

Oct. 21, 1958

L. L. HERCIK

2,856,802

FORGING MACHINE FEED DRIVE

Filed July 20, 1955

8 Sheets-Sheet 1

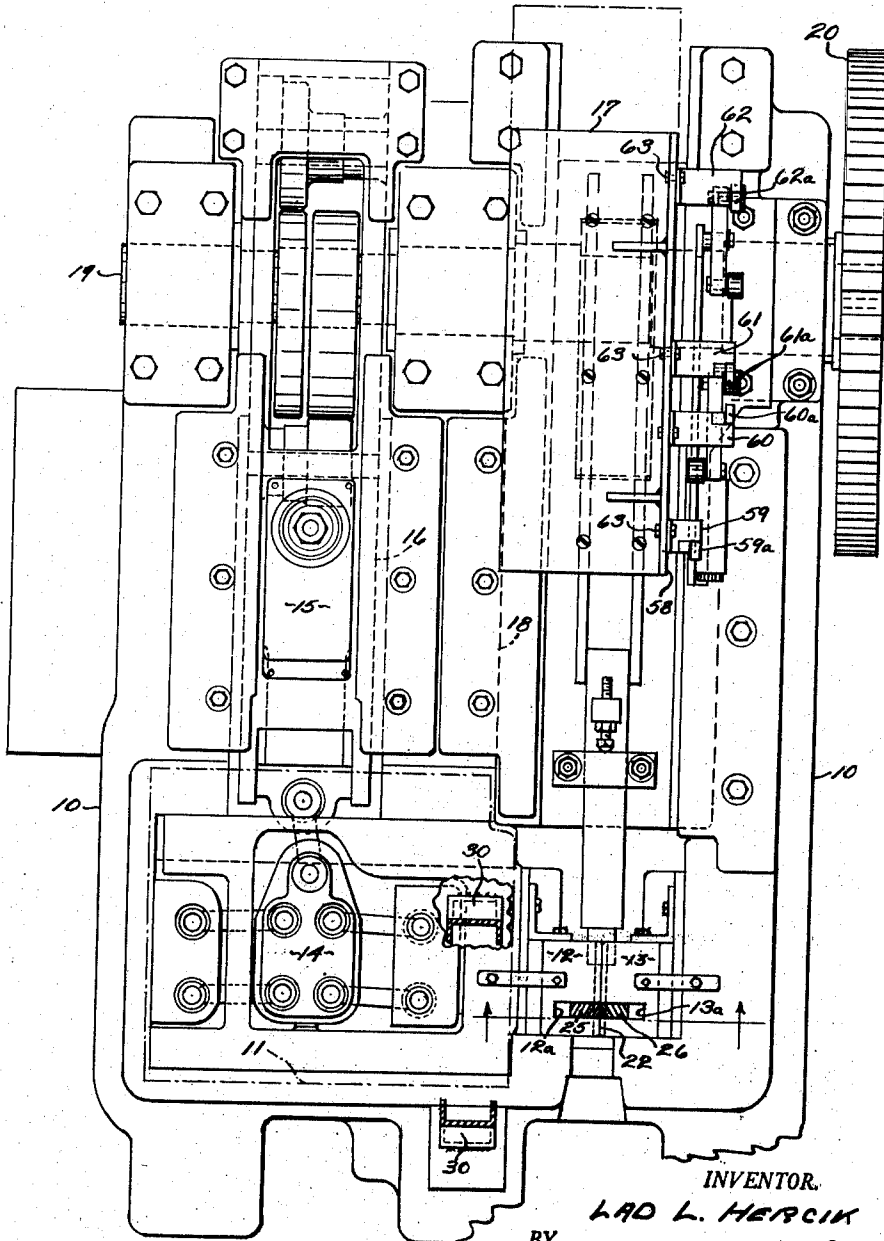


Fig. 1

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8 Sheets-Sheet 2

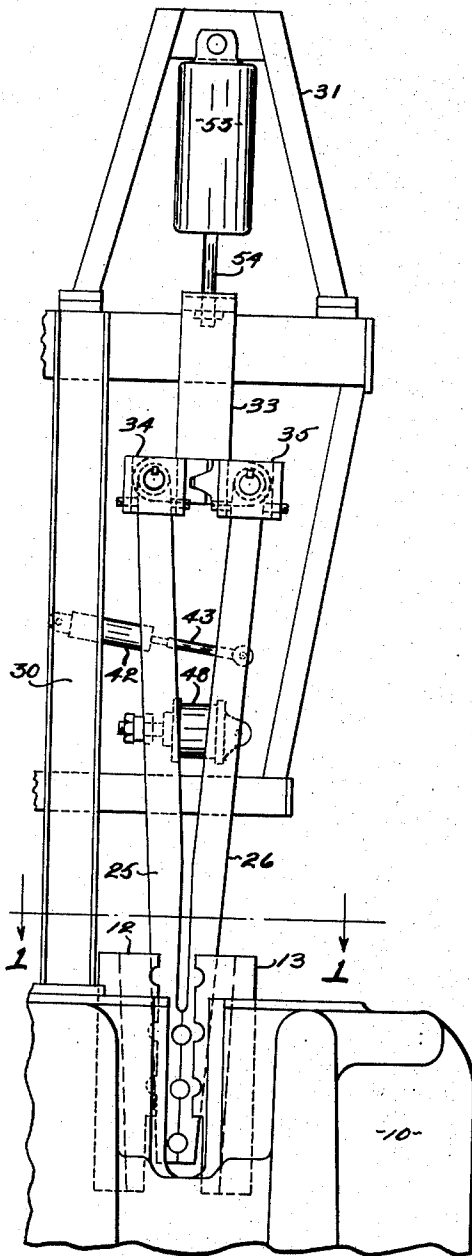


Fig. 2

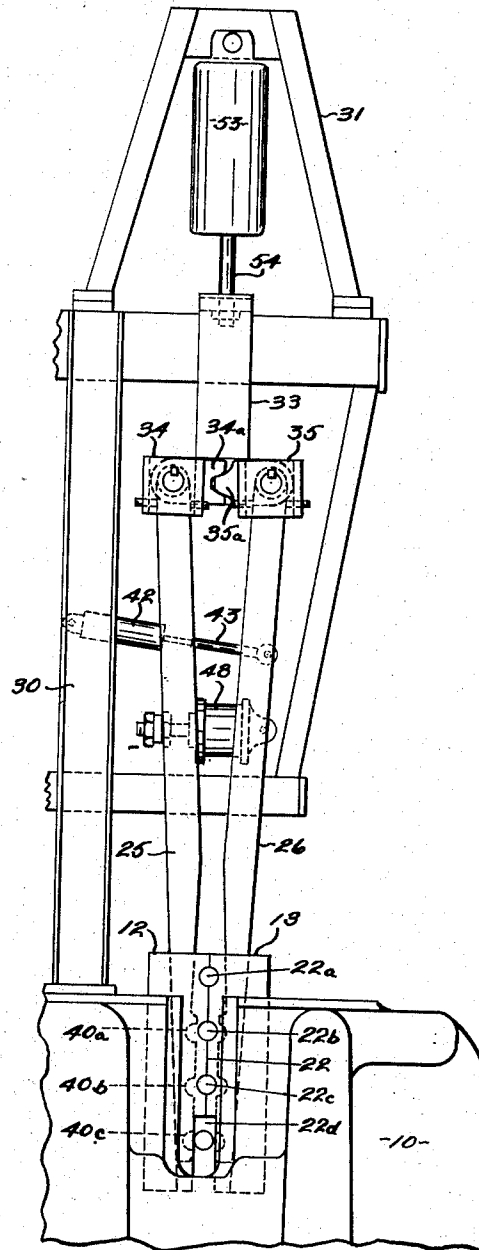


Fig. 3

INVENTOR.

LAD L. HERCIK

BY

Hyde, Meyer, Baldwin & Grant

ATTORNEYS

