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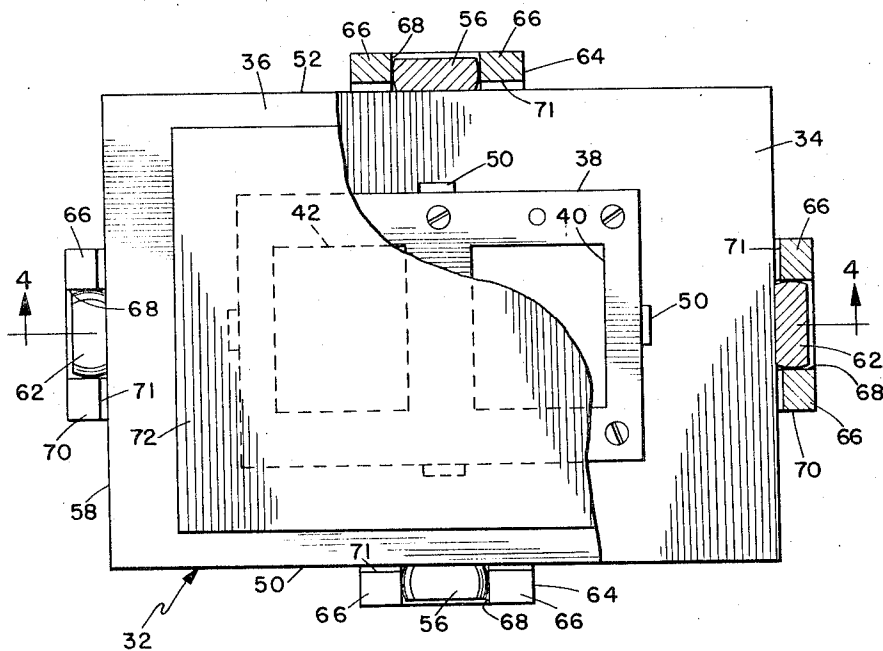
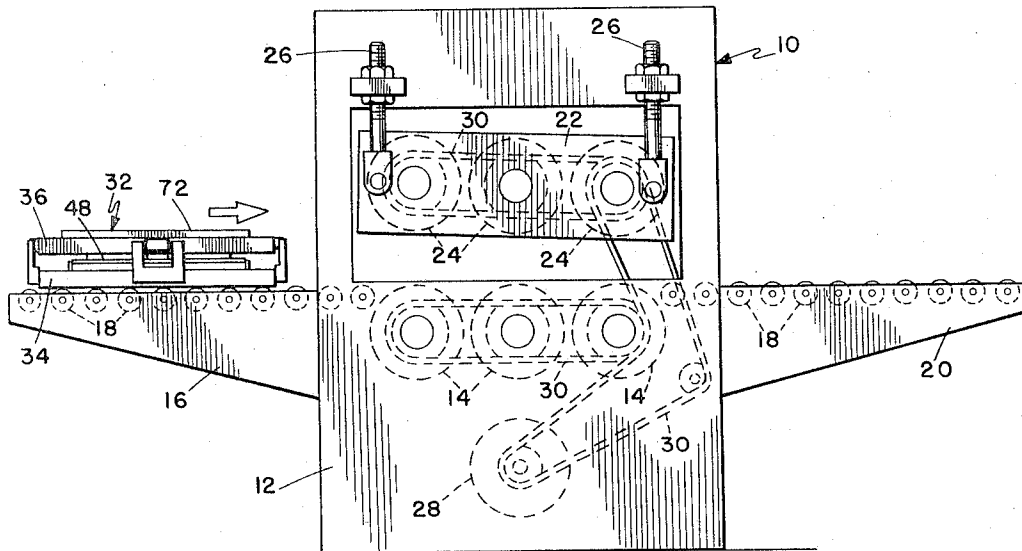
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3,301,110

