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(54) MACHINE FOR SWAGING TUBULAR WORKPIECES

(71) We, MANUFACTURE DE MACHINES DU HAUT-RHIN S.A., a French Company of 10 rue de Soultz, 68200 Mulhouse, France, do hereby declare the invention, for which we pray that a patent of may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to swaging machines, particularly, but not exclusively, for forming necks on tubular workpieces such as cartridge cases of small and medium calibre.

More particularly the intention in the present invention is to provide a machine of this kind capable of swaging tubular workpieces such as cartridge cases at a high rate of output.

The swaging machine according to the invention comprises a turret mounted on a frame for rotation about a stationary axis and having a plurality of individual axially acting swaging presses regularly spaced around its periphery, each press having a cradle opening radially of the turret axis for receiving a tubular workpiece, a hollow swaging die axially aligned with each cradle, a press rod for transferring the workpiece from the cradle and introducing it to the die, and an extractor for extracting the swaged workpiece from the die, means being provided for driving the turret in rotation, for actuating the press rod and for actuating the extractor, and arranged so that in operation both the swaging and the extraction take place during only a portion of a revolution of the turret.

In a preferred version of the invention each individual press has a movable sizing rod which penetrates into the interior of the die for sizing the swaged part of the workpiece.

Each sizing rod is preferably arranged so that after the workpiece has been swaged and sized, the rod makes contact with the bottom of the workpiece for extracting it from the die, this rod thus forming the extracting device mentioned above.

The invention will be better understood from a reading of the following description, and with the help of the drawings, given as examples, in which:

Figure 1 is an axial section of a machine according to the invention for swaging and sizing tubular workpieces.

Figure 2 is a cross section taken in the plane II—II of Figure 1.

Figure 3 represents diagrammatically the sequence of operations performed by the machine of Figure 1.

Figure 1 shows the stationary frame 10 of the machine which is intended for swaging necks in tubular workpieces constituted as cartridge case blanks of small and medium calibre and for sizing the necks thus formed. But this application is not intended to be limiting. The machine can if desired by used for swaging and/or sizing any kind of tubuler workpiece.

The stationary frame 10 of the machine has a lower portion in the form of a double chamber hollow base 12 supporting a tubular column 14 suitably fixed to one side of the hollow base.

A rotary turret, indicated generally at 16, is arranged to rotate about a vertical axis, driven by any suitable means. In the example shown the turret 16 comprises a central shaft 18 which carries three rotary barrels 20, 22, 24, suitably keyed to the shaft.

The central shaft 18 has a cylindrical upper end 26 rotating in a roller bearing 30 in an annular bearing housing 28 fixed to the upper end of the column 14, but preferably detachable therefrom.

The cylindrical lower end 32 of the shaft 18 rotates in two taper roller bearings 38*a*, 38*b*, in an annular bearing housing 34 which is mounted, preferably detachably, in the separating wall 36 of the double chamber hollow base 12 of the machine. From the bearings 38*a*, 38*b* the shaft 18 extends downwards to support a worm wheel 40 which is driven in rotation by a driving

worm 42, whose axis of rotation is horizontal.

According to a feature of the invention the rotary turret 16 is equipped with several, for example eight, individual swaging presses 56 fixed at regular intervals to the periphery of the turret 16 and rotating with it. Each swaging press 56 comprises a die 46 set in a bore 48 of the middle rotary barrel 22 of the turret 16. Under the barrel 22 there is a crown 54 fixed to the upper end of the lower rotary barrel 24, the crown 54 therefore also rotating with the turret 16. The crown 54 has, in this case 8, peripheral notches, each forming a radially opening cradle 52 for receiving and temporarily retaining a tubular workpiece. When the machine is in operation a press rod 50 thrusts the workpiece upwards into the swaging die 46. The completed tubular workpiece is subsequently ejected from the die 46 by an ejector 44.

Each die 46 is secured adjustable in height in the bore 48 of the barrel 22. For this purpose there can be used positioning nuts 58*a*, 58*b* which are threaded internally to take the die 46 and can be screwed together to lock against upper and lower surfaces of the rotary barrel 22.

When the machine is in operation each cradle 52 of the rotary crown 54 receives a tubular workpiece from a feeding wheel 60 (Figure 2) which has notches around its periphery for taking the workpiece. The feeding wheel 60 is driven to rotate synchronously with the turret 16 of the machine. The completed workpieces are removed from the cradles 52 by a removal wheel 62 which also has peripheral notches and is driven to rotate synchronously with the shaft 18 of the turret. It should be observed that the tubular workpieces are upright in the cradles 52 and are fed and removed sideways, that is to say in directions perpendicular to their own axis. There is therefore no time lost in these operations and consequently the swaging machine functions at a rapid rate of output.