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L. L. HERCIK

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8 Sheets-Sheet 3

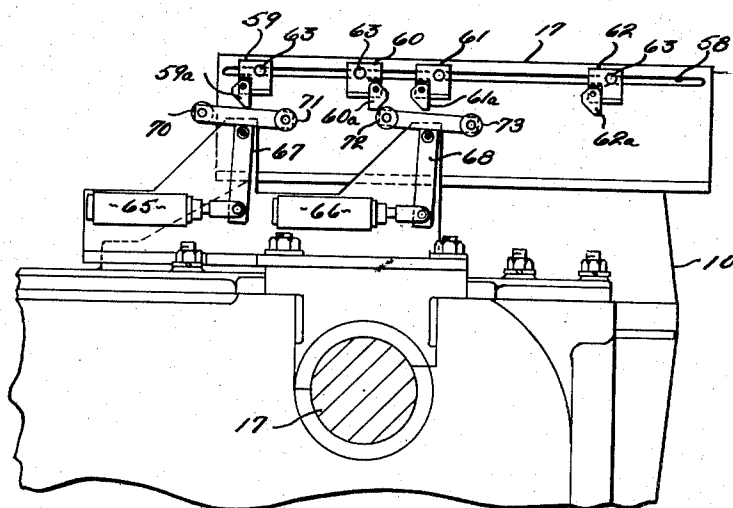


Fig. 2a

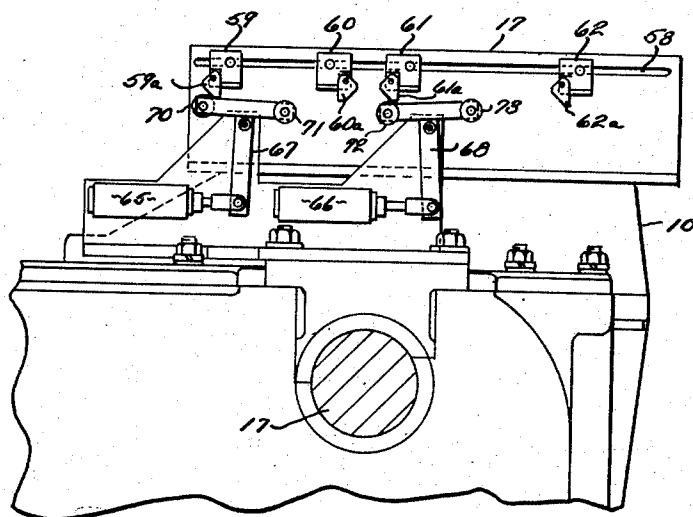


Fig. 3a

INVENTOR.

L. L. HERCIK

BY

Hyde, Meyer, Blum & Dean
ATTORNEYS

Oct. 21, 1958

L. L. HERCIK

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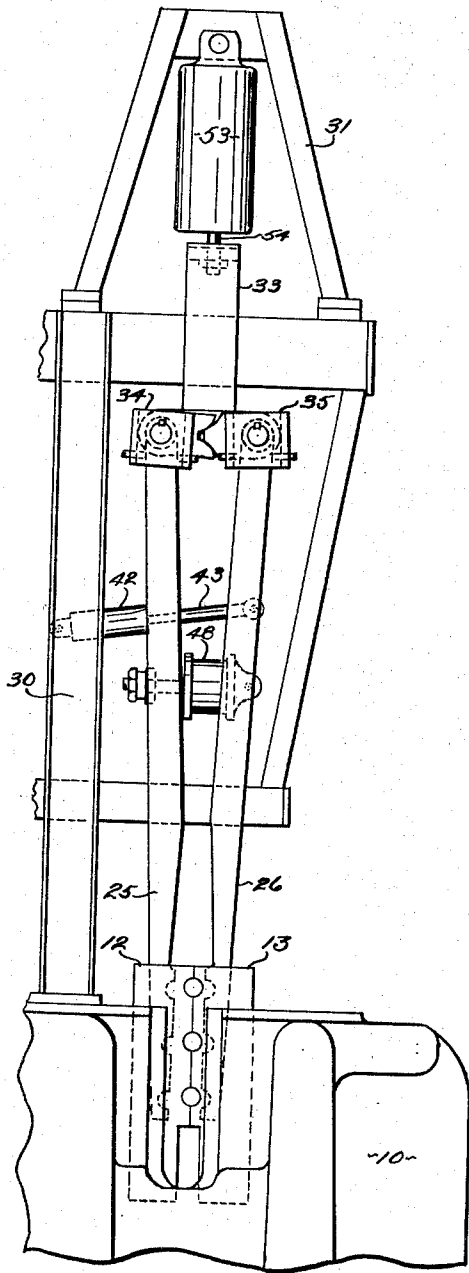