MEANS AND METHOD OF ROLL FORMING AND PUNCHING

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2 Sheets-Sheet 1



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2 Sheets-Sheet 2

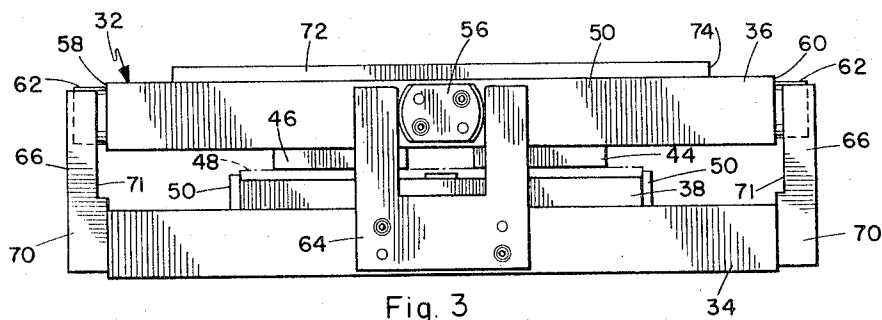


Fig. 3

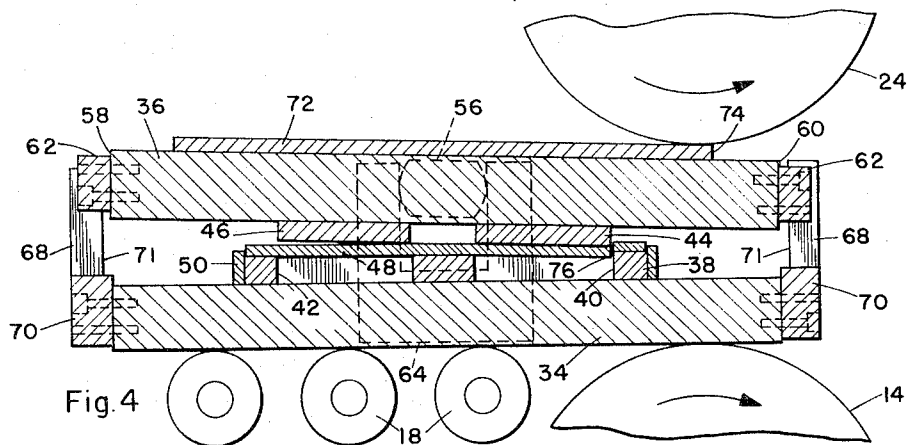


Fig. 4

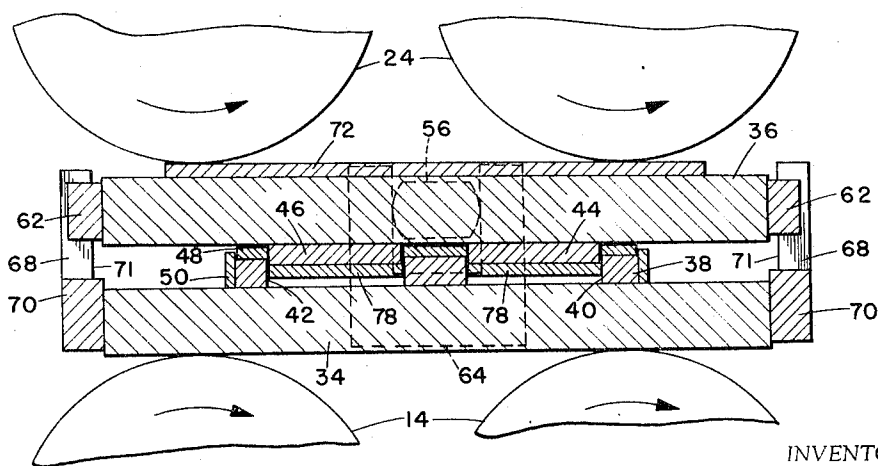


Fig. 5

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3,301,110 MEANS AND METHOD OF ROLL FORMING AND PUNCHING

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9 Claims. (Cl. 83—56)

The present invention relates to forming and punching of parts and more specifically to means and method of roll forming and punching.

