determined by a distance piece.

A stripper 63 is placed in the lower part of the case 55 with a hub, which serves to strip sheet metal from the punch 1.

A check ring 46 is pressed into the upper part of the slide 3 and fits the pivot shoulder 43; at the same time, channels 47 are created here to distribute air and lubricants. The outside circumference of the slide 3 has grooves 64 to distribute lubricants and grooves 61 for tongues 60 fitted in the insert 57 of the gear wheel 56. The lubricant is led to the grooves 64 on the outside circumference of the slide 3 by means of channels created in the body of the slide 3. The air is led using a system of channels to the slide 3. The air opening leads to the place where the punch 1 is loaded. Using information from the pressure sensor, the control unit 9 evaluates the accuracy of loading of the punch 1 into the slide 3.

The punch 1 is placed in the lower part of the slide 3. The punch 1 is fitted in the centre of the slide 3 and leans against a semicircular groove created in the body of the slide 3, being also pushed by stops 10. The stone 11 fits the neck 13 of the punch 1, thus holding it axially. The stops 10 lean against the punch 1 with their tapered parts 14. The stops 10 are pushed into the working position by means of springs 15. The stops 10 and the springs 15 are fitted in grooves 16 created in the front of the slide 3. The stops 10 have a groove 17 in the centre of their front with a tapered part 18 that serves to guide the jig while changing the punch 1. To prevent turning, the punch 1 is secured by a tongue 19 placed in the upper surface of the clamping ring 20 of the punch 1 that fits the groove created in the body of the slide 3.

The front of the slide 3 is arranged in the following way: the body 65 attached to the front of the slide 3 by means of screws 66 closely fits the stone 11 placed in the groove created in the slide front. The springs 15 fitted in grooves 16 are secured both by covers 67 fitted in the front side of the slide 3 and by covers 68 that close the grooves 16 from the side of the slide 3.

The lower case 6 is composed of a bed 4 with a die 2, a base 35, a guiding table 36 and a drive 8.

The bed 4 where the die 2 is fitted is firmly attached by means of screws 69 to a gear wheel 70 fitted by sliding it on a hub 71. There is a sliding sleeve 72 between

the hub 71 and the gear wheel 70. The precise position of the bed 4 is determined by means of two pins 73.

The gear wheel 70 is fitted on the hub 71, axially leaning against a hardened washer 74 placed on the flange 75 that leans against the shoulder 76 of the hub 71. The flange 75 is secured on the shoulder by means of screws 77. The gear wheel 70 is axially secured by means of a barrier 78 attached by means of screws 79 to the hub 71.

The toothed belt 80 is fitted in the gear wheel 70 and the gear wheel of the motor. The drive 8 is attached to a holder 81 placed in the flange 75. The tension of the toothed belt 80 is ensured by means of a tightening mechanism composed of a tightener 82 and a screw 83.

Air and lubricants are led to the flange 75. Using a system of channels, the lubricant lubricates contact surfaces between the axial hardened washer 74 and the gear wheel 70, the radial sliding sleeve 72 and the gear wheel 70, and the bed 4 and the stops 23.

Air is led to the bed 4 using a system of channels. The air opening leads to the place where the die 2 is loaded. Using information from the pressure sensor, the control unit 9 evaluates the accuracy of loading of the die 2 into the bed 4.

The die 2 is fitted in the bed 4 on a guide 22 created in the hollow of the bed 4. The die 2 is inserted into the axis of the bed 4 via stops 23 that secure it in the axis of the bed 4: the stops keep it in a stable position by leaning against at several points. While inserting the die 2, the stops 23 fit the grooves 25. The stops 23 are pushed into the working position by means of springs 26. The stops 23 and the springs 26 are fitted in the grooves 25 created in the bed 4.

The stops 23 have bevelling 24 on the front that simplifies the insertion of the die 2. Another bevelling 29 is on the upper surface of the stop 23 that enables the jig to be easily inserted while changing die 2. The die 2 is secured against turning by a tongue 27 placed in the wall of the inner hollow of the bed 4.

To guide the jig while changing the punch 1 and the die 2, a guiding table 36 is attached to the flange 75. The guiding table 36 is attached to the flange 75 by means of screws 85.

A holder 86 of the sensor 33 is attached to the flange 75. The sensor 33 detects the leading edge of the opening 87 in the bed 4 and using zero pulse of the

incremental rotary sensor of the motor of the drive 8, it determines the reference position of turning of the bed 4 with the die 2.

The lower case 6 is fitted in the machine frame 37 on a hub 71, the machine frame 37 leaning against the shoulder 76 of the hub 71; to prevent any movement, the case is secured by a bottom ring 88 attached to the hub 71 by means of screws 89, and check screws that are part of the punch machine.