Fig. 4

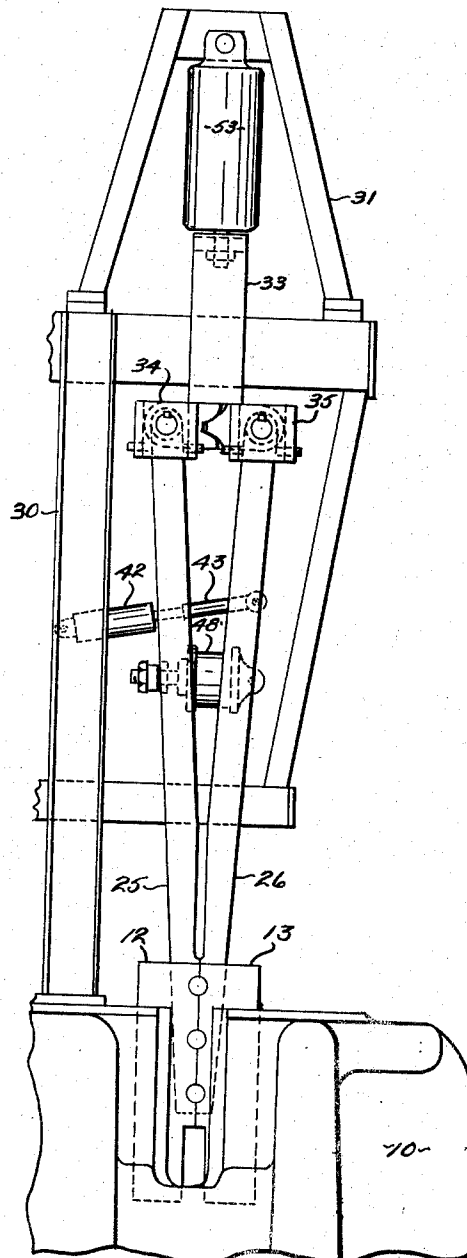


Fig. 5

INVENTOR.

L. L. HERCIK

BY

Hyde, Meyer, Robinson & Doran
ATTORNEY

Oct. 21, 1958

L. L. HERCIK

2,856,802

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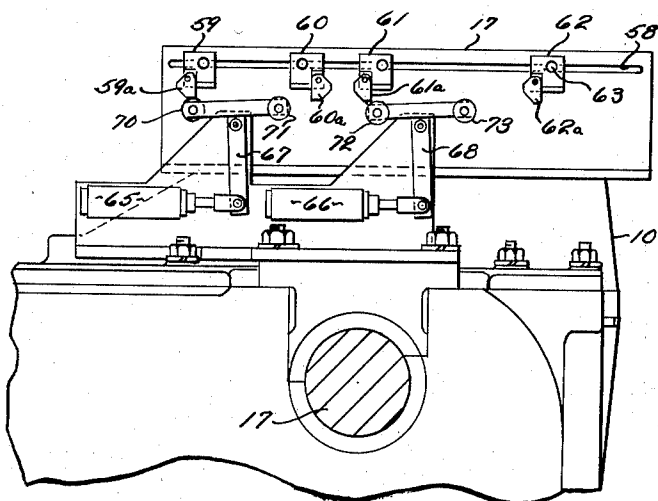


Fig. 4a

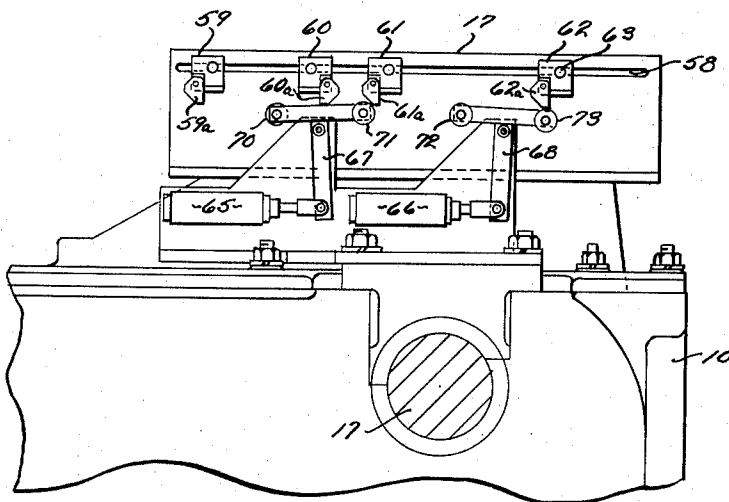


Fig. 5a

INVENTOR.

LAD L. HERCIK

BY

Hyde, Meyer, Baldwin & Doran
ATTORNEYS

Oct. 21, 1958

L. L. HERCIK

2,856,802

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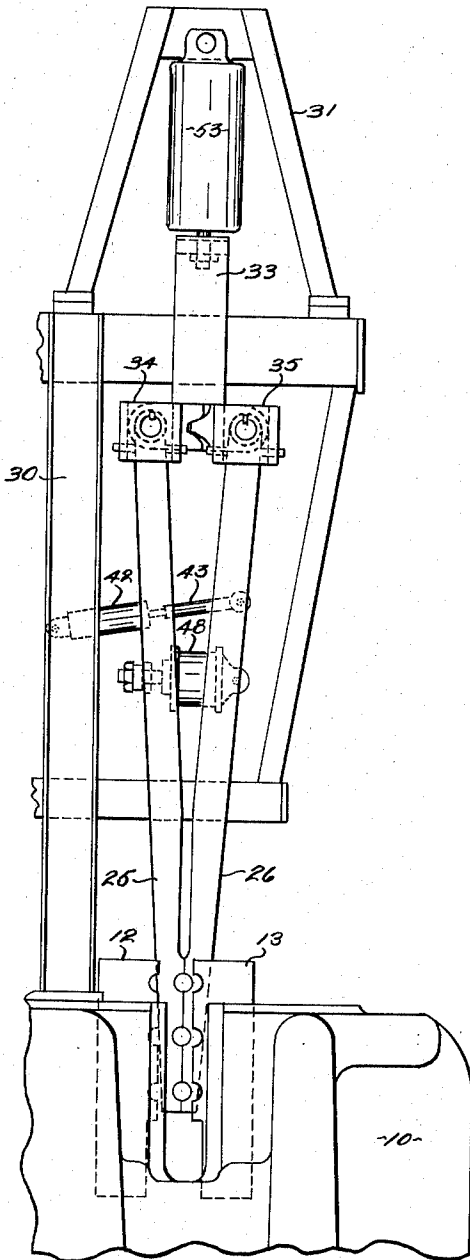


