

[54] **AUTOMATIC QUICK PRESS FOR
MANUFACTURING SMALL-DIAMETER
SHORT-SHANK BOLTS**

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[58] Field of Search..... **10/6, 12, 12 T, 12.5,
10/13, 15, 39, 52, 60, 69, 77, 158**

[56] **References Cited**

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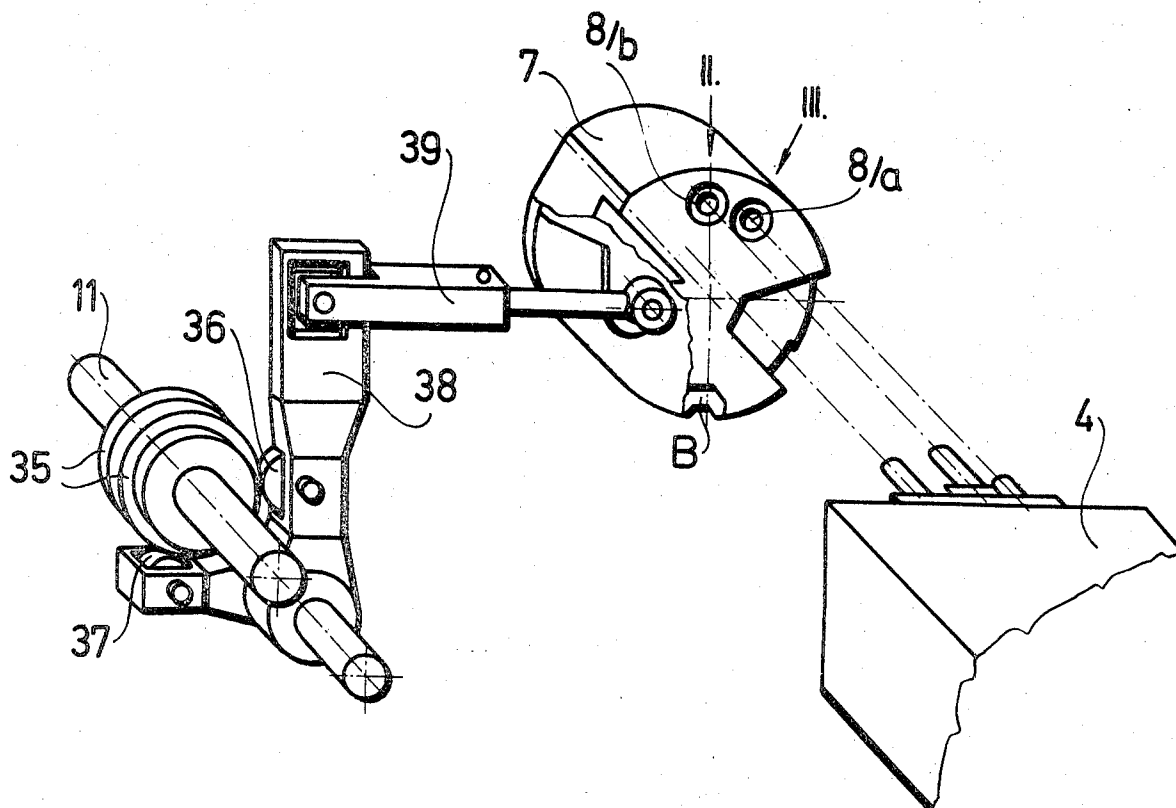
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[57]

ABSTRACT

A press for the production of short-shank small-diameter bolts comprises an angularly oscillatable die-head having two die members disposed along an arc centered upon the axis of oscillation of the head and juxtaposed with a ram carrying three forming tools arranged upon a similar arc of the same axis with the same angular spacing as said die. Indexing means is provided for enabling the head to be displaced into either of two angular extreme positions whereby, in one position, the central tool and another tool of the ram form workpieces in the dies while the third tool is not ineffective, and a position in which the central tool and the third tool form workpieces in the die and the second tool is ineffective.