The loading jig 91 consists of a holder 92, an upper part 93 to change the punch 1, a lower part 94 to change the die 2 and a control mechanism 95.

The upper part 93 is composed of an upper stop 96, a right upper jaw 97, a left upper jaw 98, an upper pushpin 99, a right middle jaw 100 and a left middle jaw 101. The right upper jaw 97 and the left upper jaw 98 are firmly fitted in the upper stop 96. The upper pushpin 99 is also movably fitted in the upper stop 96. The right middle jaw 100 and the left middle jaw 101 are fitted in the upper part 93, rotating on pivots 102. While changing the punch 1, the middle jaws 100, 101 clamp the clamping ring 20 of the punch 1 by entering the grooves in the side of the clamping ring 20. The middle jaws 100, 101 are opened by means of springs 103 and pushed into the working position by the leading edge 62 of the control mechanism 95. The upper jaws 97, 98 release the stops 10 in the slide 3 and enable the punch 1 to be loaded and removed. The upper pushpin 99 pushes the punch 1 while it is being loaded and ensures that the punch is not pulled out of the slide 3.

A circular cut 104 is created in the lower part 94. In the lower part 94, a lower plate 105 is firmly attached, a pushpin 106 is movably fitted and an arm 107 rotates on a pivot 108. The die 2 fits the lower plate 105 and the circular cut 104 and from above it is clamped by the arm 107 whose beak 109 fits into the groove in the die 2. There is a control mechanism 95 to clamp and release the arm 107 into and from the working position. The lower pushpin 106 pushes the die 2 while it is being loaded and ensures that the die is not pulled out of the bed 4.

If loading is manual, the control mechanism 95 consists of a control 110, a tongue 111, an arresting screw 112, pushpins 113 and forcing springs 114. The control 110 pushes the middle jaws 100, 101 into the working position by means of leading edges 115 via the pushpins 99; the arresting screw 112 fixed in the control 110 pushes the arm 107 into the working position via a set screw 116. The stopping of the control 110 in the working position is ensured by the tapered part 117 of the tongue 111.

For manual loading, the holder 92 is terminated with a handle 118. As an option for automatic loading, the holder 92 is attached to the handling equipment and the control mechanism 95 independently controls the upper part 93, which serves to clamp the punch 1, and the lower part 94, which serves to clamp the die 2.

The tool magazine 119 is arranged in the following way: 1 - 3 dies 2 with different sizes of cutting clearance are assigned to one punch 1. The control unit 9 selects a punch 1 and a die 2 corresponding to the thickness of the cut material; the loading jig 91 attached to the handling equipment brings the selected tools, after removing the currently used set of tools, into the working position, or the control unit 9 selects a die 2 to the punch 1 that is clamped in the slide 3 corresponding to the thickness of the cut material and the loading jig 91 only changes the die 2.

Patent Claims

1. A punch press with a universal rotary head, consisting of a frame with a drive, an upper case, composed of a slide with a punch, a basket, an attachment to the frame of the machine and the drive, a lower case, composed of a bed with a die, a base, a guiding table and a drive, a tool magazine, a loading jig, and of a control unit, **characterised by the fact** that the drive (7) of the upper case (5) consists of a motor (30) with a gearbox and a belt gear, which is composed of a gear wheel (56) fitted on the slide (3), a gear wheel (21) fitted on the motor (30) and a toothed belt (90); the drive (8) of the lower case (6) consists of a motor (31) with a gearbox and a belt gear, which is composed of a gear wheel (70) fitted in the bed (4), a gear wheel (84) of the motor (31) and a toothed belt (80), the rotary movement of the slide (3) with the punch (1) fitted in the upper case (5) being performed by a drive (7) independent of the drive (8) creating rotary movement of the bed (4) with the die (2) fitted in the lower case (6); rotary movements of the slide (3) with the punch (1) and of the bed (4) with the die (2) are controlled by a control unit (9).
2. A punch press with a universal rotary head, under claim 1, **characterised by the fact** that the punch (1) is fitted in the slide (3) leaning against a semicircular groove (12) created in the slide body (3) and against a stone (11) and, at the same time, being pushed by stops (10); the stone (11) fits into the neck (13) of the punch (1) and the stops (10) lean against the punch (1) with their tapered parts (14).
3. A punch press with a universal rotary head, under claim 2, **characterised by the fact** that the stops (10) that have a groove (17) with a tapered part (18) in the middle of their front are pushed into the working position by means of springs (15); the stops (10) along with the springs (15) are fitted in grooves (16) created in the front of the slide (3) and the punch (1) is also secured against turning by means of a tongue (19): the tongue (19) placed on the upper surface of the clamping ring (20) of the punch (1) fits into the groove created in the body of the slide (3).
4. A punch press with a universal rotary head, under claim 1, **characterised by the fact** that the die (2) is fitted in the bed (4) placed in the lower case (6)

being on a guide (22) created in the hollow of the bed (4); to ensure a stable position, it is secured by stops (23) leaning against the die (2).