With the rotation of the turret each press rod 50 is driven up and down, axially with respect to the swaging die 46, by a mechanical, hydraulic, pneumatic or electric driver of any known kind, upwards movement of the press rod 50 thrusting the workpiece upwards into the swaging die 46.

In this version of the invention each press rod 50 is mounted detachably on the upper end of a slide 64 which slides up and down in suitable bearings in a bore 66 of the lower rotary barrel 24. In the example shown each press rod 50 has enlarged foot 70 which is anchored in an axial bore 68 in the upper end of the slide 64, the foot 70 being locked in place of an externally threaded locking ring 72.

At its lower end each slide has a fork containing a tapered roller 74 whic rolls on a stationary ring-cam 76 forming the upper edge surface of an annular support 34, whose lower portion forms the bearing housing for the bearings 38*a*, 38*b*. The annular support 34 is fixed to the separating wall 36 of the double-chamber hollow base of the stationary frame 10 of the machine. Each tapered roller 74 rotates on a shaft 78. This shaft 78 projects inwards of the fork, that is to say it has a projecting inner end on which rotate two further rollers 80 and 82. Of these two rollers the outer one 80 rolls up and down in a vertical slot 84 in a rotary skirt 86 fixed to the lower portion of the lower rotary barrel 24. The innermost roller 82, on the other hand, rolls in a cam channel 88 in the outer surface of a stationary tubular piece 90 fixed to the annular support 34. It will be observed that the stationary tubular piece 90 projects upwards between the rotating shaft 18 and the rotating skirt 86.

With rotation of the shaft 18 the tapered roller 74 of each slide 64, rolling on the stationary ring-cam 76, thrusts the slide 64 upwards in a direction parallel to the vertical axis of the central shaft 18. During further rotation, the innermost roller 82, rolling in the cam channel 88 of the stationary tubular piece 90 returns the slide 64 downwards. The function of the roller 80, working in the vertical slot 84 of the rotating skirt 86, is to prevent the slide 64 from rotating on its own axis. Using tapered rollers 74 considerably reduces noise and helps to centre the lower end of the slide 64.

The extractor device 44 consists of an extractor rod 92 which, after the necking operation has been completed, penetrates axially downwards into the interior of the die 46 and, striking the bottom of the workpiece, extracts it from the die. The extractor rods 92 can be actuated purely mechanically or, if desired, pneumatically, hydraulically or electrically. In the present example each extractor rod 92 is fixed detachably, for example by a chuck 94, to the lower end of the slide 96 which slides up and down in a bore 98 in the upper rotary barrel 20. The upper end of each slide 96 has a roller 100 which rolls in a stationary cam channel 102 in the side wall of the stationary annular bearing housing 28 fixed to the upper end of the column 14 of the machine. With rotation of the upper barrel 20, the two working faces of the stationary cam channel 102 act on the roller 100 of each slide 96 to move the slide up and down parallel to the axis of the central shaft 18. To prevent the slide from rotating on its own axis, each slide 96 has a longitudinal groove 104 cooperating with a screw-pin 106 fixed in the rotary barrel 20, the inner end of the

screw-pin projecting inwards into the groove.

An important feature of the embodiment illustrated consists in that each extractor rod 92 possesses at its lower end an enlarged rounded head 108 whose greatest diameter is the desired internal diameter of the neck of the tubular workpiece. As will be explained further below, the rounded head 108 of each extractor rod 92 sizes the workpiece neck to give it accurately the desired internal diameter, before the workpiece is extracted from the die 46.

When the machine is in operation, the turret 16 is driven in rotation by the driving worm 42. The feeding wheel 60 feeds a tubular workpiece into each cradle 52 of the crown 54, which is rotating with the turret. At this time the press rod 50 is in a retracted position, its upper end level with the horizontal upper surface 110 of the double-chamber hollow base 12 of the stationary frame 10 of the machine. The extractor-rod 92 is part-way down, as shown at A' B' C in Figure 3, with its rounded head 108 in the interior of the swaging die 46.

In the next phase of the operation the tubular workpiece is introduced into the swaging die and the neck is formed. The workpiece, retained in the cradle 52, is pushed upwards into the interior of the neck die 46 by the press rod 50, which is itself thrust upwards by the stationary cam 76. During this operation the upper portion of the tubular workpiece is gradually reduced in diameter by the narrower upper portion of the swaging die 46. This operational phase is shown at C' D' E' F and G in Figure 3.

It will be observed that during the swaging operation the upper edge of the tubular workpiece moves upwards over the rounded head 108 of the expander push-rod 92, so that the rounded head is now, as shown G, in the interior of the workpiece, the swaging operation proper having been completed.