Fig. 6

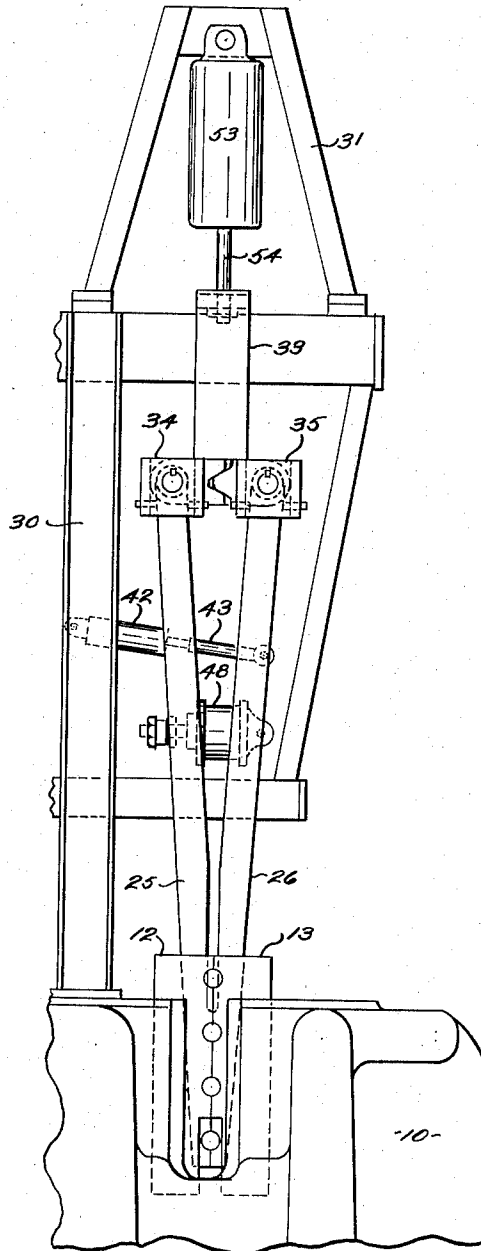


Fig. 2b

INVENTOR.

LAD L. HERCIK

BY

Myer Baldwin & Dorn

ATTORNEYS

Oct. 21, 1958

L. L. HERCIK

2,856,802

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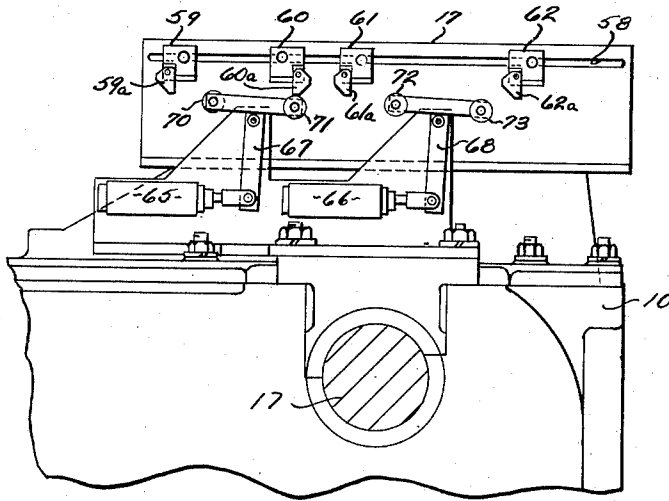


Fig. 7a

INVENTOR.