5. A punch press with a universal rotary head, under claim 4, **characterised by the fact** that the stops (23) that have bevelling (24) on the front and bevelling (29) on the upper surface (28) are fitted in grooves (25) created in the body of the bed (4) and pushed into the working position by means of springs (26); the die (2) is secured against turning by a tongue (27) placed in the wall of the inner hollow of the bed (4).
6. A punch press with a universal rotary head, under claim 1, **characterised by the fact** that the gear wheel (56) is fitted in a rotating set, with a sliding contact in the hollow between the case (55) with a hub and a flange (50), being pressed on an insert (57); washers (58) are placed on its upper and lower side firmly fixed together by means of screws (59) placed in holes created in the insert (57); tongues (60) are fixed on the inside circumference of the insert (57) and are fitted in grooves (61) created on the upper surface of the slide (3).
7. A punch press with a universal rotary head, under claim 1, **characterised by the fact** that the gear wheel (70) to which the bed (4) with the die (2) is firmly attached by means of screws (69) is fitted by sliding it on the sleeve (72) placed on the hub (71) and, at the same time, it axially leans against a hardened washer (74) fitted on the flange (75) which leans against the shoulder (76) of the hub (71), being axially secured by means of a barrier (78) attached by means of screws (79) to the hub (71).
8. A punch press with a universal rotary head, under claim 1, **characterised by the fact** that the motor (30) with the gearbox and the gear wheel (21) is firmly fitted in an adjustable holder (52) placed in a groove (51) created in the upper surface of the flange (50), which is firmly fixed to the lower part of the base plate (39); a stone (53) is attached to the lower surface of the flange (50), which serves as the base to lean the tightening mechanism (54) placed on the lower surface of the holder (52).
9. A punch press with a universal rotary head, under claim 1, **characterised by the fact** that the motor (31) with the gearbox and the gear wheel (84) is attached to a holder (81) placed in the flange (75), the tension of the toothed

belt (80) being ensured by means of a tightening mechanism composed of a tightener (82) and a screw (83).

10. A punch press with a universal rotary head, under claim 8, **characterised by the fact** that on the base plate (39) is placed sensor (32) which monitors the edge of a target (49) which is attached on the upper washer (58) of the gear wheel (56).
11. A punch press with a universal rotary head, under claim 7, **characterised by the fact** that on the flange (75) is attached holder (86) in which is fitted sensor (33) that detect the leading edge of hole (87) created in the bed (4).
12. A punch press with a universal rotary head, under claim 1, **characterised by the fact** that the guiding table (36) is attached by means of screws (85) to the flange (75).
13. A punch press with a universal rotary head, under claim 1, **characterised by the fact** that the loading jig (91) consists of a holder (92), an upper part (93), a lower part (94), and a control mechanism (95); the upper part (93) is composed of an upper stop (96), a right upper jaw (97) and a left upper jaw (98) firmly fitted in the upper stop (96), an upper pushpin (99) movably fitted in the upper stop (96), a right middle jaw (100) and a left middle jaw (101) that are opened by means of springs (103) and rotate on pivots (102) in the upper part (93), being pushed into the working position by the leading edge (62) of the control mechanism (95); in the lower part (94) where a circular cut (104) is created, a lower plate (105) is firmly attached, a lower pushpin (106) is movably fitted and an arm (107) is fitted on a pivot (108) controlled by the control mechanism (95).
14. A punch press with a universal rotary head, under claim 13, **characterised by the fact** that the holder (92) is terminated with a handle.
15. A punch press with a universal rotary head, under claim 13, **characterised by the fact** that the handle (92) is attached to the handling equipment and the control mechanism (95) independently controls the upper part (93), which serves to clamp the punch (1), and the lower part (94), which serves to clamp the die (2).
16. A punch press with a universal rotary head, under claims 13 and 14, **characterised by the fact** that the control mechanism (95) consists of a control (110), a tongue (111), an arresting screw (112), pushpins (113) and

forcing springs (114); the control (110) pushes the middle jaws (100, 101) into the working position by means of leading edges (115) via pushpins (99); the arresting screw (112) fixed in the control (110) pushes the arm (107) into the working position via a set screw (116), the stopping of the control (110) in the working position being ensured by the tapered part (117) of the tongue (111).

17. A punch press with a universal rotary head, under claim 1, **characterised by the fact** that the tool magazine (119) is arranged in the following way: 1 to 3 dies (2) with different sizes of cutting clearance are assigned to one punch (1).

