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Alvi et al.

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[54] **MULTI-STAGE FORMING MACHINE**

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[52] **U.S. Cl.**.....**72/405**

[51] **Int. Cl.**.....**B21j 9/18**

[58] **Field of Search**.....72/405, 335, 338, 403, 404, 72/421, 426, 428, 472; 10/12, 12.5; 83/255

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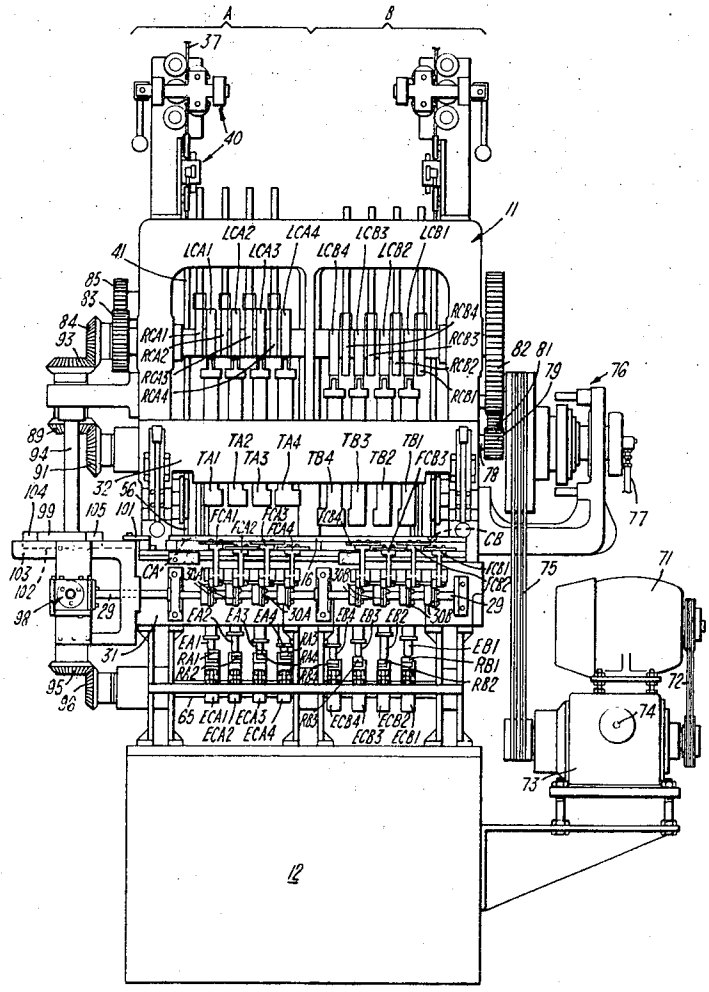
[57] **ABSTRACT**

A machine for cold forming workpieces in which workpieces are subjected to a sequence of work operations performed by a bank of co-operating tools and dies, therebeing transfer means for transferring each workpiece through successive work stations in the bank so as to be subjected sequentially to the action of successive co-operating tools and dies. The machine has two such banks operating 180° out of phase and the transfer means of both banks are carried by a common reciprocable slide, the arrangement being such that, in one direction of its reciprocating movement, the common slide moves the transfer means of one bank in a direction which advances the workpieces in that bank to successive work stations while the transfer means of the other bank are returning, and, in the other direction of reciprocating movement of the slide, the transfer means of the other bank advance the workpieces in the other bank while those of the one bank return.

1 Claim, 11 Drawing Figures



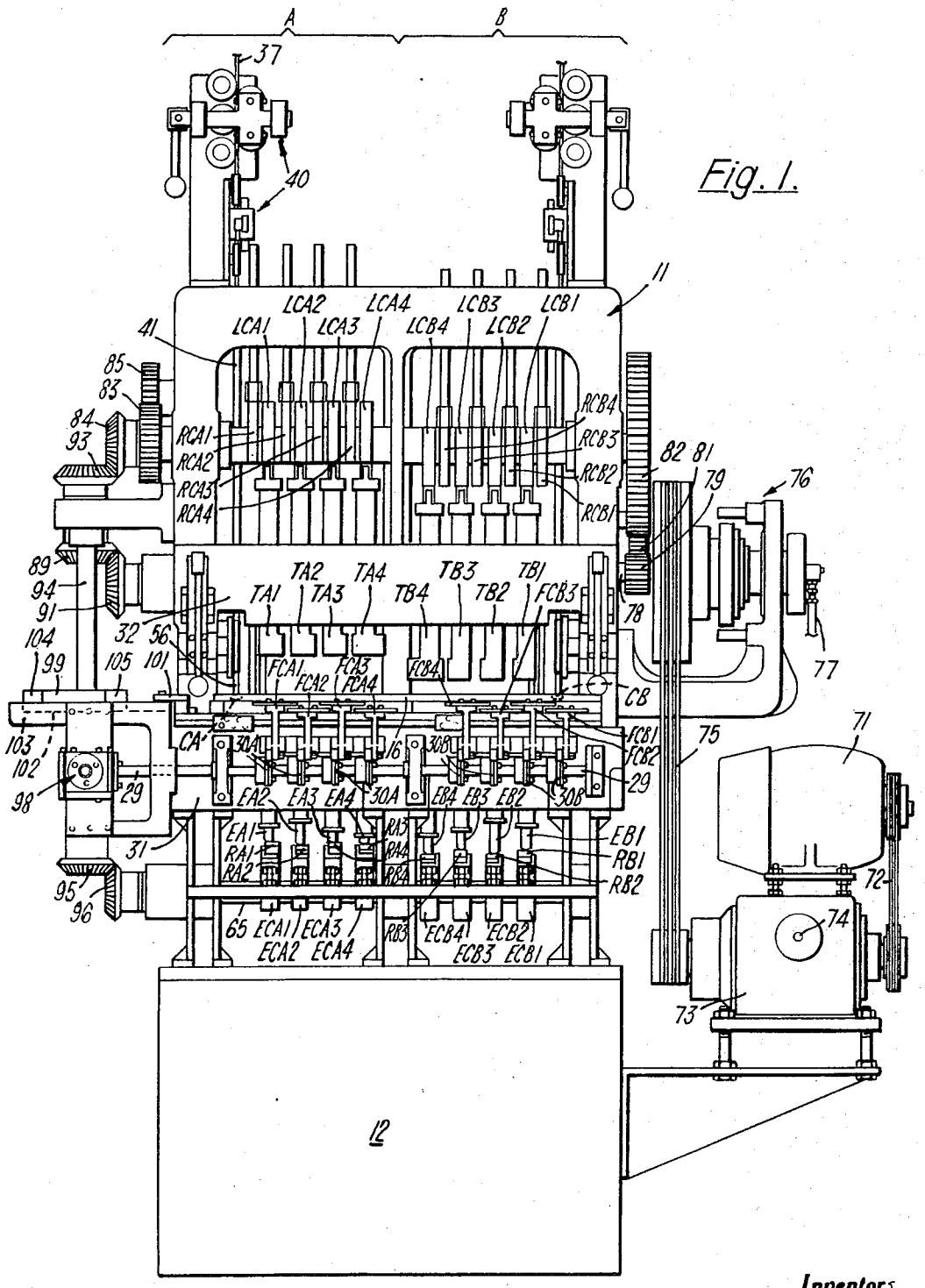


Fig. 1.