5 Claims, 7 Drawing Figures



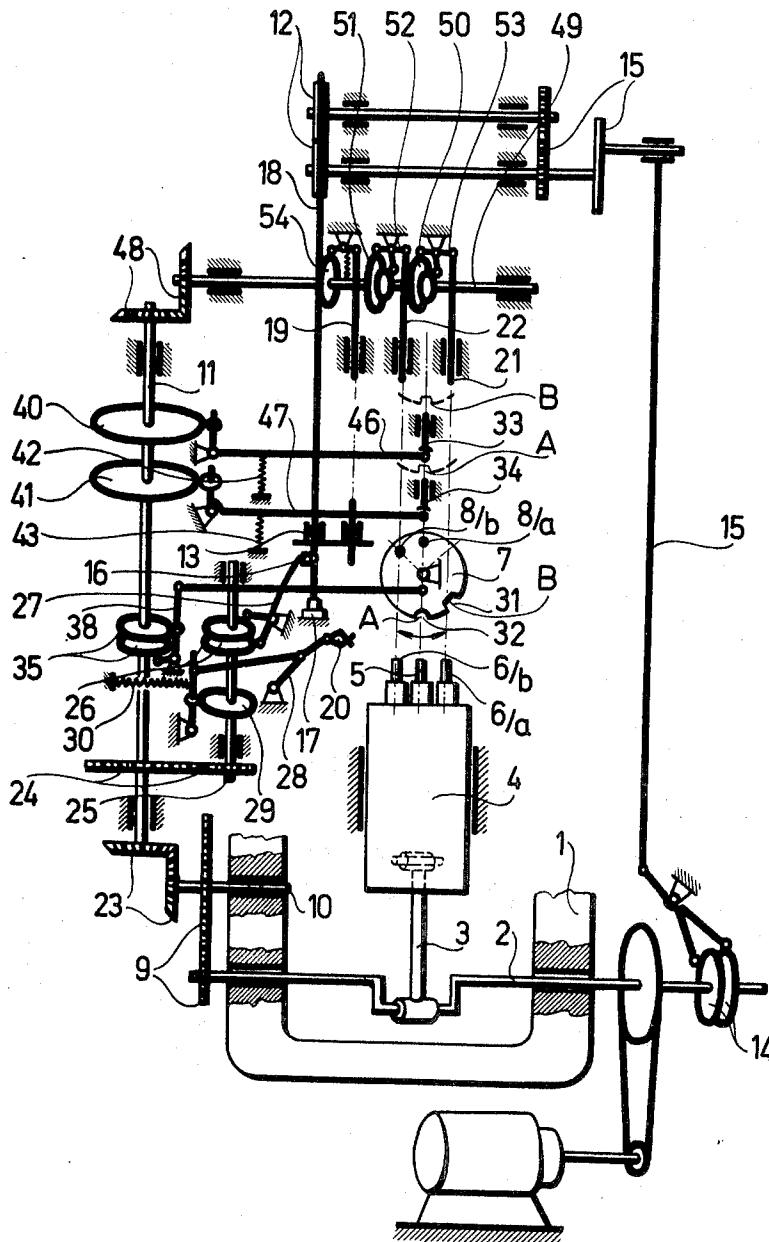


Fig.1

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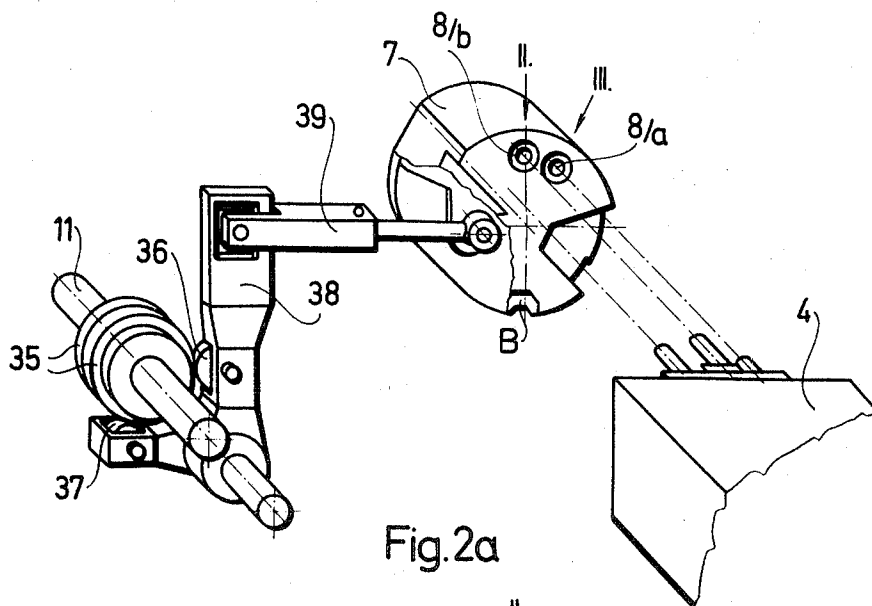