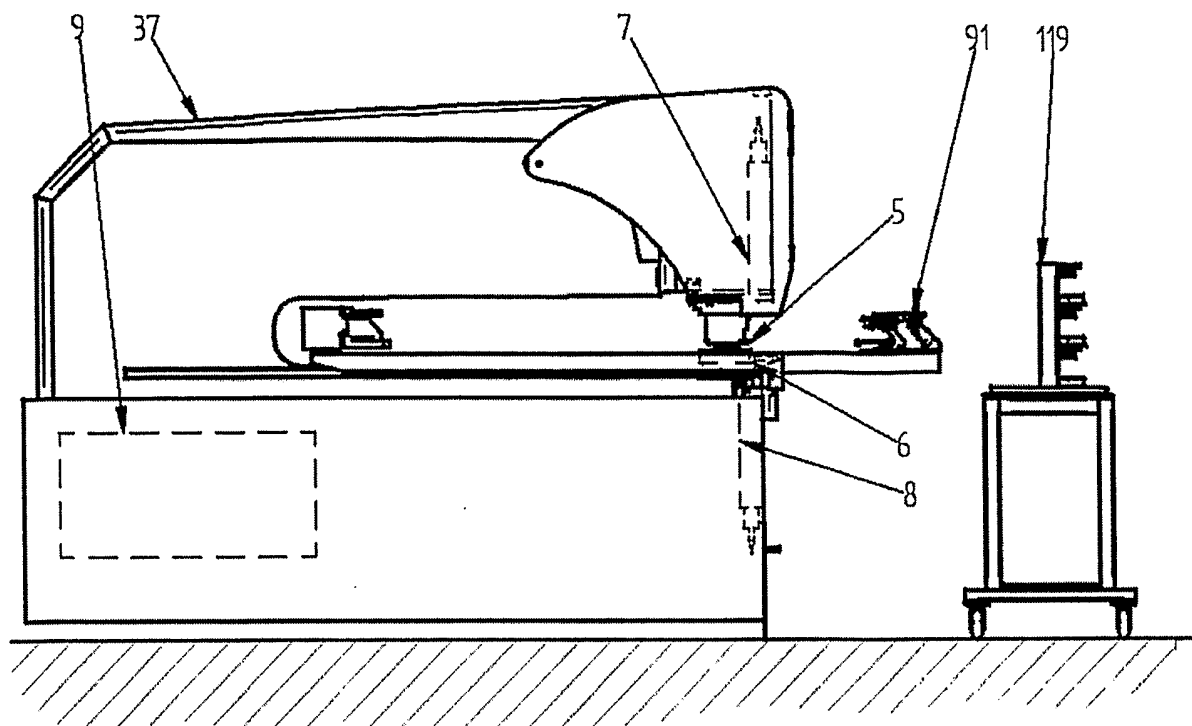


Fig.1

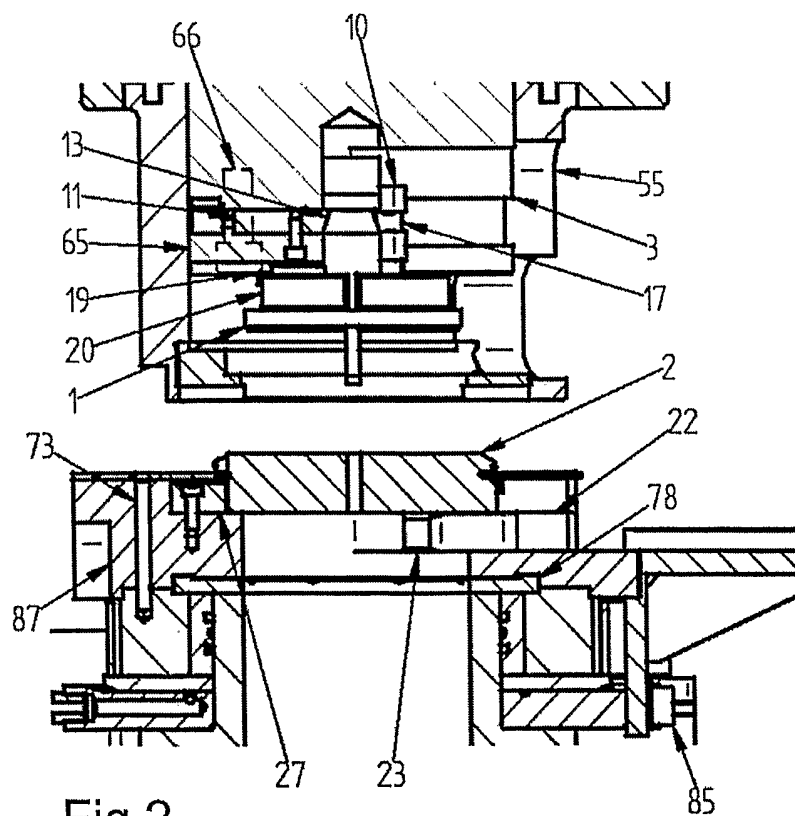