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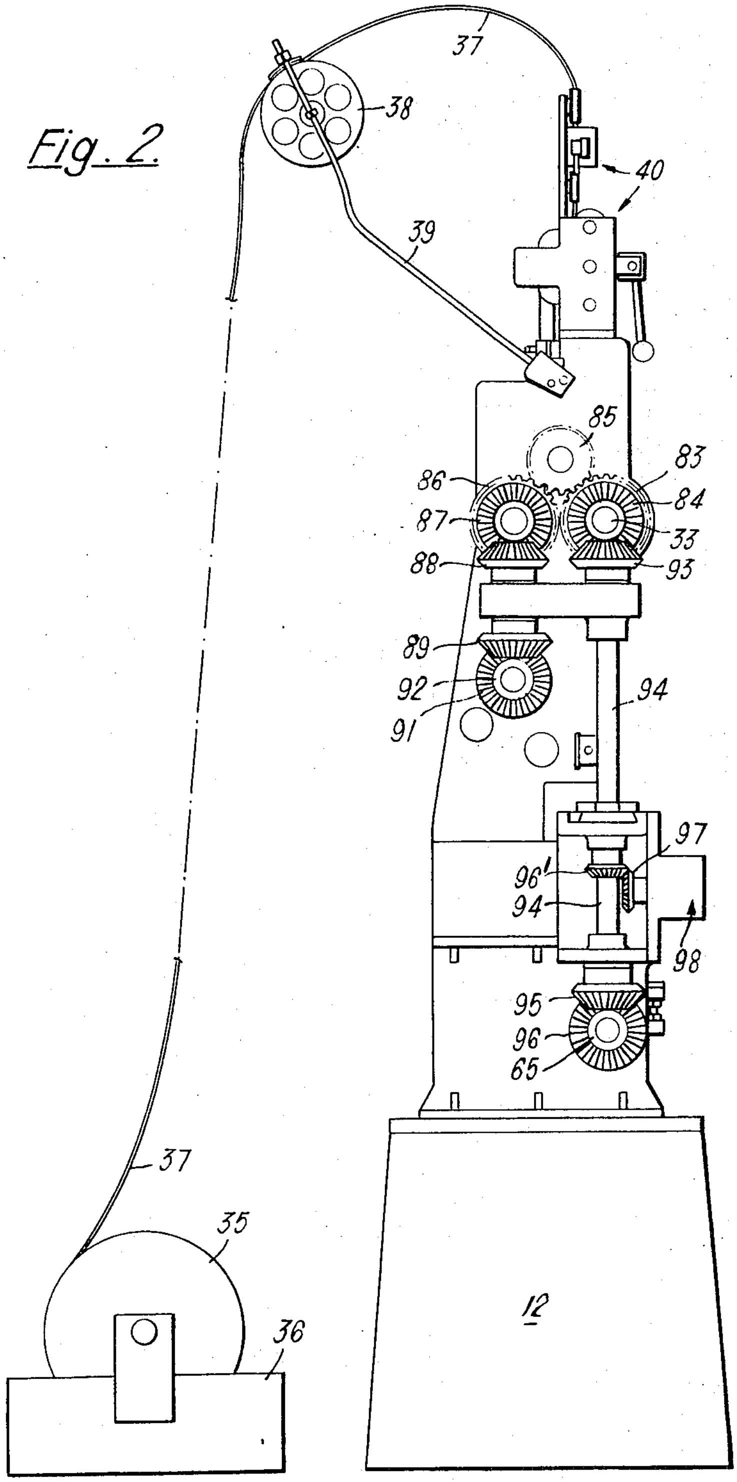
Fig. 2.



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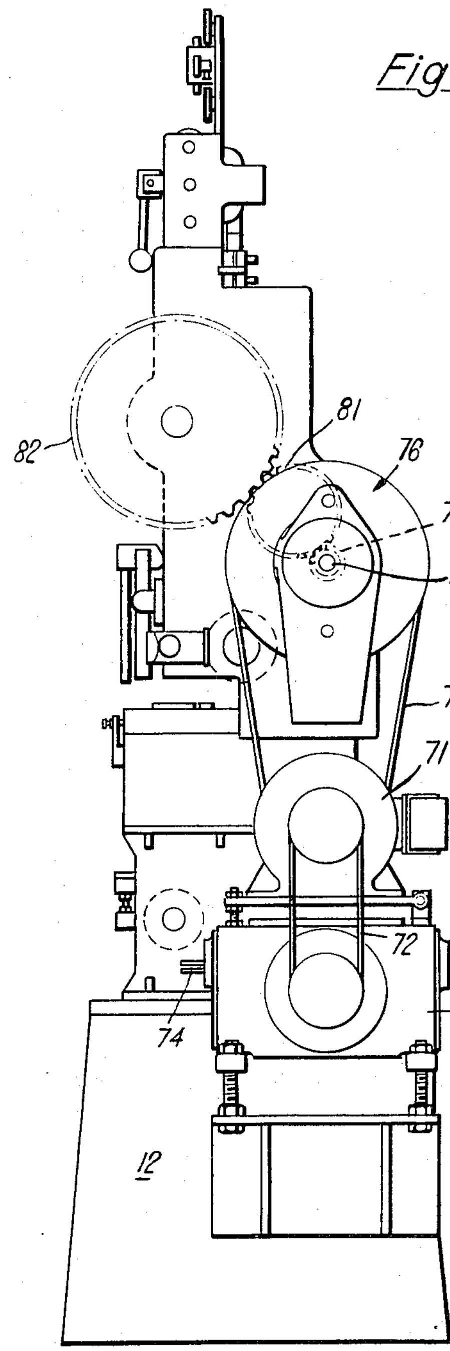

Fig. 3.

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Fig. 4.