Fig. 2a

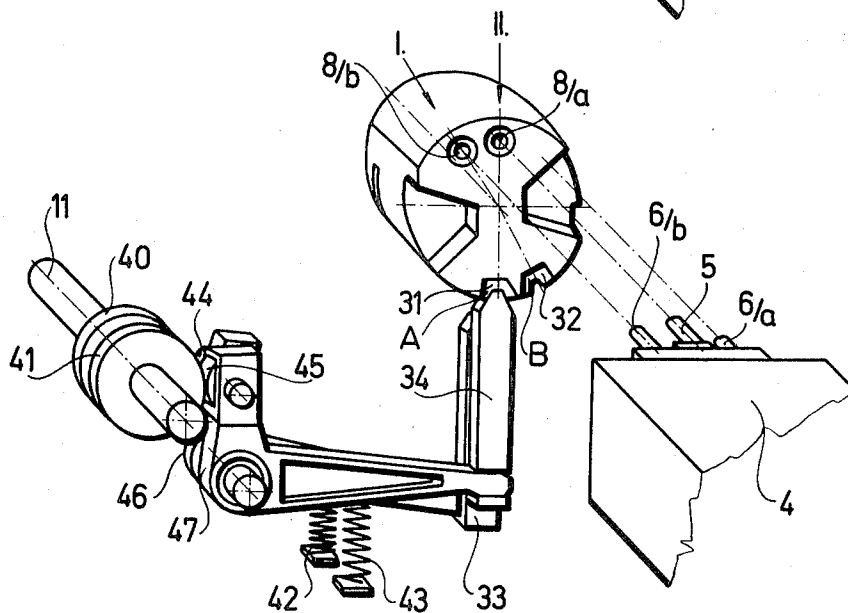


Fig. 2b

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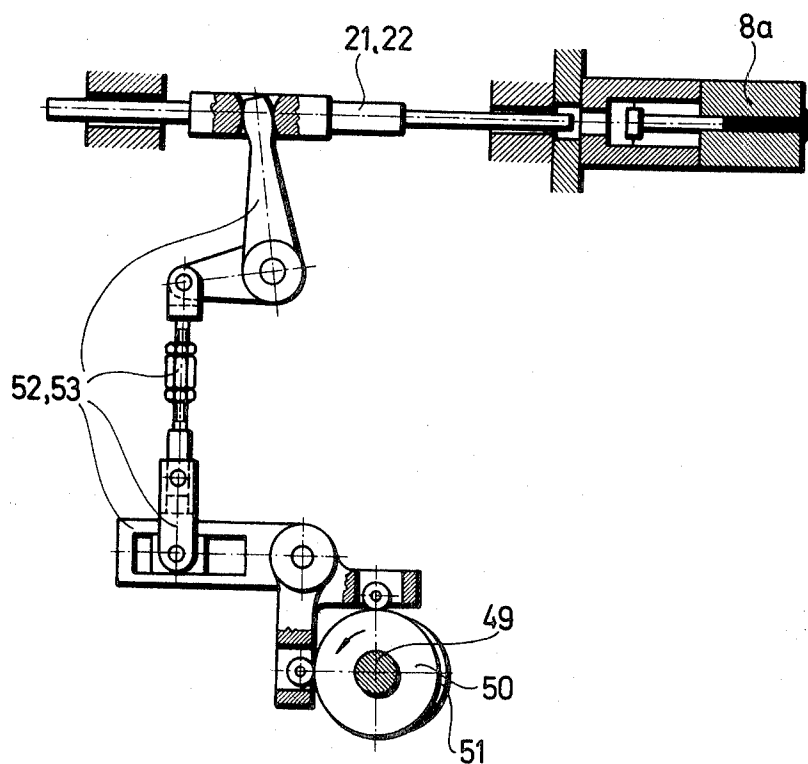