LAD L. HERCIK

BY

Hyde, Meyer, Robinson & Meyer

ATTORNEYS

Oct. 21, 1958

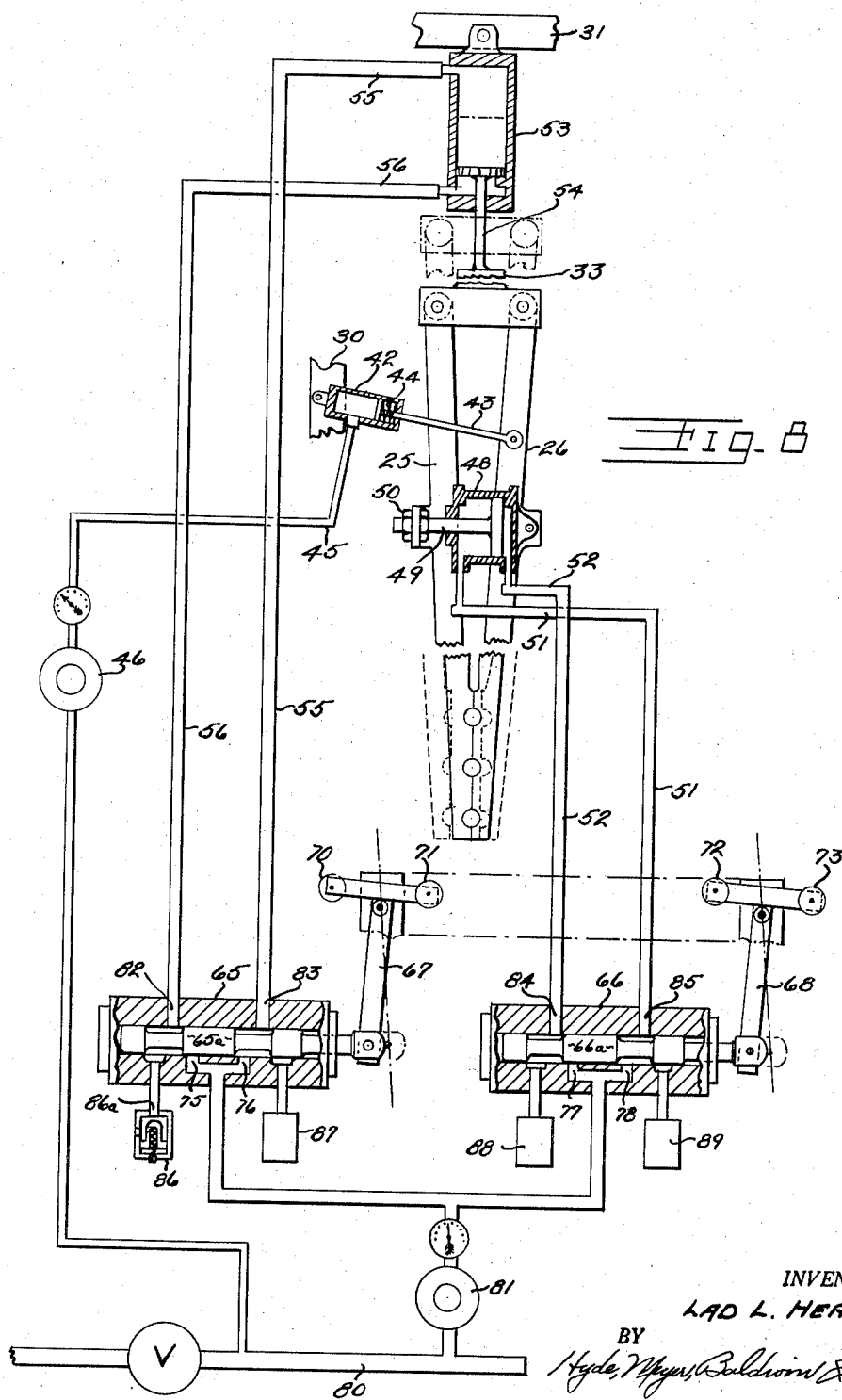
L. L. HERCIK

2,856,802

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INVENTOR.

LAD L. HERCIK

BY

Hyde, Myers, Baldwin & Toran
ATTORNEYS

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2,856,802

FORGING MACHINE FEED DRIVE

Lad L. Hercik, Lakewood, Ohio

Application July 20, 1955, Serial No. 523,302

15 Claims. (Cl. 78—99)

This invention relates to improvements in stock feeding and transfer mechanism for moving a blank from one position to another between the dies of a forging machine.

An object of the present invention is to provide a novel mechanism for transferring workpieces progressively along a series of work operation stations located in a common plane, wherein a pair of dies having mutually engaging faces meeting in the plane, a pair of depending stock transfer fingers having mutually engaging faces meeting in said same plane, a plurality of workpiece embracing recesses provided in the mutually engaging faces of the pair of dies and the pair of fingers and being spaced apart by the same predetermined distance in the case of each pair, are provided together with a forging machine header slide having adjustable cam and power control means associated therewith and means for reciprocating said slide, whereby reciprocation of said header slide causes said cam means to actuate suitable power means and thereby cause closing of the dies, opening of the fingers, raising of the fingers, closing of the fingers, opening of the dies and lowering of the fingers progressively in that order.

Another object of the present invention is to provide a device as above described wherein the number of recesses in the pair of fingers is equal to the number of recesses in the pair of dies, the dies being cut away starting at the above-mentioned predetermined distance below the lowest recess where work is performed so as to release a workpiece there, preferably with feeding means for releasably holding a workpiece at the level of the uppermost recess where work is done upon a workpiece, whereby the fingers grip a new workpiece at their every "up" excursion, and the dies drop a completed workpiece upon every "down" excursion of the fingers.

Another object of the present invention is to provide a novel mechanism for raising and lowering the fingers mentioned hereinabove wherein said fingers are caused to move in unison and are opened and closed and raised and lowered by parts coacting with the header slide of a forging machine.

Still another object of the present invention is to provide novel finger operating mechanism which is simple in operation and requires little maintenance.

Another object of the present invention is to provide a forging machine feeder device characterized by its structural simplicity, the ease of assembly of its parts, its strong and sturdy nature and its low manufacturing cost. Other features of this invention reside in the arrangement and design of the parts for carrying out their appropriate functions.

Other objects and advantages of this invention will be apparent from the accompanying drawings and the following description. The essential features will be set forth in the appended claims.

In the drawings,

Fig. 1 is a fragmental top plan view of a forging machine embodying my invention with the transfer fingers cut off at the level of the forging dies;

Figs. 2, 2b, 3, 4, 5, and 6 are fragmental sectional views taken along the plane of line 2—2 of Fig. 1 and

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showing successive positions of the stock transfer fingers;

Figs. 2a, 3a, 4a, 5a, and 7a are fragmental side elevational views showing the successive positions of the reciprocating header slide and its associated cam means which actuate the stock transfer fingers through suitable coordinating means, these first four mentioned views corresponding to finger positions as shown in Figs. 2, 3, 4, and 5 respectively while Fig. 7a occurs between the Fig. 6 and Fig. 2 positions in the cycle;

Fig. 8 is a diagrammatic illustration of the coordinating means for causing proper movement of the stock transfer fingers.

Although my invention has many uses, I have chosen to show the same as applied to a forging machine of the type fully described in United States Patent No. 2,011,106, granted August 6, 1935, to Merle W. Lamprecht. Reference may be had to this patent for a more complete description of the forging machine. It will suffice to say here that a frame 10 provides a die slide 11 in which a movable die 12 is moved toward and away from a stationary die 13, by means of a toggle arrangement 14 which is operated by toggle operating mechanism on slide 15 which moves in a toggle slideway 16 in the frame 10. A header slide 17 reciprocates in ways 18, and carries at its forward end suitable tools for operating upon a workpiece. A shaft 19 extending crosswise of the frame 10 is operatively connected with the header slide 17 and the toggle slide 15 and is driven by a source of power connected at 20.

The die 12 is moved toward and away from the die 13 by means of the toggle mechanism 14 operated by the toggle slide 15. The dies meet in a common plane indicated at 22 in Figs. 1 and 3. Positioned substantially in this plane and formed in dies 12 and 13 are a plurality of parallel work gripping recesses 22a, 22b and 22c, which are spaced apart vertically a predetermined distance. New workpieces are fed to the dies on a level with recess 22a by hand or any other suitable feeding means, not herein shown. A recess 22d is cut away in the mutually engaging faces of the dies 12 and 13 extending downwardly from just below the work station 22c which is the predetermined distance below the last work operating position 22b. The recess 22d, as seen in Fig. 3, extends to the bottom of the die so that a workpiece reaching the location 22d will drop out through the bottom of the dies.