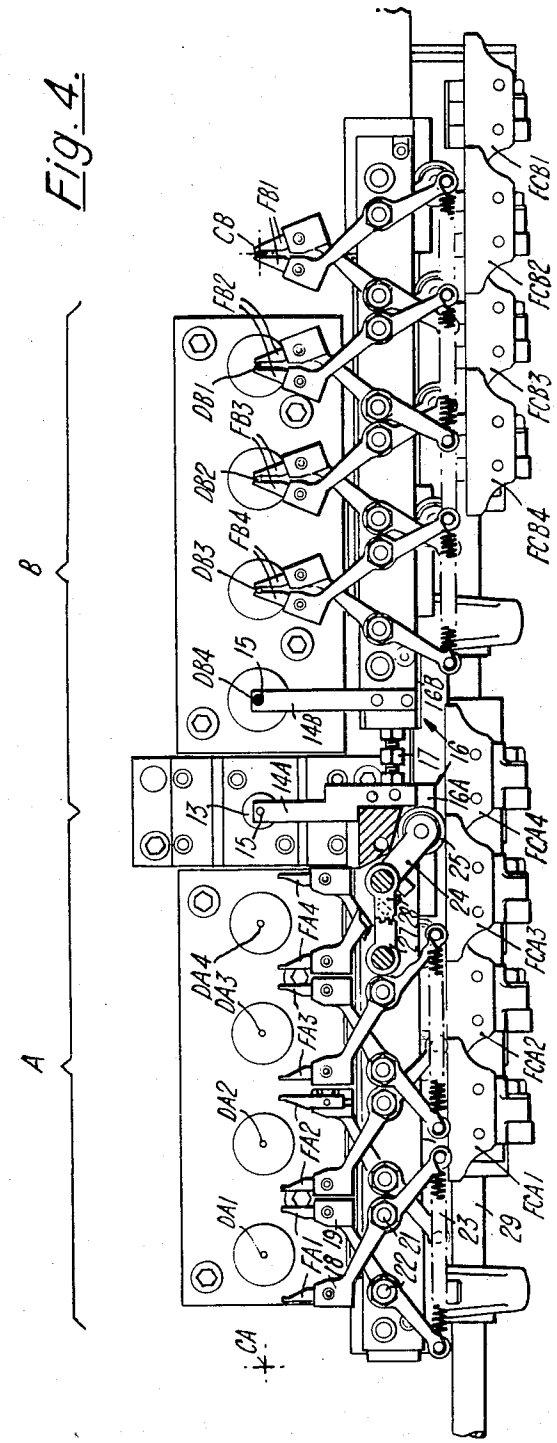

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Fig. 5.

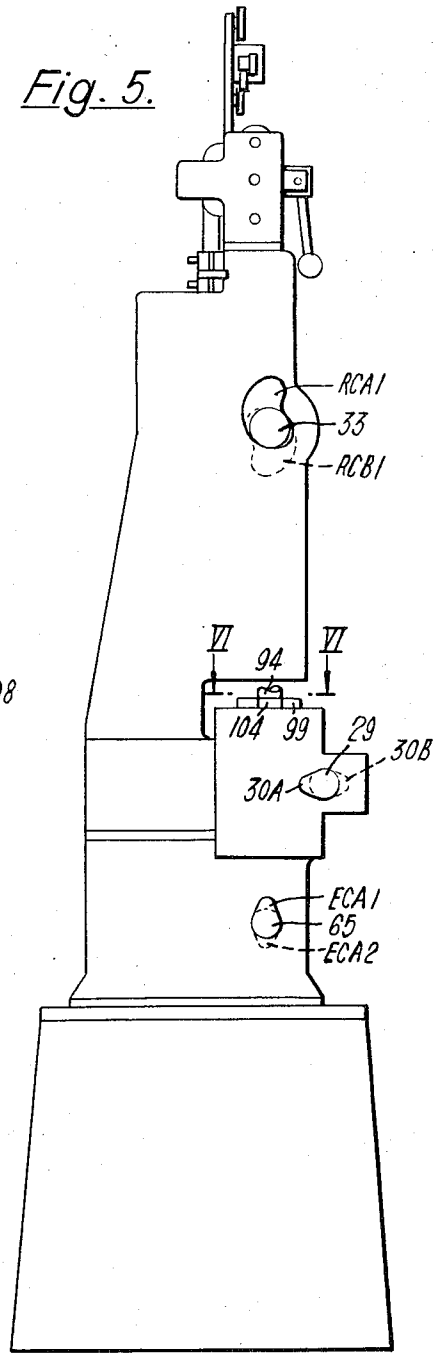
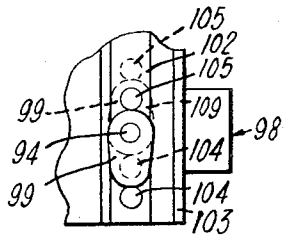


Fig. 6.



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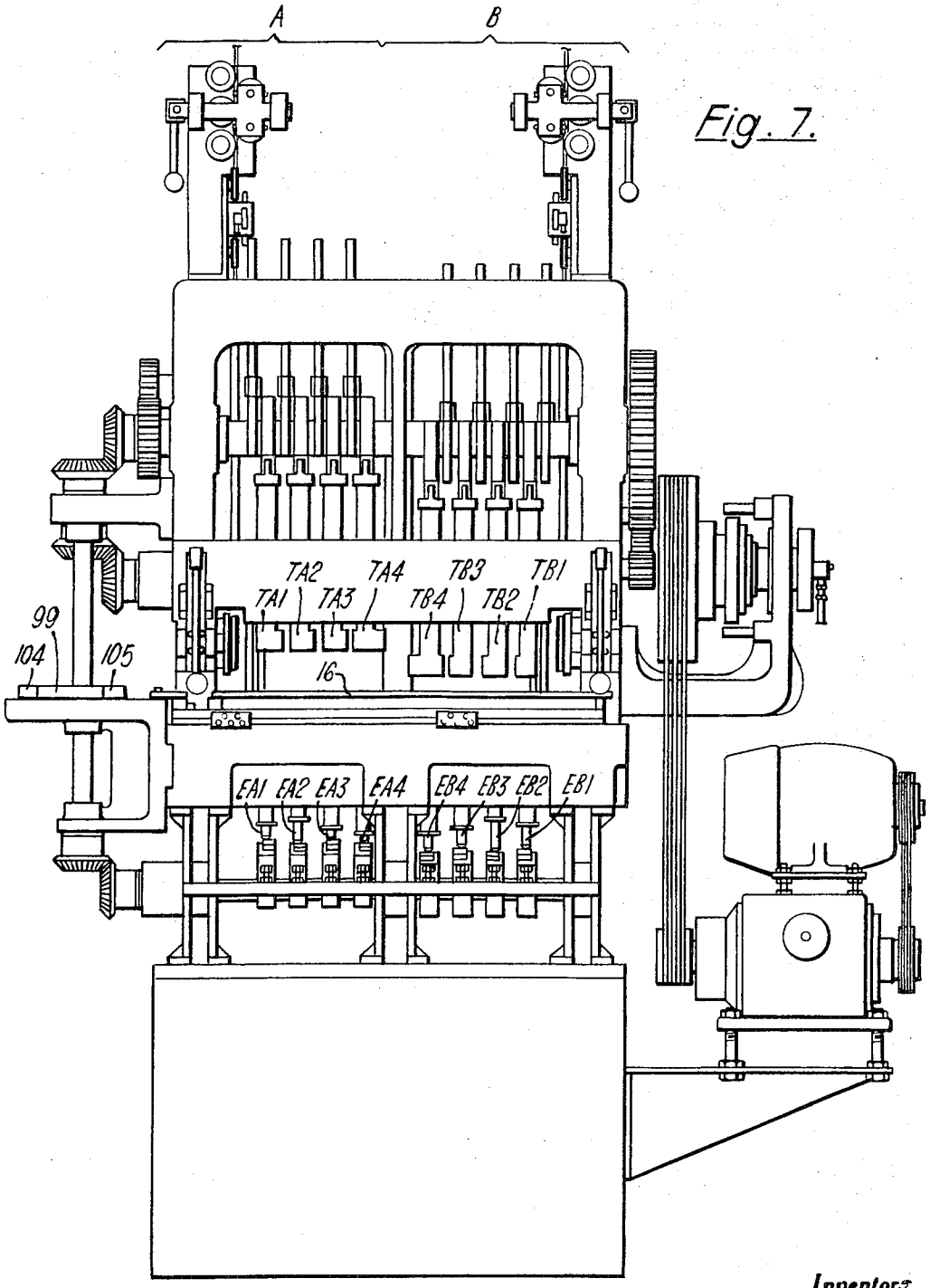

Fig. 7.