Fig.3

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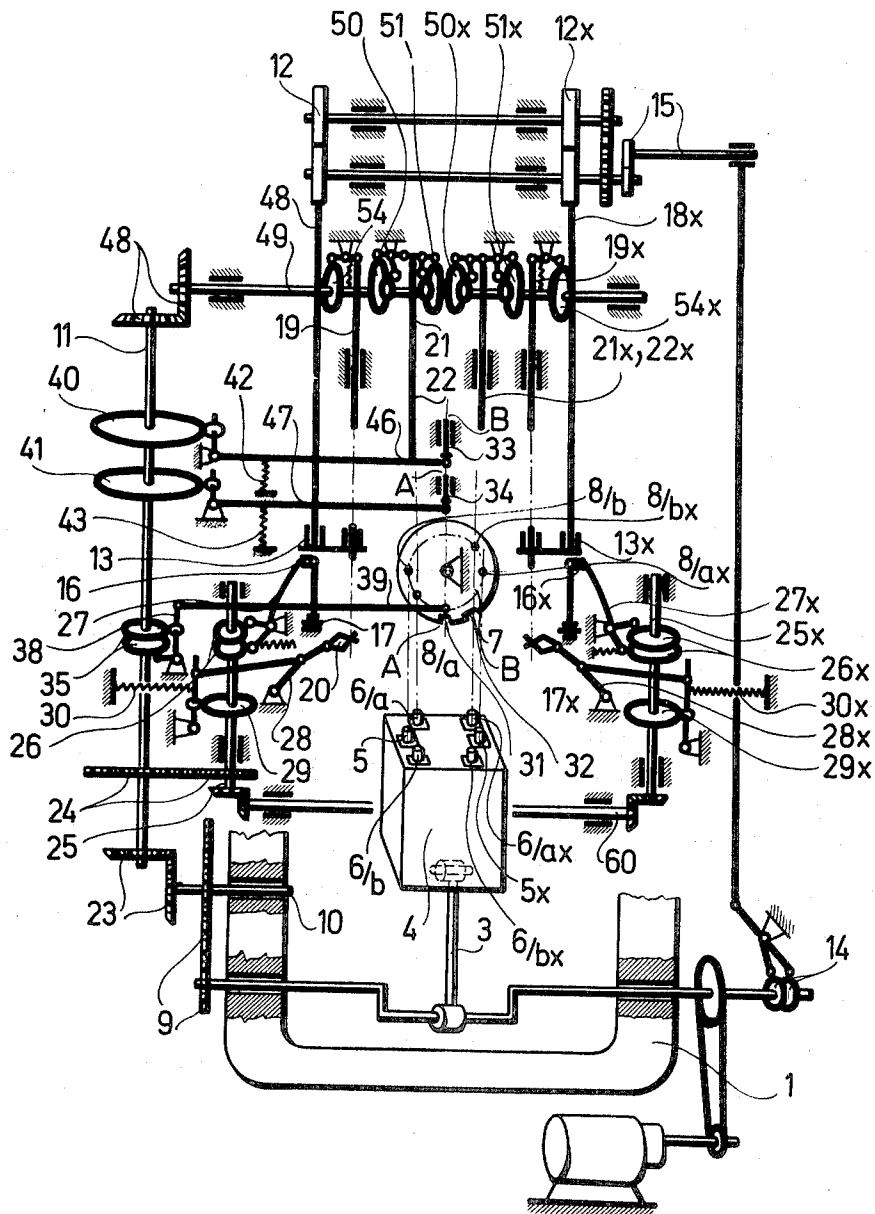


Fig.4

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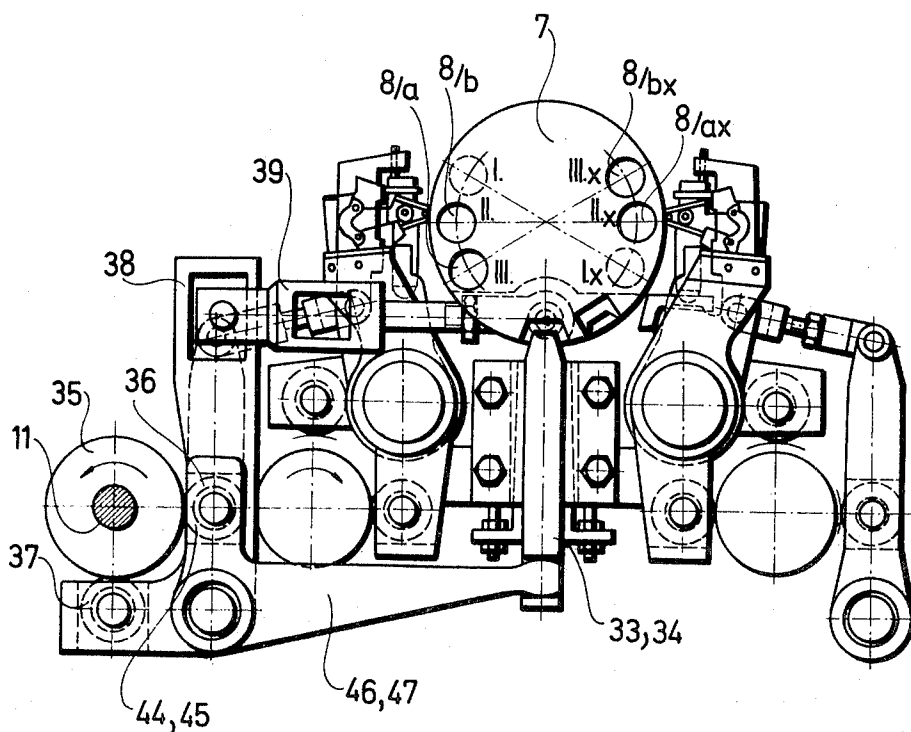