Referring to Fig. 1, each of the dies 12 and 13 is provided with a vertically extending slot, 12a and 13a respectively. These slots open toward the mutually engaging faces of the dies 12 and 13. Fingers 25 and 26 are mounted for both horizontal and vertical movement in the slots 12a and 13a respectively. The fingers 25 and 26 depend in much the same manner as pendulums, from a supporting frame structure which includes a vertical upstanding frame member 30 which in turn rigidly supports a suitable truss 31 made up of a plurality of structural members. The upper ends of the fingers 25 and 26 are spaced apart and pivotally secured to a support member, such as a yoke 33. Rigidly secured to the upper end of the fingers 25 and 26 are a pair of complementary gear sections 34 and 35 respectively. The gear teeth 34a and 35a of said gear sections are always in meshing engagement and thereby cause the fingers 25 and 26 to move in unison laterally toward and away from one another. The upper end of yoke 33 is connected to suitable means for causing a raising and lowering movement of fingers 25 and 26 (to be hereinafter described), which means is pivotally secured to the truss 31.

The lower ends of the fingers 25 and 26 converge toward one another and are provided with mutually engaging faces which in turn are provided with a series

of parallel work gripping recesses numbered 40a, 40b and 40c corresponding to the work operating stations and die recesses 22a, 22b, and 22c previously described. The vertical distance between the work gripping recesses on the fingers 25 and 26 is the same predetermined distance as between the work gripping recesses on the dies. Preferably, there are an equal number of work gripping pairs of recesses on both the finger and die members.

Pressure means is provided for urging at all times the fingers 25 and 26, while in a closed or work gripping position, and their work gripping recesses 40a, 40b and 40c in a clockwise direction relative to truss 31 away from stationary die 13 so as to swing the workpieces out of recesses 22a, 22b and 22c when dies 12 and 13 are open. Compare Figs. 5 and 6. Such means include a cylinder 42 pivotally secured to the upright support member 30 and its associated rod 43 which projects outwardly from the cylinder 42 and pivotally engages finger 26. A spring 44 normally urges the finger 26 clockwise with the pivot between the upper end of cylinder 53 and frame 31 permitting this swing. It will be understood that any movement of finger 26 is in turn transmitted to finger 25 by means of the gear sections 34 and 35. The total effect, then, of cylinder 42, spring 44 and rod 43 is to normally urge both fingers 25 and 26 in the clockwise direction from Fig. 5 to Fig. 6. The force of spring 44 and the extent of swinging movement caused thereby is controlled by supplying cylinder 42 with offsetting fluid pressure by means of fluid communicating line 45, as seen in Fig. 8. It will be understood that the fluid supplied to this line may be either gaseous or liquid and is controlled by a suitable valve 46. Through the provision of opposed pressures which are provided by the fluid and spring 44 within the cylinder 42, it is possible to achieve a precise adjustment of the swinging force exerted on and the arcuate extent of swing of the fingers 25 and 26.

Means is provided for causing separating and approach movements of the fingers 25 and 26 at appropriate times, compare Figs. 2b, 3, 4 and 5. Said means takes the form of a double-acting cylinder and piston motor having a cylinder 48 pivotally connected to finger 26 and having a piston rod 49 which is connected to finger 25 at 50, as seen in Fig. 8. The cylinder 48 is of normal construction and has two fluid pressure inlets supplied by lines 51 and 52 at its opposite ends. The piston rod is caused to reciprocate back and forth within the cylinder 48 depending upon which line is supplying the pressure. Motor 48, 49 is strong enough to overcome the effect of pressure in cylinder 42, whereby reciprocation of the piston rod 49 causes the fingers 25 and 26 to move laterally toward and away from each other.

Means is also provided for causing upward movement of the fingers 25 and 26 while the dies 12 and 13 are closed, and for causing downward movement of the fingers while the dies are open. Such means takes the form of a double-acting cylinder and piston motor having a cylinder 53 which pivotally depends from the truss 31 having a piston rod 54 contained therein which is secured to the upper end of the yoke 33. Opposite ends of the cylinder 53 are provided with fluid inlets which are supplied by fluid pressure lines 55 and 56. The rod 54 is caused to reciprocate upwardly and downwardly within cylinder 53 in the desired direction by supplying fluid under pressure through the proper inlet line.

In a preferred form of the invention the double-acting cylinders 48 and 53 are associated with the header slide 17 which makes its forward or working stroke to the left, from a position as seen in Fig. 2a to that of Fig. 3a at a time when the dies 12 and 13 are closed as seen in Fig. 3. Referring now to Figs. 1, 2a, 3a, 4a, and 5a, the header slide 17 is provided with a laterally extending flange 58 which extends for substantially the entire length of the slide. Four dogs 59, 60, 61, and 62 are adjustably mounted on the flange 58 by means of lock screws 63. Each dog is L-shape having a vertical leg fixed to the