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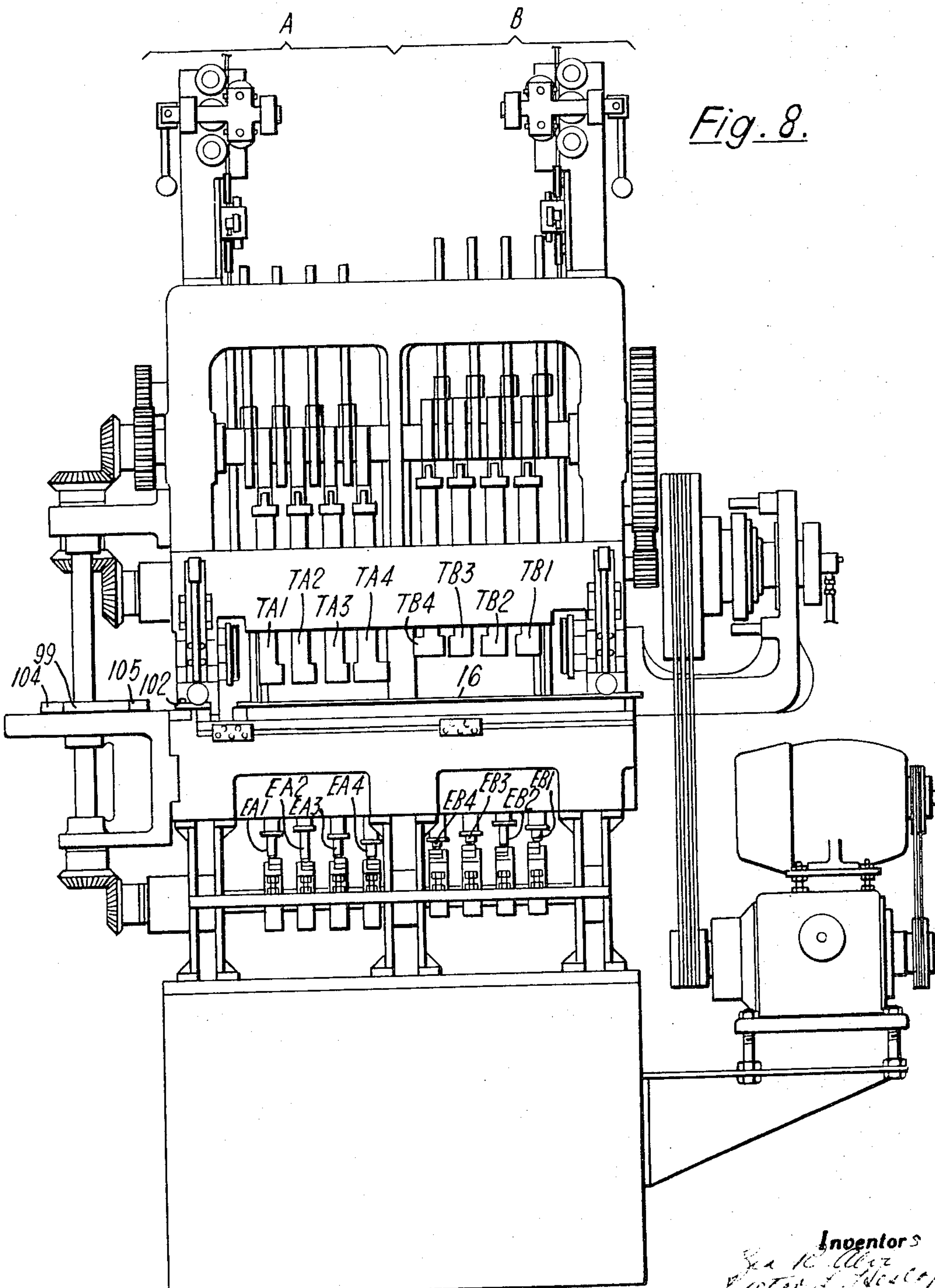

Fig. 8.

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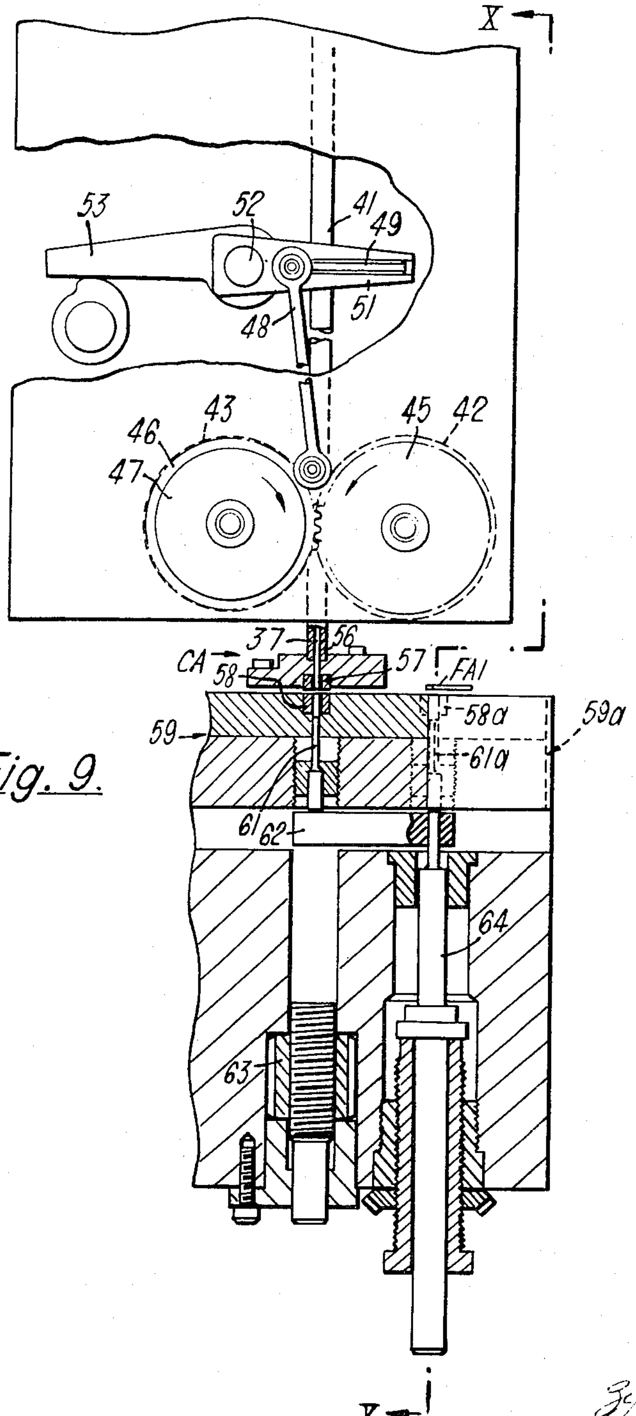

Fig. 9.