Fig.5

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AUTOMATIC QUICK PRESS FOR MANUFACTURING SMALL-DIAMETER SHORT-SHANK BOLTS

FIELD OF THE INVENTION

This invention relates to improvements in a quick press for manufacturing small-diameter, short-shank workpieces having diameters of 2 mm to 6 mm and lengths of, primarily 5 mm to 30 mm, especially screws, rivets, and the like hereafter denominated generally as bolts.

BACKGROUND OF THE INVENTION

In industry bolts up to a diameter of 6 mm are used in large quantities and, mass production of these bolts has been desired. One of the aims of mass production is to produce in a unit of time as many bolts as is possible.

For manufacturing bolts up to 6 mm in diameter conventional presses have a fixed tool and two moving tools. The workpiece laid into the fixed tool or (die is preformed by one of the moving tools (preheaded), and is finished in the next operation by the other moving tool.

The moving tools of such conventional machines perform motion in two directions i.e. a reciprocating motion in the pressing direction, and another motion generally perpendicular to the first, with interchanging of the positions of the tools, for double working of the piece. This mode of manufacture has the drawback that it is able to produce a finished bolt only with every second revolution of the main shaft so that the productivity of such machines is low.

To increase productivity it has been proposed to obtain with every stroke of the machine a finished product. One of these solutions makes use of two or more dies, juxtaposed with the same number of moving tools. These are so-called transverse transport.

The moving tools perform with the ram carrying them a reciprocating motion only, while transfer of the work piece uses a motion perpendicular to the travel of the ram, via a transport device. This transport device is of large mass and performs a periodic motion. During one transport operation two starts and stops are effected, i.e. two accelerating and braking forces arise.

Although with these machines one piece is finished per revolution of the main shaft, the shapes and dimensions of the transporting grippers generally do not permit the transfer of short-shank bolts. Therefore these machines have become common exclusively for manufacturing long-shank bolts, primarily with a diameter (above 8 mm).

To produce long shank but small diameter bolts, the above-mentioned transverse transport presses, although suitable in theory, have not been employed to any significant extent because they cannot be economically used on fast running machines. For this reason, in the production of small diameter (below 6 mm), but long shank (over 30 mm) bolts, instead of transverse transport machines, dump transport machines are more economical.

In these machines the transfer mechanism performs a circular motion; therefore the energy needed for imparting motion to the mechanism assuming identical mass - is less than with straight line motion.

A dump transport press with two dies and two moving tools produces, with every revolution of the main shaft, a finished bolt.

Productive and economic manufacture of small diameter and short shank bolts has been attempted without significant success.

More recently presses with revolving (rotary) heads have become known.

In the revolving heads of these machines two dies are placed in the same plane an angular offset of 180° from one another. Opposite to the dies there are provided the two forming (preforming and finishing) tools on the ram which do not perform any auxiliary motion. In these machines preforming and finishing of the pieces is effected in the same clamping tool (die) and it is possible to produce one finished bolt with each main shaft revolution. The raw material fed by the cutting device is preupset in the first die by the preforming tool, and subsequently the die rotates during the next main shaft revolution by 180° below the finishing tool, which performs final forming.

At the same time, during this rotation through 180° , the second die of the revolving head returns empty into the first position, where upsetting of a new piece starts, and the process repeats.