Fig.2

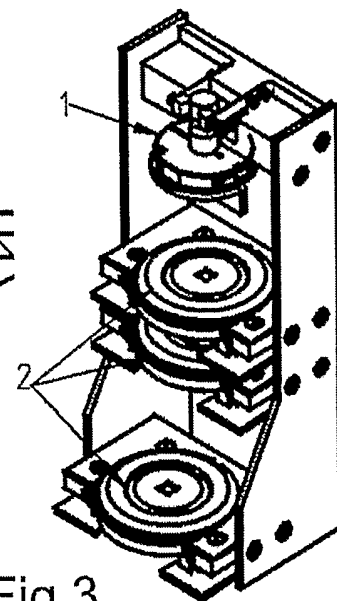
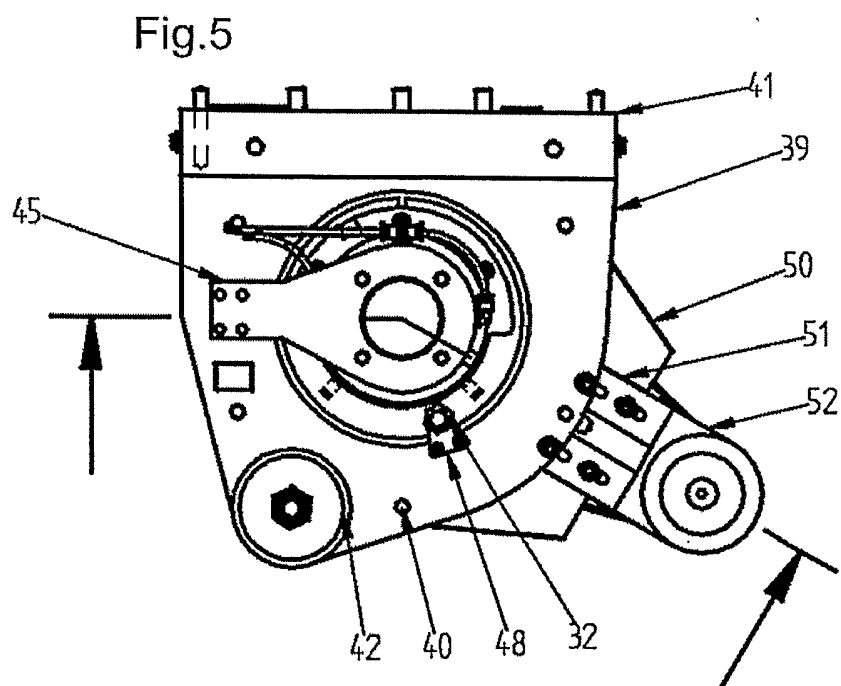
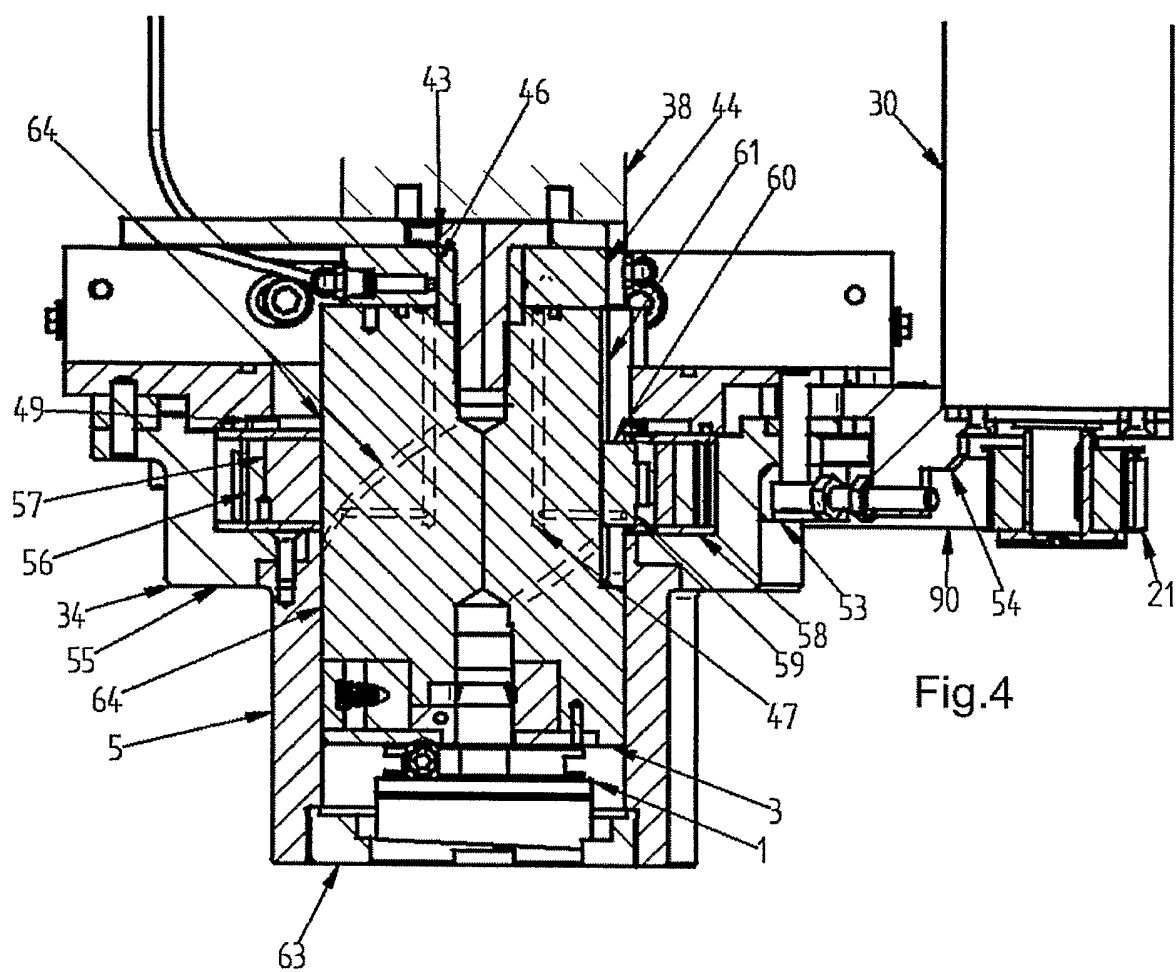