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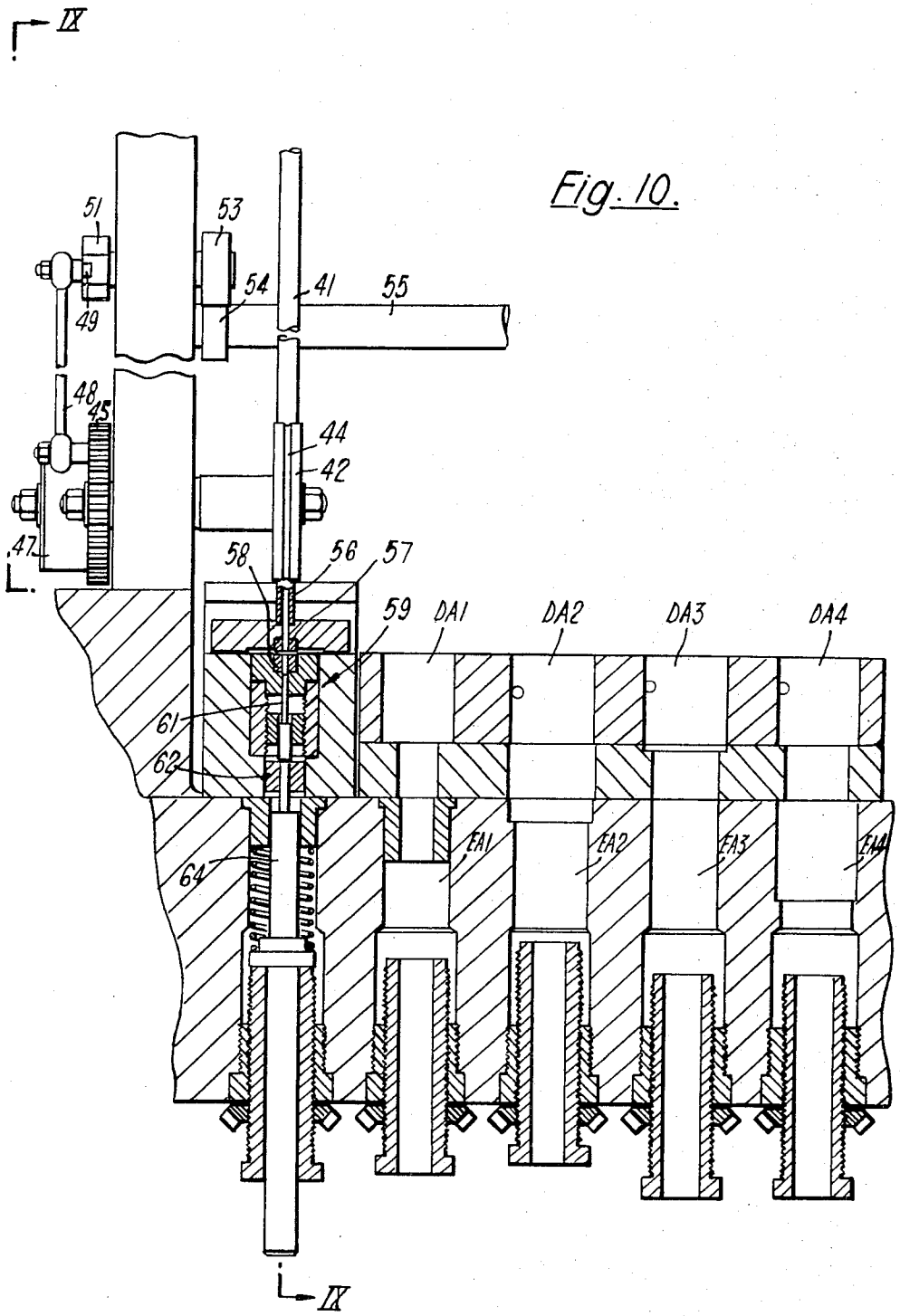

Fig. 10.

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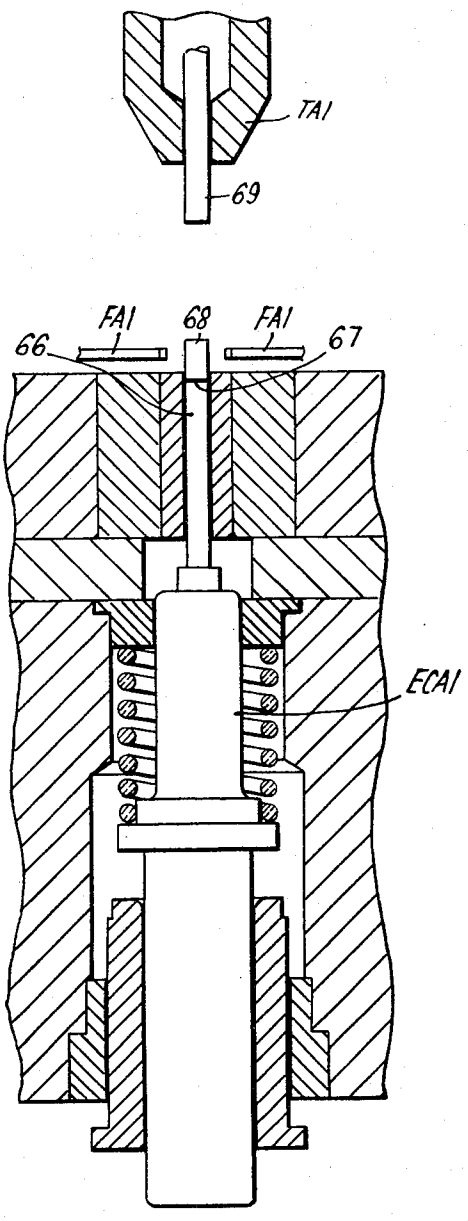
Fig. 11.



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MULTI-STAGE FORMING MACHINE

The invention relates to a multi-stage forming machine of the type comprising:

- a plurality of dies for receiving workpieces successively;
- a plurality of toolholders each associated with one of the dies, each for holding a tool and each reciprocable to bring the tool to strike a workpiece received in the associated die;
- means for reciprocating the toolholders substantially in unison so that the tools are all withdrawn from the dies at least for a common withdrawal period in each reciprocation;
- and transfer means for transferring workpieces successively from one die to the next during each common withdrawal period of the tools, the transfer means comprising workpiece-gripping means and a reciprocable transfer slide, reciprocation of the transfer slide in appropriate relationship to the reciprocation of the toolholders causing, during advance movement, advance of the workpiece-gripping means from one die to the next and, during return movement, return of the workpiece-gripping means from the said next die to the said one die.

Such a multi-stage forming machine is hereinafter referred to as "a multi-stage forming machine of the type defined." Such machines, and their manner of operation, are well known to those skilled in the art of manufacturing large numbers of small metal articles, e.g. rivets.

The invention provides, in one of its aspects, a multi-stage forming machine of the type defined, which machine comprises:

- two banks each consisting of a plurality of dies and associated toolholders;
- means for reciprocating the toolholders of one bank substantially 180° out of phase with the toolholders of the second bank;
- and a common reciprocable transfer slide for the transfer means of both banks;
- the arrangement being such that when the common reciprocable transfer slide is moving in one sense the workpiece-gripping means of the first bank are advancing while the workpiece-gripping means of the second bank are returning, and when the common reciprocable transfer slide is moving in the opposite sense the workpiece-gripping means of the first bank are returning while the workpiece-gripping means of the second bank are advancing.

The common reciprocable transfer slide may comprise a single member. However, in a preferred embodiment of the invention, it comprises two members, each associated with the workpiece-gripping means of one of the banks, linked together for movement in unison. Preferably the members are linked together by an adjustable linkage which provides for relative adjustment of the two members in the direction of their reciprocation.