Also moving head machines with similar results are known, in which the moving head does not perform complete revolutions, but only half revolutions (angular oscillations) to and fro through 180° .

The output obtained with rotary head machines is more favorable than with other conventional machines, but at these rotary machines, in spite of the production of a finished product on every main shaft rotation, the theoretical 100 percent increase in performance, as compared with two stroke machines is not achieved, because the rotation of the two dies in the moving head requires a 180° rotation between press operation, i.e. a displacement of half of the periphery of the circle defined by to the center of the dies in the moving head. Characterizing all rotary head machines is the die travel through $\pi d/2$ i.e. the 180° swing over, which is a small useful angular displacement.

The short time limited by the feed and locking operations and the long travel path require a high circumferential speed " v ", raising the energy of the moving head $m \cdot v^2/2$ to a high level. The mass of the head has to be started, accelerated, braked and stopped every half revolution.

With increase of the rotational speed of the press main shaft, the circumferential speed " v " of the rotating die head increases proportionally, and as the dimension " d " of these dies is relatively large, the path $d \pi/2$ is long and the resulting energy of motion causes strong dynamic vibrations and high wear in the control equipment.

OBJECT OF THE INVENTION

It is the object of the present invention to provide a press for the production of short-shank, small-diameter bolts whereby the aforementioned disadvantages are avoided.

SUMMARY OF THE INVENTION

The moving head of the press according to the invention comprises at least one pair of dies. The moving head oscillates about its own axis along an arc with 30° central angle between three positions of the machine

body opposite to a preforming tool and two finishing tools. In both extreme positions of the oscillating motion the two dies periodically alternating preform and finish the workpiece

The oscillation through a central angle by 30° of the moving head bearing the two dies is made possible by enabling recognition that the two dies alternately to be fixed in three positions of the body, so that out of these three positions, the central one should always be one of the two die positions, while at the same time opposite to them, on the ram one preforming tool and two finishing tools are located at $2 \times 30^\circ$ central angle on the same arc as the dies, with the preforming tool in the intermediate position. This means that the preforming tool works at every stroke and the two finishing tools operate alternately.

The equipment according to the invention reduces the rotary path of the dies with respect to conventional rotary head machines to $30/180 = 1/6$ (16.6 percent, also the circumferential speed "v" is six times smaller in relation to conventional rotary head machines at the same r.p.m. of the main crankshaft.

The design of the automatic quick press according to the invention, the layout of the dies and forming tools, and the new mode of operation, makes it possible to double the output of the machine without any additional pressing equipment,

When in the oscillating head in line with the horizontal axis, two dies are disposed, and two other dies are disposed on another diameter including with the former an angle of 30°, then out of the four dies of the head, two on opposite sides always performing an oscillatory motion between alternating positions to produce at every stroke with the three forming tools arranged on the ram opposite to them, a finished piece on both sides.

This opposite oscillatory motion of the dies on both sides produces such changes in position which enable two preforming steps to be carried out on every revolution of the crankshaft in the dies lying on the horizontal diameter of the head, while at the same time, but alternately on diameters turning up and down by 30° from the horizontal plane of the head, two finishing steps are carried out of identical or different kinds.

On the oscillating head of the ram on a circle with a diameter corresponding to that of the die locations, along the horizontal diameter two preforming tools are provided.

At the points of intersections of the diameters passing through the planes turned up and down by 30° from the above diameter and the circumference of the central circle, four forming tools are applied.

Concerning the form of the head of these tools, when two kinds of products should be manufactured, only the outlines of the tools lying on the same side are identical, while the outlines of the two tools on the other side are identical again; at the manufacture of uniform but double the output, all four tools are identical.

It will be clear that the energy of movement $m \cdot v^2/2$ necessary for displacing the oscillating head, is reduced in relation to the quadratic function ($1/6 v^2$), because in the formula

$$v = [(d/2) \pi n]/60$$

$$d/2.6 = d/12$$

is to be placed, and so

$$v = [(d/12) \pi n]/60$$

Thus the machine according to the invention to surpass as the performance possible heretofore, because the number of strokes is raised significantly. Our tests show that a machine working with one pair of dies may produce 600 pieces per minute, while a machine working with two pairs of dies may reach 1,200 pieces per minutes.