header slide and having a horizontal leg carrying pivoted cams. Each of the dogs is provided with a cam 59a, 60a, 61a and 62a respectively. Each cam is pivotally secured to its respective dog and constructed so as to pivot in only one direction. As seen in Fig. 2a, cams 59a, 61a and 62a are constructed to pivot in a clockwise direction about their pivot points, while cam 60a is constructed to pivot in a counterclockwise direction about its pivot point. A pair of identical double-acting cylinders 65 and 66 (see Figs. 2a and 8) are positioned below the cams and are secured to the base 10 of the forging machine. Each cylinder contains a reciprocating valve member 65a and 66a respectively. It should be understood that Fig. 8 is diagrammatic, commercially available valves being used. Each of the valves 65a and 66a is actuated by a rocker arm 67 and 68 respectively. The rocker arms 67 and 68 are identical in construction and are pivotally secured to the base 10. Each rocker arm is T-shaped and is provided with a pair of roller cam followers. Rocker arm 67 is provided with roller cam followers 70 and 71, while rocker arm 68 contains roller cam followers 72 and 73. The valve members 65a and 66a are caused to reciprocate within the cylinders 65 and 66 due to the rocking of the rocker arms as they are caused to pivot due to the cams striking the roller cam followers. It will be understood that the various cams successively strike the roller cam followers of the rocker arms during a forward or working stroke of the header slide 17. As the rocker arms pivot about their pivot points they open and close the respective ports of the cylinders 65 and 66. Each of the piston valves 65 and 66 is of common construction, as diagrammatically seen in Fig. 8, and is provided with a pair of spaced pressure inlets 75, 76 and 77, 78 respectively. The inlets are fed by fluid under pressure from a central supply line 80. The pressure in line 80 is controlled by a suitable regulating valve 81. It will be understood that the fluid, so applied, may be either of a liquid or gaseous form. Each of the piston valves 65 and 66 is provided with a pair of spaced outlets 82, 83 and 84, 85 respectively, and a pair of exhaust outlet valves 86, 87 and 88, 89 respectively. The exhaust valve members are identical and comprise a housing such as shown in detail by valve member 86. The housing contains a valve which is normally urged against the port 86a by a spring. The valve is normally closed but opens when subjected to a specific pressure. The reciprocating slide valves 65a and 66a in each cylinder are provided with a pair of spaced recesses intermediate their ends. By this construction it will be seen that through proper positioning of the slide valve within its associated cylinder the fluid pressure may be selectively passed through one of the lines and discharged from the other line. It will be seen in Fig. 8 that lines 55 and 56 from cylinder 53 are connected to piston valve 65 while lines 51 and 52 which feed cylinder 48 are connected to the other piston valve 66. It results from this construction that the position of the cams 59a, 60a, 61a and 62a may be very nicely adjusted with respect to the roller cam followers to give the exact timed movement desired, to the reciprocating valve members 65a and 66a via rocker arms 67 and 68 respectively. Thus, the timing at which the fingers 25 and 26 are sequentially raised and lowered and laterally opened and closed may be precisely controlled. Through this mechanism the oscillation of rocker arm 67 causes upward and downward movement of fingers 25 and 26 while the oscillation of rocker arm 68 causes opening and closing movement of fingers 25 and 26 in timed relation to movements of the header slide 17. Through the gear sections 34 and 35, previously described, the fingers 25 and 26 partake of the same lateral movement. Those familiar with this art will recognize that the workpiece progresses downwardly from a first position 22a in the dies to a first operating position in recess 22b where an appropriate first operation is performed on the

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workpiece. The workpiece then travels progressively to the second operation position at 22c, where a different operation produces a further change on the workpiece as desired.

Referring now to Figs. 2, 2b, 3, 4, 5, 6, 7, 2a, 3a, 4a, 5a, 7a and 8, it is believed that the operation of my device will be clearly shown. Starting at Fig. 3, the dies 12 and 13 are closed upon the workpieces in the various operating positions, and the fingers 25 and 26 have opened and are ready to move upwardly. By comparing Fig. 2a with Fig. 3a we see that the header slide 17 has moved slightly to the left in Fig. 3a to a position wherein cam 59a is about to engage the roller cam follower 70 of rocker arm 67 and cam 61a has already engaged roller cam follower 72 of rocker arm 68 to cause the rocker arm 68 to be pivoted in a counterclockwise direction, thereby causing valve member 66a to move to the right to a dot-dash position wherein inlet 78 (see Fig. 8) is closed cutting off line 51 and allowing the fluid pressure to enter inlet 77 and line 52. Fluid pressure from line 52 moves rod 49 in cylinder 48 to the left, as viewed in Fig. 8, causing the fingers to begin to open. The valve member 65a in cylinder 65 remains in the position shown in Fig. 8 wherein fluid pressure is directed to line 55 and to the upper portion of cylinder 53 thereby holding the rod 54 and fingers 25 and 26 in a down position. Referring to Fig. 4, the dies are still closed and the fingers are moving upwardly due to the continued movement of header slide 17 to the left, as viewed in Fig. 4a, as the header slide moves forward on its working stroke. Cam 59a has engaged roller cam follower 70 and caused the rocker arm 67 to pivot in a counterclockwise direction thereby causing slide valve 65a to move to the right in cylinder 65 to the dot-dash position. This position of the valve causes the fluid pressure to be directed to line 56 and converts line 55 into an exhaust line. The pressure exerted in line 56 causes rod 54 and the fingers 25 and 26 to be moved upwardly, as seen in Fig. 4. Cam 61a has passed over roller cam follower 72 of rocker arm 68.

In Fig. 5, the fingers have completed their upward movement and have closed upon the various workpieces at the various working stations as well as the uppermost workpiece which is a new piece placed there by the operator or by other suitable mechanism. The dies 12 and 13 are still closed so that the recesses in the mutually engaging faces of the dies also hold the workpieces. As seen in Fig. 5a, cam 60a which is free to pivot in a counterclockwise direction has freely cleared roller cam follower 71 of the rocker arm 67 and in no way affects the position of rocker arm 67 or slide valve 65a in cylinder 65. Cam 61a is about to strike roller cam follower 71, but has not yet done so. Cam 62a, being rotatable only in a clockwise direction, has engaged roller cam follower 73 of rocker arm 68 and caused it to pivot in a clockwise direction and thereby moved slide valve 66a to the left, into a position as seen in full lines in Fig. 8 wherein the fluid pressure is directed to line 51 into cylinder 48. The fluid pressure causes valve rod 49 to be moved to the right or into the position as seen in Fig. 8 which has the effect of closing the fingers 25 and 26 so that they assume the position shown in Fig. 5.

Referring to Fig. 6, the dies have now opened due to reciprocation of toggle operating mechanism 15 which moves the toggle arrangement 14 at properly timed intervals. Here the header slide is moving backward and the dies are opened. Since the dies 12 and 13 have opened, the recesses in their mutually engaging faces no longer hold the workpieces; however, the fingers 25 and 26 remain closed at this moment and they in turn support the workpieces but spring 44 swings both fingers and the workpieces therein in the clockwise direction away from stationary die 13 as die 12 moves away so that the workpieces clear die 12 to permit lowering movement of the workpieces past protrusions on sta-