In a preferred embodiment of the invention, the two banks are positioned relatively end-to-end in a straight line, and the machine is arranged so that workpieces in each bank are moved progressively towards the adjacent ends of the banks where there may be provided a common discharge station for workpieces from both banks. In this case, workpieces are discharged at the discharge station from the two banks alternately. Alternatively, separate adjacent discharge stations, one for each bank, may be provided at the adjacent ends of the two banks. This enables workpieces from the two banks to be collected separately.

The invention provides, in another of its aspects, a multi-stage forming machine of the type defined, including means for feeding wire stock vertically and means for cropping lengths from the stock to provide workpieces, and in which each die faces vertically upwards to receive a workpiece in a vertical position, whereby after being struck by the associated tool the workpiece can be fully ejected from the die before being gripped by the workpiece-gripping means, without tending to tip sideways out of its vertical position.

A specific embodiment of the invention will now be described by way of example and with reference to the accompanying drawings, in which:

FIG. **1** is a front elevation of a multi-stage forming machine;

FIG. **2** is an elevation of one end of the machine;

FIG. **3** is an elevation of the other end of the machine (part being omitted);

FIG. **4** is a plan view of the transfer means;

FIG. **5** is a diagrammatic section through the machine showing the relative positions of some cams;

FIG. **6** is a plan view, on the line VI — VI of FIG. **5**, of the transfer slide reciprocating means;

FIGS. **7** and **8** are front elevations of the machine, partially simplified, illustrating the toolholders and transfer slide at two positions respectively 180° apart in their cycles of reciprocation;

FIGS. **9** and **10** are sections (on the lines IX — IX of FIG. **10** and X — X of FIG. **9** respectively) at right-angles to each other, showing part of the wire feed and the cropping means; and

FIG. **11** is a cross-section showing by way of illustration, a die and tool of one of the banks.

The twin bank multi-stage forming machine of this example has a general arrangement which will be apparent from FIGS. **1**, **2**, **3** and **4**. It is built in a strong frame **11** supported on a substantial base **12**. The The machine has two banks A and B adjacent each other in end-to-end relationship, each bank occupying one half of the machine frame. The two banks are substantially identical with each other, except that one is substantially a mirror image of the other. Each bank comprises a slug cropping station, at which a slug is cropped from the end of a wire feed to form a workpiece, four workpiece forming stages through which the workpiece passes successively, and a discharge station at which the workpieces are discharged from the machine. In this example, there is a single discharge station **13** which is common to both banks, positioned at the junction between the banks in the center of the machine, and the two slug cropping stages are positioned one at the outer end of each bank.

Bank A comprises four dies DA**1**, DA**2**, DA**3** and DA**4**, and bank B likewise comprises four dies DB**1**, DB**2**, DB**3** and DB**4**. (In FIG. **4**, the dies are represented schematically, the actual construction of the die forming no part of the present invention). The common discharge station **13** is situated midway

between the two final dies DA4, DB4. The spacing between each die and the next is the same for both banks, and is also the same as the distance between each final stage die DA4, DB4 and the common discharge station 13.

At the outer end of each bank A, B, is situated a cropping station CA, CB respectively, the positions of the center line of each being indicated in FIG. 4. FIG. 4 also illustrates the transfer means. This comprises workpiece-gripping means associated with each die, in the form of a pair of fingers. Associated with bank A are four pairs of fingers FA1, FA2, FA3 and FA4 and an arm 14A. Likewise, associated with bank B are four pairs of fingers FB1, FB2, FB3 and FB4 and an arm 14B.

The pairs of transfer fingers of both banks are carried on a reciprocable slide 16, which comprises two separate members 16A and 16B rigidly connected together by a linkage 17. The member 16A carries the set of four pairs of fingers and the arm 14A of bank A and the member 16B carries the set of four pairs of fingers and the arm 14B of bank B. The linkage 17 can be adjusted to adjust the distance between the two members 16A and 16B in the direction of reciprocation of the slide 16, in order to correctly align the two sets of fingers and arms relatively to each other. The arms 14A and 14B are fixed in position relative to the slide members 16A and 16B respectively and the fingers of each pair are movably mounted on the slide members so as to be capable of gripping and releasing workpieces.

When the machine is operating, the first pair of fingers FA1 transfer a cropped slug from the cropping station CA to the die DA1 while the second pair of fingers FA2 transfer a workpiece from die DA1 to die DA2, and so on. Workpieces from the two final dies DA4, DB4 are transferred to the discharge station 13 by means of the fixed arms 14A, 14B respectively. Each fixed arm has a circular workpiece receiving aperture 15 near its end in which the workpiece is carried from the final stage die to the discharge station. As the slide reciprocates, the apertures 15 are moved between positions in which they are aligned alternately with the center of the final die and the discharge station.

The general construction and method of operation of the pairs of transfer fingers used in this machine is well known to those skilled in the art of multi-stage progressive cold forming machines, and will only briefly be described here. Taking as an example the pair of fingers FA1, these two fingers are each mounted at one end of an arm 18, 19 respectively. Each arm is pivoted approximately mid-way along its length on a pillar 21, 22 respectively. The other end of the two arms are joined by means of a tension coil spring 23 which urges the two fingers FA1 together. In FIG. 4, the fingers of bank B are shown in their closed position and the fingers of bank A are shown open. Adjustable stops are provided for adjusting the extent to which the fingers close on each other to properly grasp the workpiece. The finger opening mechanism is illustrated in FIG. 4 with reference to the pair of fingers FA4. Secured to one finger of the pair is an arm 24 having at its remote end a cam follower roller 25 which engages with an elongated closing cam FCA4. The two fingers are coupled together for opposing pivoting movement about their respective pivots by means of interengaging toothed arms 27, 28, each constituting part of a spur gear. Each closing cam is elongated in the direction of reciprocation of the transfer slide so that the follower roller 25 can be engaged by the cam face throughout the travel of the slide. When the cam is moved into the open position (as in bank A in FIG. 4) it engages the roller 25 and causes the two arms to rotate about their pivot to open the fingers. When the cam is in its closed position (as in bank B in FIG. 4) the tension coil spring of each pair of arms closes the fingers. Movement of each finger closing cam FCA1, FCA2, FCA3, FCA4, FCB1, FCB2, FCB3, FCB4 is actuated by an associated rotating cam 30A or 30B (for banks A and B respectively) on a camshaft 29 in the machine. In general, the finger closing cams of each bank move in synchronism, but minor adjustments in the phase of their relative movements are possible.

As illustrated in FIG. 1, the transfer slide 16 reciprocates in a machine slideway in the front lower cross member 31 of the machine frame. The mechanism causing its reciprocation will be described later.