DESCRIPTION OF THE DRAWING

The invention will be more particularly described by with reference to the accompanying drawing, in which

FIG. 1 shows in diagrammatic form, the kinematic scheme of one embodiment of an automatic quick press according to the invention;

FIGS. 2a and 2b illustrate in perspective views partly broken away two phases of the oscillating head, of the locking device and of their control gear;

FIG. 3 shows, in an elevational view, partly in cross section, the operation of the double kicking up;

FIG. 4 illustrates in a view similar to FIG. 1, the kinematic scheme of an automatic quick press operating with two wires;

FIG. 5 shows the elevation of the oscillating head equipped with two pairs of dies, with their locking devices, with their control gear and with two charging rods; and

FIG. 6 illustrates, in a view similar to FIG. 3, the actuating rods of the kicker rods with different gearing ratio.

SPECIFIC DESCRIPTION

According to FIG. 1, in the machine body receives a movable ram 4 actuated by a crankshaft 2 via a connecting rod 3. On the front plate or face of ram 4 in a vertical plane at the highest point of a pitch circle, is disposed the preforming tool 5; on the same circle, 30° to the right and to the left from the preforming tool 5, heading dies 6/a and 6/b are provided. Opposite these tools, is an oscillating head 7, supported in bearings in the machine body 1. The head 7 is formed with 8/a and 8/b angularly offset by 30° from each other along the same pitch circle as the tools on ram 4.

Raw wire 18 is fed into the cutting sleeve 13 on the machine body 1. The raw wire is pulled through the cutting sleeve and over circular forming cutter (disc cutter) 16 to stop 17.

The circular forming cutter cuts a piece of wire from the raw wire 18 and transfers it to gripper 20 in front of the transfer mandrel 19. Transfer mandrel 19 pushes the wire piece from the circular forming cutter 16, into the transfer gripper 20, which passes the wire piece in front of the die — in this case member 8/a — in position II of the oscillating head 7, relative to the upper body. Below the preforming tool of ram 4 approaching its first dead center position the said wire piece is introduced into die 8/a and the is formed head.

During the next stroke of the ram 4, the oscillating head 7 swings by 30°, to bring die 8/a relative to the body 1 into its right side position III, while aligning die 8/b arrives to its upper position II (see FIG. 2a). Transfer gripper 20 introduces another wire piece in front of die 8/b. The heading tool 6/a of ram 4 approaching to its front dead center position, finishes the bolt preformed in die 8/a, simultaneously performing via tool 5 processes the wire piece in die 8/b.

During the next stroke of ram 4, kicker (ejector) rod 21 pushes in position III of the oscillating head 7, the finished product from die 8/a (see also FIG. 3), whereupon head 7 swings back by 30°, so that die 8/a arrives again in its upper position II, while at the same time die 8/b is shifted into its left side position I. Transfer gripper 20 introduces a wire piece cut from the raw wire 18 in front of die 8/a. In this period the heading tool 6/b of ram 4 approaching its first dead center position, finishes the bolt already preformed in die 8/b, while contemporaneously preforming tool 5 processes the new wire piece being in die 8/a.

After this period the finished product is ejected in position I of the oscillating head 7 by a kicker rod from die 8/b, whereafter with swinging of head 7 by 30° the processes repeat.

From the abovesaid it will be clear that during two subsequent revolutions of crankshaft 2, tool 5 carries out preforming in position II of the oscillating head 7, once in die 8/a again in die 8/b, while contemporaneously during this revolution heading tool 6/a cooperates with die 8/a being in position III, while during the next revolution heading tool 6/b cooperating with die 8/b in position I to produce respective bolt.

Also kicker rods 21 and 22 operate alternately on every second revolution. The design and the kinematic chain of the equipment according to the invention can be followed in the way described here.

Crankshaft 2 drives by gearing 9 (ratio 1 : 2) the control shaft 10.

Control of drawing of raw wire 18 is effected conventionally by a pair of camwheels via rod 15 and a pair of drawing rolls 12.

Bevel gear 23 with ratio 1 : 1 located on control shaft 10 drives an auxiliary spindle 11 parallel to ram travel. From this auxiliary spindle 11, by a gearing with ratio 2 : 1, the cutting auxiliary spindle 25 is driven. The pair of cam discs 26 on the cutting auxiliary spindle 25 controls the circular forming cutter 16 fixed on rod 27, passing over the wire pieces cut from raw wire 18 on the arc between the cutting sleeve 13 and transfer mandrel 19.