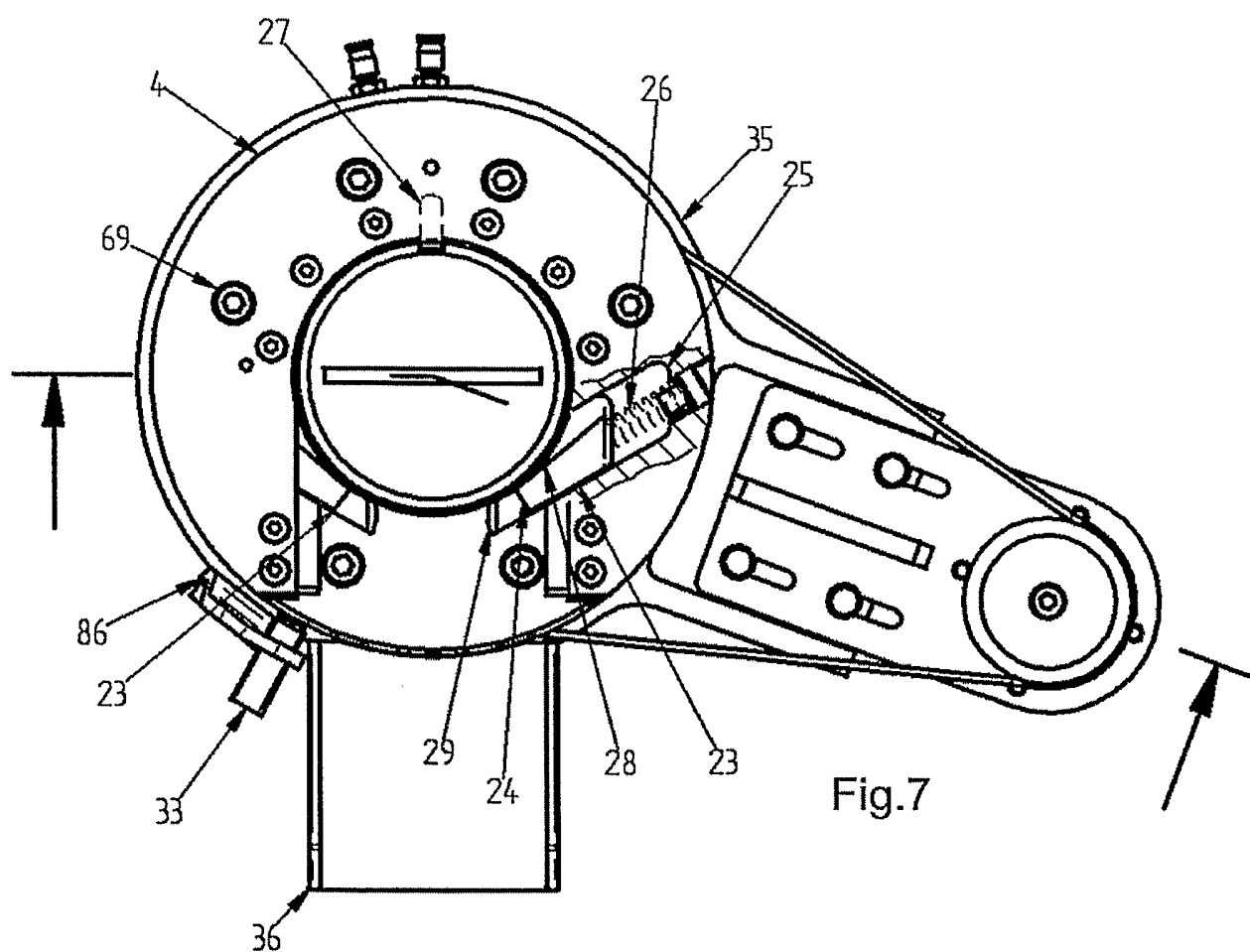
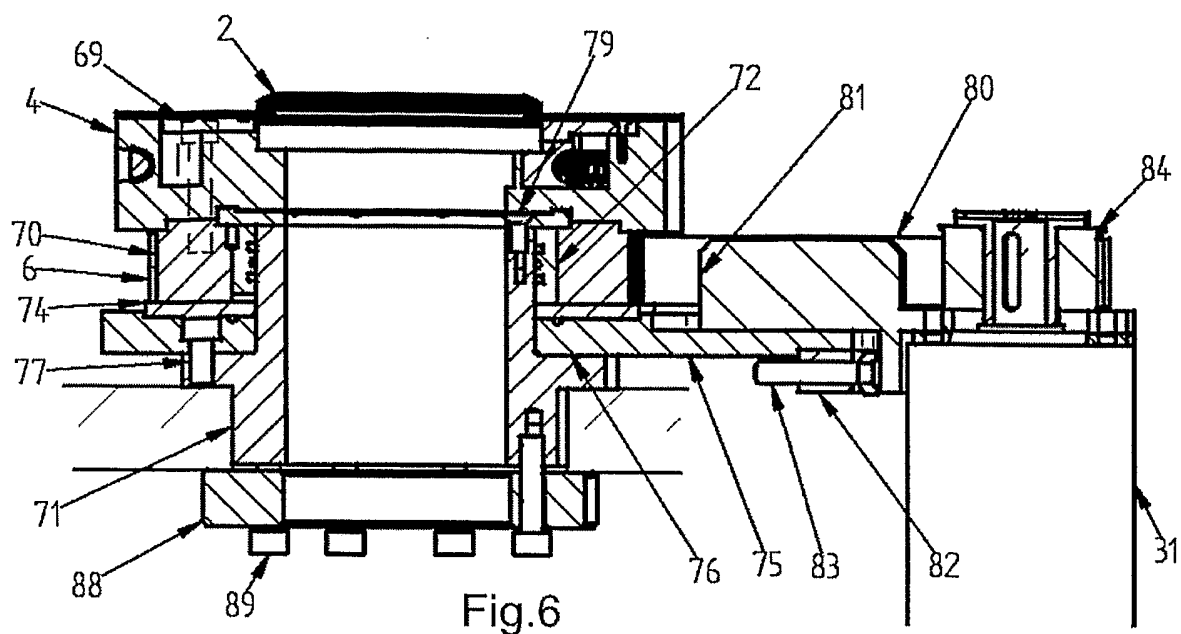