Also as illustrated in FIG. 1, associated with each die in each bank is a toolholder which is reciprocable vertically to cause a tool mounted in the lower end of the toolholder to strike the workpiece in the associated die when the toolholder reaches the bottom of its stroke. Thus in bank A there are four toolholders TA1, TA2, TA3 and TA4 and likewise in bank B, there are four toolholders TB1, TB2, TB3 and TB4. The design and operation of the particular tools secured to the bottoms of the toolholders of each bank is arranged so that each tool provides a further stage in the forming of the workpiece as the workpiece progresses from the slug cropping station to the discharge station but otherwise forms no part of the present invention, and will not be described further. In this machine, each toolholder is provided in the form of a vertically disposed ram reciprocable in suitable slide bearings in the frame middle cross member 32. Each toolholder is reciprocated by means of a pair of cams, one for raising the toolholder and one for lowering it. The four toolholders of bank A have respectively four raising cams RCA1, RCA2, RCA3 and RCA4, and four lowering cams LCA1, LCA2, LCA3 and LCA4. Likewise, the toolholders of bank B have respectively four raising cams RCB1, RCB2, RCB3 and RCB4, and four lowering cams LCB1, LCB2, LCB3 and LCB4. A suitable separate follower is provided for each raising and lowering cam respectively, secured to the upper part of the associated toolholder. All the raising and lowering cams are mounted on the same main camshaft 33. The cams are generally arranged so that the four toolholders of one bank are raised when the four toolholders of the other bank are lowered i.e. the reciprocation of the two banks of toolholders is substantially 180° out of phase. Each cam is suitably shaped for the function which it performs, and provision is made for minor adjustment of the phase of each cam in order to permit the most efficient working of the machine.

Associated with each bank of the machine is means for feeding wire to the cropping station of that bank. The wire feed means associated with bank A will be described, that associated with bank B being similar. As shown in FIG. 2, a feed reel 35 of wire stock is situated

on the floor behind the machine, supported in a suitable stand **36**. The wire **37** passes upwardly and over a guide pulley **38** secured to the outer upper end of an arm **39** mounted on the upper part of the machine frame. The wire then passes forwardly and downwardly, and passes vertically downward through two straighteners **40**. The straightened wire then passes vertically downwards just inside the side of the machine frame and behind the camshaft **33**. While within the machine frame and adjacent the reciprocating toolholders and camshaft, the wire passes through a tube **41** which protects it from contamination by lubricating oil splashes. At the bottom end of the tube **41** the wire emerges into a feeding device and cropping means, which are shown in FIGS. **9** and **10**.

The feeding device comprises two feed wheels **42** and **43** which touch tangentially to provide a nip, the peripheral face of each wheel having in it a groove **44** of part circular cross-section to receive and grip the wire. These two feed wheels are geared together by means of gear wheels **45** and **46** (only a few teeth of each gear wheel are illustrated in FIG. **9**) for rotation in unison in opposite directions to feed the wire stock downwards through their nip. The feed wheels are rotated intermittently by means of a drive to the gear wheel **46**, comprising a ratchet device **47** driven by a connecting rod **48**, the remote end of the rod **48** being secured in a slide **49** along a rocking arm **51**. The rocking arm **51** pivots about a pin **52**, and is oscillated by means of a follower arm **55** also secured to the pin **52** and spring urged into contact with a cam **54** on a shaft **55**. The shaft **55** is rotated continuously in synchronism with the remainder of the machine. The length of wire fed at each revolution of the shaft **55** is determined by the position of the upper end of the rod **48** along the slide **49** in the oscillating arm **51**. The position of the upper end of the rod **48** relative to the slide **49** is adjustable so as to vary the angle through which the feed wheels **42** and **43** are advanced at each revolution of the shaft **55** and so to adjust the length of wire fed at each revolution.

Below the feed wheels **42, 43** the wire **37** passes through a further short length **56** of protective tubing and then through a fixed cropping die **57** formed of hardened steel. This cooperates with a similar movable hardened steel cropping die **58** carried in a cropping slide **59**. The cropping slide **59** is reciprocable between two positions, i.e. a rearward position (shown in FIG. **9** in solid lines) in which the cropping dies **58** and **57** are superposed, and a forward position (illustrated in FIG. **9** in broken lines and with reference numerals with the suffix *a*) in which the movable cropping die **58** is in alignment with the center of the first stage fingers **FA1**. The cropping slide **59** is reciprocated by means of a suitable rocker mechanism which is actuated by a cam shaft driven in synchronism with the remainder of the machine. When the cropping slide **59** is in its rearward position with the movable cropping die **58** aligned with the fixed cropping die **57**, a length of wire is fed downwardly through the die **57** into the die **58** by the feed wheels **42, 43**. The maximum length of wire which can be fed into the movable cropping die **58** is determined by a positive stop provided by the upper end of a pin **61** underneath the die **58** within the slide **59**. The lower end of the pin **61** rests on and slides along the upper face of a bar **62**, the height of which is adjustable by means of a screw device **63**. Thus the length of wire cropped to provide a slug or billet is accurately adjustable.

When the cropping slide **59** moves from its rearward position, the wire within the movable cropping die **58** is sheared from the stock at the interface of the two dies **57, 58** to provide a slug. The slug is supported in the die **58** on the top end of the pin **61** and is carried forward within the die **58** until the slide **59** reaches its forward position, indicated by numeral **59***a* and shown in broken lines in FIG. **9**. This position is also shown (in full lines) in FIG. **10**. When the slide **59** reaches its forward position, the pin **61** is then immediately above an ejector **64**, the upper end of which passes through the block **62**. The ejector **64** is then actuated (by means which will be described later) to eject the cropped slug from the cropper die **58**, so that it stands vertically upon the upper end of pin **61**. The slug is then grasped by the fingers **FA1** and transferred to the die **DA1** of the first stage of bank A.

The four dies **DA1, DA2, DA3** and **DA4** are each provided with ejectors, **EA1, EA2, EA3** and **EA4** respectively, which are indicated in FIG. **1** and also, in outline, in FIG. **10**. Likewise the dies **DB1, DB2, DB3** and **DB4** of bank B have four ejectors **EB1, EB2, EB3** and **EB4**. Each ejector is actuated by means of a separate ejector cam, the lower end of each ejector resting on a rocker arm and the underside of the rocker arm contacting the ejector cam. The eight rocker arms **RA1, RA2, RA3, RA4, RB1, RB2, RB3, RB4** and the eight ejector cams **ECA1, ECA2, ECA3, ECA4, ECB1, ECB2, ECB3, ECB4** respectively are indicated in FIG. **1**. The ejector cams are mounted on a cam-shaft **65** passing through the lower part of the machine frame. The two cropping ejectors are also actuated by ejector cams on the shaft **65**, but these ejectors and cams are not illustrated in FIG. **1**.

FIG. **11** illustrates, in somewhat simplified form, the first stage of bank A. The ejector **EA1** includes an ejector pin **66** which is a close sliding fit within the bore of the die **DA1**. The pin **66** has a flat upper end **67** on which rests the workpiece **68**. FIG. **11** shows the position when the workpiece **68** has been struck by the tool **69** in the bottom of the toolholder ram **TA1** which has now withdrawn upwards. The ejector pin **66** is nearing its uppermost position, and the workpiece **68** is in a vertical position, resting on the upper end **67** of the pin **66**. The workpiece **68** remains in this vertical position as the ejector pin **66** completes its upward travel, completely ejecting the workpiece **68** from the die. The workpiece **68** is then grasped by the fingers **FA1** and transferred to the next die.