Components or parts of metal or other materials are often made by forming in dies at various stages in their manufacture. Conventional presses to perform these operations are not only costly but are also large and require solid foundations, since the shock of impact during operation is considerable. In metal rolling mills, heated metal is rolled between successive rolls which are spaced progressively closer together, so that the thickness of the metal is gradually reduced.

It is a primary object of this invention to provide means for forming or punching a part between mated dies which are passed between progressively closer spaced rolls, so that pressure is applied in steps, each requiring only a fraction of the total pressure necessary to form a complete part, and in such a manner that the part is processed without slipping or distortion.

Another object of this invention is to provide die means specially adapted to progressive forming, the mated die portions being designed to seat against each other with one portion free to rock into inclined relation relative to the other portion while remaining in proper alignment as the die set passes between the rolls.

Another object of this invention is to provide die means having an initial starting shoulder, by which the first rolls apply a starting impact to cause the initial upsetting of the part, and which then holds the part against shifting during the remainder of the forming operation.

A further object of this invention is to provide die means which can be made in any size, within the capacity of the progressive roll apparatus, and with a wide variety of punching and forming elements as used in conventional dies, so that no new technique is necessary in the making of the dies per se.

In the drawings:

FIGURE 1 is a side elevation view of a progressive roll machine with a die assembly in position for starting an operation;

FIGURE 2 is an enlarged top plan of the die set, partially cut away;

FIGURE 3 is a side elevation view of the die set;

FIGURE 4 is a sectional view taken on line 4—4 of FIGURE 2, showing the initial action between the rolls; and

FIGURE 5 is a view similar to FIGURE 4, with the action substantially completed.

Similar characters of reference indicate similar or identical elements and portions throughout the specification and throughout the views of the drawing.

Basic apparatus

The progressive rolling machine, generally indicated at 10, has a rigid base frame 12 in which are mounted a plurality of generally horizontal back-up rollers 14 in a common plane. At one end of frame 12 is an entry table 16 having a plurality of freely rotatable support rollers 18 mounted thereon, and at the other end of said frame is a similar exit table 20 with further support rollers 18. All of the support rollers are rotatable on axes parallel to the back-up rollers 14 and are aligned so that the upper surfaces of all rollers are co-planar and form

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a substantially horizontal platform through the machine. In the upper portion of base frame 12 is a bridge frame 22 in which are mounted pressure rollers 24 parallel to and individually opposed to back-up rollers 14. Bridge frame 22 is attached to the base frame 12 at opposite ends by jack screws 26 of suitable type, allowing the bridge frame to be set in an inclined position with the pressure rollers 24 spaced progressively closer to their opposed back-up rollers 14 from the entry table 16 toward the exit table 20. All of the back-up rollers 14 and pressure rollers 24 are driven by a motor 28 through chains 30, or similar drive means.

The actual configuration of the machine 10, the number and disposition of the various rollers, the means for adjusting the pressure rollers and the drive means, are all subject to considerable variations depending on the specific use and capacity of the machine. The arrangement illustrated is merely typical.

Die set

The die set 32 is basically conventional with a base or lower platen 34 and an upper platen 36, both of simple rectangular form. Secured to the upper surface of lower platen 34 is a die 38, illustrated as a rectangular block with a pair of rectangular sockets 40 and 42. Fixed to the lower surface of upper platen 36 are punches 44 and 46 aligned to fit into sockets 40 and 42, respectively. When a blank 48, of metal or other sheet material, is placed on the die 38 and held between locating pins 50, and the two portions of the die set are brought together in proper register, punches 44 and 46 will punch out rectangular portions of the blank into sockets 40 and 42. It will be obvious that many different parts of various shapes, with various slot, holes and the like can be produced with the appropriate die and punch elements. Also, with shaped forming dies, flanges, beads, swaged portions and various indentations can be made in a blank. Ejection pins or similar means, not shown, can be used to release the finished parts and scraps, all of these techniques being well known in the art. Locating pins 50 are necessary only when the blank 48 is pre-cut to a specific size and may be omitted if an over-size blank is used, as in some operations.