Transfer gripper 20 located on rod 28 is actuated by control disc 29 located on the cutting auxiliary spindle 25, and by the cooperating compression spring 30, between the transfer mandrel 19 and position II of the oscillating head 7.

The oscillating head 7 equipped with two dies, according to the invention is supported in bearings in the machine body 1, and is so designed that dies 8/a and 8/b are located on a circle of the oscillating head 7 and can be induced in the three positions I, II and III, being shifted between them by a determined angle, preferably by 30°; the indexing means is constructed and arranged so that one of the positions is the midposition (II) suitable for preforming, while the others are extreme positions (I or III), which are finishing positions and are equipped therefore by controlled kicker rods.

Opposite to the locations of the dies, on a circle in diametric symmetry are two indexing slots 31 and 32, cooperating with indexing or pins wedges 33 and 34 respectively, ensuring the fixed positions of the oscillating head 7.

Movement of the oscillating head 7 is derived from a pair of control discs 35 located on the auxiliary spindle 11, via rolls 36 and 37 coupled with it, and through the forked lever 38 by an intermediate rod 39.

Locking and releasing of the oscillating head 7 between movements is ensured by registry at suitable intervals of time of the fixing slots 31 and 32 of the oscillating head 7 with the fixing wedges 33, 34 driven by the control discs 40 and 41 located on the auxiliary spindle 11, and by the intermediate rolls 36 and 37, through the forked arm 38, and intermediate rod 39.

The 1 : 1 ratio bevel gear 48 on the end of the auxiliary spindle 11, controls the ejector auxiliary shaft 49, perpendicular to the travel of the ram. On this auxiliary shaft are located in the plane of positions I and III of the oscillating head 7 two pairs of cam discs 50, 51, controlling by rods 52, 53 the motion of the ejector mandrels 21 and 22.

Similarly the auxiliary shaft 49 carries the cam disc 54 operating the transfer mandrel 9 for feed of the wire piece.

An alternative construction of the machine according to the invention equipped with two pairs of dies, i.e. for manufacturing simultaneously two products, is shown in FIGS. 4-6. The operation of this device is similar to that previously described, with the identically functioning parts being followed by "x".

What we claim is:

1. A press for the production of short-shank small-diameter bolts, comprising;

a forming head rotatable about an axis and provided with two angularly spaced die members disposed along an arc;

a press ram axially aligned with said head and provided with three forming tools arrayed along an arc corresponding to the arc of said die members and with an angular spacing between said tools equal to the spacing between said die members, said tools including a central tool for effecting a first shaping operation upon a workpiece received in a registering die member, and first and second tools for effecting a subsequent forming operation upon a workpiece received in a registering die member; means for axially displacing said ram toward and away from said head for forming of workpieces in said die members by the tools registering therewith on each forward stroke of the ram;

indexing means for angularly oscillating said head in the cadence of operation of said ram and for temporarily locking said head in a first extreme angular position wherein said central tool is aligned with a first of said die members and said first tool is aligned with the other die member, and a second extreme angular position wherein said central tool is aligned with said other die member and said second tool is aligned with said first die member;

gripper means engageable with workpieces in succession for introducing them into said die members upon positioning of said die members substantially in alignment with said central tool; and

respective ejectors cooperating with said die members when the latter are offset from alignment with said central tool for ejecting shaped workpieces from said head; and

drive means for said ejectors, said gripper means, said indexing means and said rams for synchronously operating same.

2. The press defined in claim 1 wherein said drive means includes a crankshaft; a connecting rod connected to said crankshaft and to said ram for displacing

same toward and away from said head once for each revolution of said crankshaft;

transmission means connecting said head with said crankshaft;

said gripper means being connected to said transmission means for operation one for each rotation of said crankshaft to insert a workpiece into the die member aligned with the central tool; and further means for alternately supplying said ejectors upon each rotation of said crankshaft.

3. The press defined in claim 2 wherein said head includes a drum rotatable about said axis and provided with wedge-shaped notches in the periphery of said

drum, said indexing means including wedges receivable in said notches, said wedges being provided with cam followers connected to said transmission means.

4. The press defined in claim 2 wherein said head is a drum angularly oscillatable about an axis, said transmission means including a cam-driven rocker arm articulated to said drum.

5. The press defined in claim 2 further comprising cutter means connected to said transmission means for feeding a succession of said workpieces to said gripper means in the cadence of operation of said ram.

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