In the next phase of the operation the extractor-rod 92 is raised by the slide 96, the the rounded head 108 expanding the neck of the workpiece with the necessary precision so as to give it accurately its final, desired internal diameter. The rounded head 108 of the extractor-rod fianally appears at the top of the workpiece, as shown in H in Figure 3.

In the next phase of the operation the stationary cam channel 102, acting on the roller 100 of each slide 96, thrusts each extractor-rod down again into the interior of the die, the rounded head 108 finally striking the bottom of the workpiece and extracting it from the die, the press rod 50 having in the meantime been retracted downwards. The process of extraction is represented at I' J and K in Figure 3.

The workpiece moves downwards until its bottom end comes to rest on the horizontal upper surface 110 of the hollow base 12 of the machine. Finally, the extractor-rod 92 rises towards it inital position, leaving the completed workpiece. To prevent the rounded head 108 of the extractor-rod from lifting the workpiece at this time, a retainer plate is provided, fixed to the stationary frame 10 of the machine. The retainer plate 112 can consist simply of a slightly curved sloping edge fixed to the hollow base 12 around rotary turret 16.

The completed workpiece, after the formation of the neck and the accurate adjustment of the internal neck diameter, can now be removed from the necking machine by the transfer wheel 62, this operation being substantially a reversal of the feeding operation effected by the feeding wheel 60. The removal of the completed workpiece is represented at N, O and P in Figure 3.

It will be noticed that the arrangement according to the invention makes it possible to perform in succession the two operations of swaging and accurately sizing the internal dimensions of the neck of the workpiece, utilizing only a single arc of the path of movement of the workpiece as it is carried around by the rotary turret 16. The response of the tapered roller 74 to the curved surface of the stationary cam 76 makes it possible to control accurately the movements of the tubular workpiece relative to the swaging die, so that the swaging operation can take place in a gradual and controlled way. This makes it possible to form the neck of the workpiece without folding or cracking the material for construction of the workpiece. This also applies to the sizing of the neck by the rounded head 108 of the extractor-rod 92. The fact that the rods 50 and 92, the swaging dies 46 and also the stationary cams 76 and 102 are all replaceable parts, the swaging dies 46 being also adjustable in position, makes it easy to adapt the machine for processing tubular workpieces of different calibres and lengths, and the arrangement of the machine enables very high output rates, e.g. of the order of 250 workpieces per minute, to be achieved.

It must be emphasized that the invention is not limited to the example described and illustrated. Numerous modifications can be introduced without leaving the scope of the invention. In particular the manner of feeding and removing the workpieces, the number of individual swaging presses, the nature of the device for extracting the workpiece from the die to the method used for swaging and sizing the neck to the

desired internal diameter, and the like, can all be varied within the scope of the invention.

WHAT WE CLAIM IS:—

1. Machine for swaging tubular workpieces such as cartridge cases, which comprises a turret mounted on a frame for rotation about a stationary axis and having a plurality of individual axially acting swaging presses regularly spaced around its periphery, each press having a cradle opening radially of the turret axis for receiving a tubular workpiece, a hollow swaging die axially aligned with each cradle, a press rod for transferring the workpiece from the cradle and introducing it to the die, and an extractor for extracting the swaged workpiece from the die, means being provided for driving the turret in rotation, for actuating the press rod and for actuating the extracting device, and arranged so that in operation both the swaging and the extraction take place during only a portion of a revolution of the turret.

2. Swaging machine according to Claim 1, characterised in that each individual press has a movable sizing rod which penetrates into the interior of the die for sizing the swaged part of the workpiece.

3. Swaging machine according to Claim 2, characterised in that each said sizing rod is constituted as a said extractor.

4. Swaging machine according to Claim 3, characterised in that a retainer device is fixed to the stationary frame of the machine for retaining the workpiece during the return movement of the extractor from the workpiece after extraction of the workpiece from the die.

5. Swaging machine according to any one of Claims 1 to 4, characterised in that the means for actuating the press rods comprises an annular cam fixed to the stationary frame of the machine and a cam-follower roller for each of the press rods.

6. Swaging machine according to Claim 5, characterised in that each cam-follower roller is a tapered roller.

7. Swaging machine according to Claim 5 or 6, characterised in that each press rod is fixed detachably to one end of a mobile slide which slides up and down in the rotary turret in directions parallel to the axis of rotation of the turret the other end of the slide supporting the cam-follower roller which drives that press rod.

8. Swaging machine according to any one of of Claims 1 to 7, characterised in that the means for actuating the extractors comprises an annular cam fixed to the stationary frame of the machine and a cam-follower roller acting on each extracting device.