The conventional posts and bushings used to align die sets cannot be used with the progressive roll operation, since they hold the two platens accurately parallel and will jam if one platen becomes offset. To pass through the progressive rolling stages the upper platen 36 must be inclined to follow the plane of the pressure rollers 24, yet must be maintained in precise alignment so that the punch and die elements interfit. This is accomplished by providing the upper platen with a limited gimbal-like freedom of motion, which allows the die set to be fed into the rolls in any direction.

On opposite side edges 52 and 54 of upper platen 36 are a pair of spherically ground key blocks 56, secured in axial alignment. On opposite end edges 58 and 60 of the upper platen are similar spherically ground key blocks 62 axially aligned on an axis perpendicular to that of key blocks 56. All of the key blocks 56 and 62 are truncated spheroid elements and may actually be made from heavy plate material, since only the horizontally opposed end portions need be spheroidal to accommodate the limited motion.

Fixed to lower platen 34 are a pair of generally U-shaped guide yokes 64 having spaced parallel arms 66 defining vertically extending slots 68, in which key blocks 56 are slidable with a close fit. Also on lower platen 34 are a similar pair of guide yokes 70 in which key blocks 62 slide. Thus the upper platen 36 is held against translatory motion, that is, longitudinal, lateral and rotational

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shifting in its own plane, but is free to rock about two orthogonal axes and be inclined in any direction relative to lower platen 34. Guide yokes 64 and 70 all have undercut portions 71 on the inner faces adjacent the platen to provide clearance for the upper platen 36 when tilted. The various components of the die set are secured together by suitable dowel pins, cap screws and the like, as in conventional die construction.

Fixed to the top surface of upper platen 36 is a shim plate 72 having an edge shoulder 74 inset from the edge of the platen. The thickness of the shim plate and the exact location of the shoulder will depend on the size and type of part being formed, as will be apparent from the description of operation. Shim plate 72 is of hardened material to prevent flattening by repeated passes through the rollers.

Operation

With a blank 48 in place, the die set 32 is placed on the support rollers 18 of entry table 16, as in FIGURE 1. Motor 28 is operated to rotate rollers 14 and 24, then the die set 32 is fed into the driven rollers. The die set is first engaged by the leading back-up roller 14, then the leading pressure roller 24 strikes the shoulder 74 of shim 72 and causes an initial downward impact on the upper platen 36, as in FIGURE 4. The upper platen 36 is thus tilted, the motion being accommodated by key blocks 56 rotating in their guide yokes 64 and key blocks 62 sliding in guide yokes 70, without the platens shifting out of registration. The initial impact causes punch 44 to penetrate blank 48 and displace a portion 76 thereof down into socket 40, the displaced portion acting as a key to hold the blank against shifting. The keying action continues as the die set advances and is particularly important in instances where locating pins 50 are not used. Even with locating pins in use as illustrated, the key effect of the initial punching action prevents the blank from jumping out of place. As the die set continues between the rollers, each opposed pair with progressively reduced spacing forces the upper platen 36 down in stages, until the waste portions or slugs 78 of blank 48 are completely displaced into sockets 40 and 42, as in FIGURE 5. Since the operation is progressive rather than by a single impact, the load on each pair of rollers is only a fraction of the total pressure and there is no violent shock, as in a punch press. Consequently the machine can be mounted on a normal floor, rather than requiring a special foundation.

By providing for gimbal-like rocking motion of the upper platen, the die set is adaptable for feeding into the rollers with any side first and does not require especially accurate positioning on the machine.