Fig.3





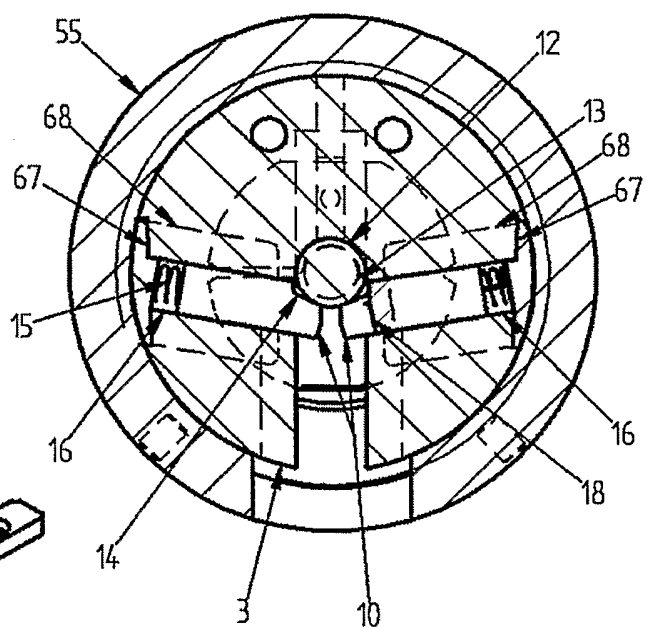


Fig. 8

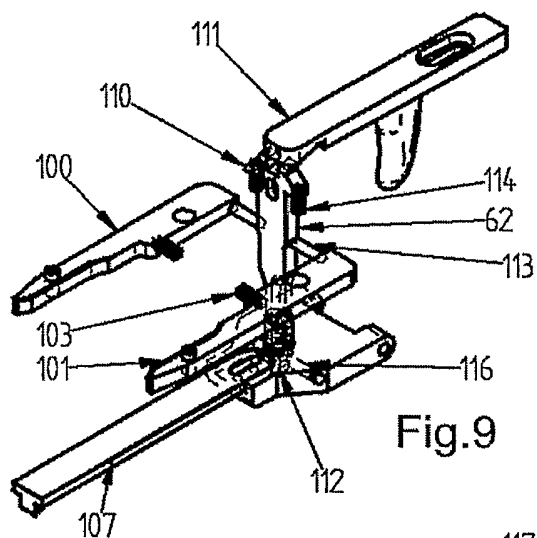


Fig. 9

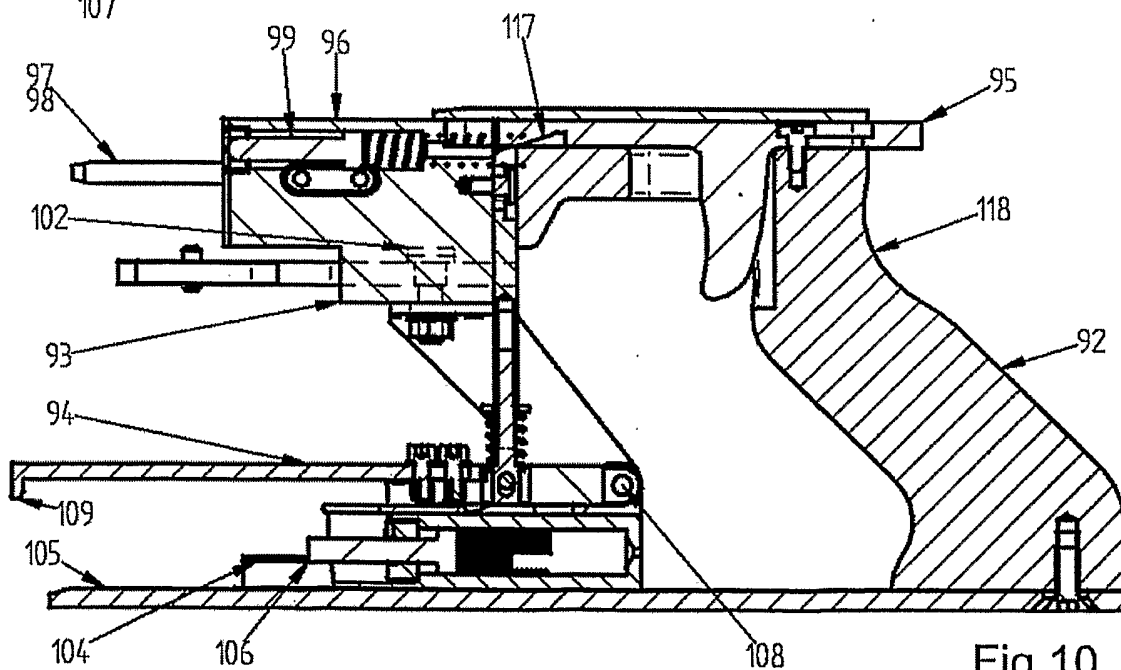


Fig. 10

INTERNATIONAL SEARCH REPORT

International Application No
PCT/CZ2004/000006

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 B21D28/12 B21D37/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B21D B23D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EP0-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 985 983 A (OTTO GERHARD ET AL) 22 January 1991 (1991-01-22) the whole document	1
A	US 5 224 915 A (KILIAN FRIEDRICH) 6 July 1993 (1993-07-06) the whole document	2-5
A	US 4 869 141 A (KLINGEL HANS) 26 September 1989 (1989-09-26) cited in the application figures	2-5
A	US 2002/088319 A1 (ICHIKAWA MICHIHARU) 11 July 2002 (2002-07-11) figures	1

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

26 April 2004

Date of mailing of the international search report

17. 09. 2004

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Authorized officer

Ris, M

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CZ2004/000006

Box II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-5

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-5

Mounting of die and punch using stops

2. claims: 1,6-12

arrangement of upper and lower case and slide

3. claims: 1,13-16

loading jig arrangement

4. claims: 1,17

tool magazine arrangement

INTERNATIONAL SEARCH REPORT

information on patent family members

International Application No

PCT/CZ2004/000006

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 4985983	A	22-01-1991	DE 3701858 A1 DE 3777799 D1 EP 0276391 A2	04-08-1988 30-04-1992 03-08-1988
US 5224915	A	06-07-1993	NONE	
US 4869141	A	26-09-1989	NONE	
US 2002088319	A1	11-07-2002	JP 2002192260 A	10-07-2002