9. Swaging machine according to Claims 3 and 8, characterised in that each extractor and sizing rod is detachably fixed to one end of a slide which slides up and down on the turret in directions parallel to the axis of rotation of the turret, the other end of the slide supporting the roller.

10. Swaging machine according to any one of Claims 1 to 9, characterised in that each swaging die is mounted in a bore of a rotary barrel fixed to the turret and is adjustable in position and is detachable.

11. Swaging machine according to one of the Claims 7 to 9, characterised in that guiding means are provided to prevent each slide from rotating about its own axis.

12. A swaging machine substantially as herein described with reference to the accompanying drawings.

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1563249 COMPLETE SPECIFICATION

3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

Fig.1

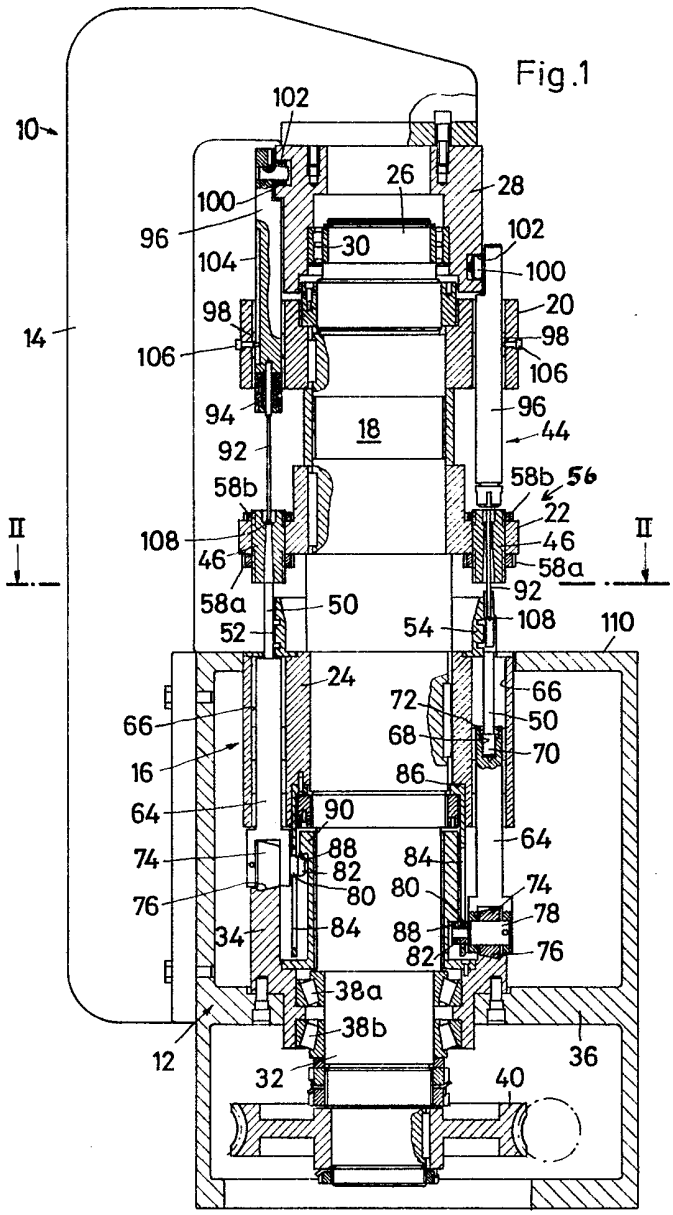

Fig.2

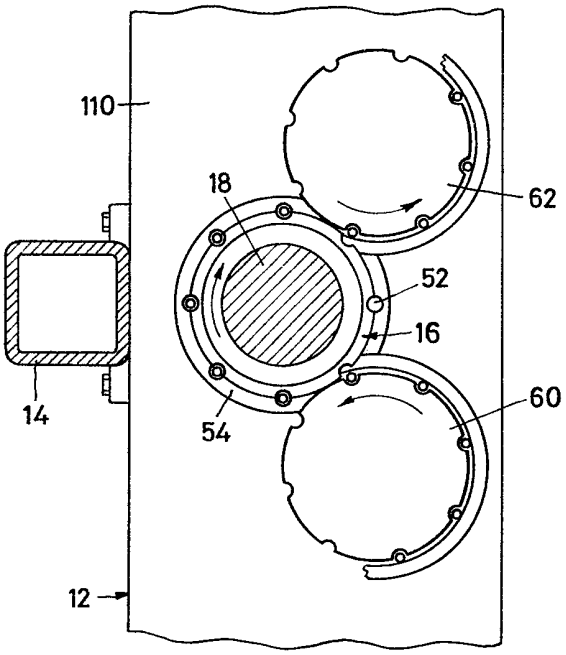

Fig.3