It is understood that minor variation from the form of the invention disclosed herein may be made without departure from the spirit and scope of the invention, and that the specification and drawings are to be considered as merely illustrative rather than limiting.

I claim:

1. A die set for use in a progressive rolling machine having successive pairs of driven rollers with progressively decreased spacing therebetween, whereby a die set passed between the rollers is subjected to successive, additive applications of pressure, the die set comprising:

- a plate-like lower platen;
- a plate-like upper platen;
- matching punch and die elements rigidly secured to said upper and lower platens to interfit and form a part therebetween when the platens are brought together;
- and guide means on one of said platens engageable with the other platen to restrain said upper platen against translatory shifting in its own general plane, while allowing the upper platen to be inclined relative to the lower platen as the die set advances between said rollers.

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2. A die set for use in a progressive rolling machine having successive pairs of driven rollers with progressively decreased spacing therebetween, whereby a die set passes between the rollers is subjected to successive, additive applications of pressure, the die set comprising:

- a plate-like lower platen;
- a plate-like upper platen;
- matching punch and die elements rigidly secured to the upper surface of said lower platen and the lower surface of said upper platen to interfit and form a part therebetween when the platens are brought together;
- a shim secured to the upper surface of said upper platen and having a shoulder inset from the edge of the platen, said shoulder providing an initial impact when the first of said rollers strikes the same and giving an initial keying of the corresponding edge of a blank being formed;
- a guide means on one of said platens engageable with the other platen to restrain said upper platen against translatory shifting in its own general plane, while allowing the upper platen to be inclined relative to the lower platen as the die set advances between said rollers.

3. A die set for use in a progressive rolling machine having successive pairs of driven rollers with progressively decreased spacing therebetween, whereby a die set passed between the rollers is subjected to successive, additive applications of pressure, the die set comprising:

- a plate-like lower platen;
- a plate-like upper platen;
- matching punch and die elements rigidly secured to the upper surface of said lower platen and the lower surface of said upper platen to interfit and form a part therebetween when the platens are brought together;
- said lower platen having guide means thereon;
- said upper platen having portions vertically slidable in said guide means and pivotal therein about at least one axis substantially in the plane of the upper platen as the die set advances between said rollers.

4. Apparatus according to claim 3 wherein said upper platen is pivotal about a pair of orthogonal axes substantially in the plane of the platen.

5. Apparatus according to claim 3 wherein said guide means includes guide yokes having vertically extending slots, and said upper platen portions are key blocks having arcuate edges engageable in said slots.

6. A die set for use in a progressive rolling machine having successive pairs of driven rollers with progressively decreased spacing therebetween, whereby a die set passed between the rollers is subjected to successive, additive applications of pressure, the die set comprising:

- a plate-like lower platen;
- a plate-like upper platen;
- matching punch and die elements secured to the upper surface of said lower platen and the lower surface of said upper platen to interfit and form a part therebetween when the platens are brought together;
- key blocks secured to the edges of said upper platen, said key blocks being of truncated spheroidal form and being disposed in opposed pairs on orthogonal axes substantially in the plane of the upper platen;
- and guide yokes on said lower platen having vertically extending slots in which said key blocks are slidable and rotatable.

7. Apparatus according to claim 6 and including a shim secured to the upper surface of said upper platen, said shim having a shoulder inset from the edge of the platen.

8. A method of forming and punching parts, comprising:

- preparing a die set with matching punch and die elements fixed on the confronting faces of a pair of interfitting platens;
- placing a blank part to be formed between the punch and die elements;

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applying force progressively from the one end of the die set to the other and thus relatively tilting the matching punch and die elements and progressively forcing the die elements toward each other, whereby the part is formed in progressive steps;
and removing the finished part from the die set.

9. A method according to claim 8 and including holding the punch and die elements against relative movement normal to the direction of the force application.

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