Referring now to FIGS. **1, 2** and **3** this multistage forming machine is powered by an electric motor **71** which is connected by belt drive **72** to the input of a variable speed device **73** having a speed control knob **74**. The output drive from the device **73** is transmitted through belt drive **75** to the input of the pneumatically operated clutch **76**. This clutch is connected by a pneumatic pipe **77** (FIG. **1**) through a suitable control valve to source of compressed air. The output shaft **78** of the clutch carries a spur gear **79** in mesh with an idler gear **81** (only part of which is seen in FIG. **1**). The idler gear **81** is in mesh with a large gear wheel **82** secured to one

end of the main camshaft **33** outside one end of the machine frame **11**. The main camshaft **33** runs completely across the machine and extends through the opposite end of the machine frame, where it carries a spur gear **83** and a bevel gear **84**. The spur gear **83** drives, in succession, an idler spur gear **85**, spur gear **86** and bevel gear **87** secured to the spur gear **86**. The bevel gear **87** meshes with a bevel gear **88** on the top end of a short vertical layshaft, the bottom end of which carries another bevel gear **89** in mesh with a bevel gear **91** mounted on a horizontal shaft. This horizontal shaft is connected through suitable gearing to drive the wire feed device and cropping device of bank A at that end of the machine. The bevel gear **91** is secured to a shaft **92** which extends back across the machine frame to drive, through suitable gearing, the wire feed device and cropping device of bank B at the other end of the machine.

The bevel gear **84** on the end of the main camshaft **33** is in mesh with a bevel gear **93** on the upper end of a long vertical layshaft **94**. To the lower end of this layshaft is secured a bevel gear **95** in mesh with a bevel gear **96** secured to the ejector camshaft **65**. Thus the ejector camshaft is driven in synchronism with the main camshaft **33**. The layshaft **94** also carries a bevel gear **96'** which is in mesh with a bevel gear **97**. This drives, through a suitable right-angle gear box **98** the camshaft **29** on which are the rotating cams **30A**, **30B**. Thus the finger closing camshaft **29** is also driven in synchronism with the main camshaft **33**. The layshaft **94** also carries an eccentric cam **99** which drives the transfer slide **16**. The left hand end of the transfer slide (as viewed in FIG. **1**) is connected, by means of a dog leg bracket **101**, with a cam follower slide **102** which can reciprocate in a suitable slideway in a bracket **103** extending from the left hand end of the machine frame. The upper face of the cam follower slide carries two cam follower rollers **104** and **105**, the distance between which is a fit on the longest diameter of the eccentric cam **99**. As the cam **99** rotates, the transfer slide is driven backwards and forwards in synchronism with the rotation of the layshaft **94**, i.e. in synchronism with the rotation of the main camshaft **33**. FIG. **6** shows in solid lines the position of cam **99** and followers **104**, **105** when the transfer slide **16** is in its most leftward position (as viewed in FIG. **1**), and shows in broken lines the positions of those parts when the transfer slide is in its most rightward position.

The movements of the two banks of the machine are arranged so that they are substantially 180° out of phase with each other. This is illustrated by a comparison of FIGS. **7** and **8**. FIG. **7** shows the situation in which the transfer slide **16** is at the left hand end of its travel, the toolholders TA1, TA2, TA3 and TA4, and the ejectors EA1, EA2, EA3 and EA4, of the bank A being all in their fully raised position, and the toolholders TB1, TB2, TB3 and TB4, of bank B all being in their fully lowered positions. FIG. **8** illustrates the position when the main camshaft has rotated through 180° from the position shown in FIG. **7**. In FIG. **8**, the transfer slide **16** is at the right hand end of its travel, the toolholders and ejectors of bank A are in their fully lowered positions, and the toolholders and ejectors of bank B are in their fully raised positions.

The other corresponding working parts of the two banks are also respectively 180° out of phase. FIG. **5** illustrates the way in which various cams of the two banks respectively are 180° out of phase. In FIG. **5**, there are shown in solid lines the position of the main raising cam RCA1 of the first stage of bank A, the ejector cam ECA1 of stage **1** of bank A and the finger closing cam **30A** of stage **1** of bank A. In broken lines are shown the positions of the corresponding main raising cam RCB1 of stage **1** of bank B, the ejector cam ECB1 of stage **1** of bank B, and the finger closing cam **30B** of stage **1** of bank B. It will be seen that in each case, the cam of bank B is 180° out of phase with respect to the corresponding cam in bank A. It should be noted that FIG. **5** is merely intended to illustrate this feature, and that the relative angular positions of the different types of cams, i.e. toolholder raising cam, ejector cam, and finger closing cam, of either bank are not necessarily accurately shown in FIG. **5**.

The multi-stage forming machine described in the foregoing example is advantageous in a number of ways. Since the two banks of the machine are 180° out of phase, the loads on the camshafts and their associated driving gear are more evenly distributed than if all the loads were taken at only one point in the cycle of rotation. The use of a single transfer slide for both banks of the machine means that the machine occupies less space than two separate single bank machines. In practice, the double bank machine of the above example occupies about three-quarters of the space which would be occupied by two separate single bank machines immediately adjacent each other. This constitutes a valuable saving of floor space in a factory. The fact that a workpiece in the machine is at all stages in a vertical position has the advantage that the workpiece does not tend to topple sideways or downwards, as occurs with multi-stage forming machines in which workpieces are horizontal. Thus the machine of this example is much less prone to jamming than machines with horizontal workpieces. It will also handle much shorter blanks and workpieces, since these can be fully ejected from the dies before being gripped by the transfer fingers.

The invention is not restricted to the details of the foregoing example. For instance, instead of the single discharge station for the finished workpieces of both banks, it would be possible to provide separate discharge stations, so that the workpieces produced by one bank are collected separately from those produced by the other bank. This could be achieved on the machine of the above example by providing a movable deflector plate at the discharge station which moves in synchronism with the transfer slide to deflect the workpieces from one bank in one direction and the workpieces from the other bank in another direction. Alternatively, the two banks could be moved slightly apart, so that the distance between the two last stage dies DA4 and DB4 is more than twice the distance between one die and the next, thus providing the two spaced apart discharge stations for the two banks. When the workpieces manufactured by the two banks respectively are collected separately, the tooling of each bank may be arranged so that the two banks form articles of different shapes. When this is so, it is desirable that the loads on each half of the main cam-shaft are kept as near as possible equal to each other.

Each bank of the machine need not contain four stages, but could contain two, three, five, six or even more stages. The invention could be applied to a machine with a somewhat different form of transfer mechanism, provided that the transfer mechanism utilizes a reciprocating transfer slide and that a common transfer slide is used for the two banks.

We claim:

1. A multi-stage forming machine of the type defined, which machine comprises:

first and second banks, each having a plurality of dies, associated toolholders, workpiece-gripping means and transfer means;

means for reciprocating the toolholders of said first bank substantially 180° out of phase with the toolholders of said second bank;

a reciprocable transfer slide common to the transfer means of both said banks;

the arrangement being such that when the said reciprocable transfer slide is moving in one sense the workpiece-gripping means of the said second bank are returning, and when the said common reciprocable transfer slide is moving in the opposite sense the workpiece-gripping means of the said first bank are returning while the workpiece-gripping means of the said second bank are advancing;

the said common reciprocable transfer slide comprising first and second members, said first member associated with the said workpiece-gripping means of said first bank and said second member associated with the said workpiece-gripping means of said second bank, said first and second members being linked together for movement in unison by an adjustable linkage which provides for relative adjustment of said first member and said second member in the direction of their reciprocation.

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