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tionary die 12. The fingers are still in their uppermost position. The relative position of the cams and rocker arms 67 and 68, at this time, are substantially the same as shown in Fig. 5a. Referring now to Fig. 2, the fingers have moved downwardly from the Fig. 6 position by the predetermined distance, due to the rearward movement of the header slide 17 as it moves from its extreme left position, shown in Fig. 5a, to the right through the Fig. 7a toward the Fig. 2a position. In Fig. 7a, cam 60a which is non-rotatable in a clockwise direction strikes roller cam follower 71 on rocker bar 67 which causes valve member 65a to be moved to the left into the position shown in full lines in Fig. 8, wherein the fluid pressure is directed through line 55 into the upper end of cylinder 53 and thereby causes the fingers 25 and 26 to be moved downwardly into the position seen in Fig. 2. The relative position of rocker arm 68 in Fig. 7a has not changed from that shown in Fig. 5a due to the fact that cam 62a pivots in a clockwise direction and has therefore freely passed over the roller cam follower 73 as the header slide moved to the right from the position of Fig. 5a to that of Fig. 7a. After the closed fingers 25 and 26 have moved from the position shown in Fig. 6 to that shown in Fig. 2, the dies 12 and 13 close due to the timed action of toggle members 14, closing of die 12 swings the workpieces and fingers counterclockwise against the force of spring 44 toward stationary die 13 into work gripping recesses 22a, 22b and 22c, and the parts assume the position as shown in Fig. 2b, located in the cycle between Figs. 2 and 3. The cam 61a, being freely pivoted in a clockwise direction, has cleared roller cam follower 72 on rocker member 68 in its movement to the right, as illustrated in Fig. 7a, so that the rocker arm 68 remained in substantially the same position in both Figs. 7a and 2a. Therefore, the fingers 25 and 26 remain in a closed position while traveling downwardly from the position shown in Fig. 6, through the Fig. 2 position, to the position shown in Fig. 2b. Upon reaching the position shown in Fig. 2b the dies 12 and 13 close and support the various workpieces in their varying positions while the header slide moves further to the left on a working stroke as seen in Fig. 3a wherein the fingers 25 and 26 are caused to open as heretofore described and the cycle is again repeated. It will be seen that as the fingers 25 and 26 open in Fig. 3, the completed workpiece at the location 22d then drops downwardly into a suitable receptacle. Also, suitable mechanism (not shown) feeds a new workpiece into the upper pocket of dies 12 and 13 while fingers 25 and 26 are in their lower position, shown in Figs. 2, 2b and 3. The timing of the cams controlling the header slide 17 and the toggle slide 15 are so coordinated in the usual manner with the movements of shaft 19 that the above-described series of operations takes place smoothly.

In view of the foregoing description, taken in conjunction with the accompanying drawings, it is believed that a clear understanding of the construction, operation and advantages of the device will be quite apparent to those skilled in this art.

It is to be understood, however, that even though there is herein shown and described a preferred embodiment of the invention, the same is susceptible to certain changes fully comprehended by the spirit of the invention.

Having thus described my invention and illustrated its views, what I claim as new and desire to secure by Letters Patent is:

1. Mechanism for transferring workpieces progressively along a series of work-operation stations located in a plane comprising a pair of dies having mutually engaging faces meeting in said plane, die actuating means for opening and closing said dies; a pair of depending fingers having mutually engaging faces meeting in said plane, a plurality of workpiece embracing recesses equally spaced apart in said mutually engaging faces of said dies

7 and said fingers, the upper ends of said fingers being pivotally connected to a support member, the lower ends of said fingers constructed to meet in said plane, intermeshing gear means at the upper ends of said fingers causing said fingers to move toward and away from each other in unison, said support member being secured to an overhead cylinder and piston motor for raising and lowering said pair of fingers relative to said dies, said motor being pivotally secured at its uppermost end to a rigid support frame, finger moving means secured between said fingers for opening and closing said fingers, and coordinating means actuating said die actuating means to close said dies, said finger moving means to open said fingers, said motor to raise said fingers, said finger moving means to close said fingers, said die actuating means to open said dies and said motor to lower said fingers progressively in that order, the number of recesses in said fingers being equal to the number of recesses in said dies, said dies having open bottom cut-out portions below the last of said recesses, said uppermost recess of said dies receiving each new workpiece, said fingers having downward movement sufficient to position their lowermost recess aligned with said cut-out portions in said dies, whereby said fingers grip a new workpiece at their every "up" excursion and said dies place a completed piece in said cut-out portions upon every "down" excursion of said fingers for vertical dropout.

2. In a machine for transferring workpieces progressively along a path of workpiece transfer between a series of workpiece operation stations, coating stationary and movable dies, a pair of coating workpiece gripping fingers, said dies and fingers having a plurality of workpiece embracing recesses equally spaced apart and located along the path of workpiece transfer, die actuating means for moving said movable die between die open and closed positions back and forth along a die path intersecting said workpiece transfer path, finger actuating means for moving said fingers between workpiece gripping and released positions, finger transfer means for moving said fingers along said workpiece transfer path for transferring workpieces individually along said transfer path, finger shift means for moving said fingers away from said stationary die in response to movable die recess release of said finger gripped workpiece during die opening movement and for moving said fingers toward said stationary die in response to movable die recess pressure on said finger gripped workpiece during die closing movement while keeping said fingers in gripping position, and control means actuating said finger actuating means to move said fingers to released position while said dies are in closed position, said finger transfer means to move said fingers backward along said workpiece transfer path, said finger actuating means to move said fingers to gripping position, said die actuating means to move said dies to open position while said finger shift means moves said fingers away from said stationary die, said finger transfer means for moving said fingers in an advancing direction along said workpiece transfer path, and said die actuating means for moving said dies to closed position while said finger shift means moves said fingers toward said stationary die progressively in that order so as to transfer said workpieces individually along said transfer path in said advancing direction from recess to recess.

3. In a machine for transferring workpieces progressively along a path of workpiece transfer between a series of workpiece operation stations, two coating dies, a pair of coating workpiece gripping fingers, said dies and fingers having a plurality of workpiece embracing recesses equally spaced apart along a line in aligned position and located along the path of workpiece transfer, die actuating means for moving at least one of said dies between die open and closed positions back and forth along a die path intersecting said workpiece transfer path, finger actuating means for moving said fingers between

workpiece gripping and released positions, finger transfer means for moving said fingers along said workpiece transfer path for transferring workpieces individually along said transfer path, finger shift means operable independently of said finger actuating means for moving said fingers away from the line connecting said recess during die opening movement and for moving said fingers toward said line during die closing movement while keeping said fingers in gripping position, and control means actuating said finger actuating means to move said fingers to released position while said dies are in closed position, said finger transfer means to move said fingers backward along said workpiece transfer path, said finger actuating means to move said fingers to gripping position, said die actuating means to move said dies to open position while said finger shift means moves said fingers away from said stationary die, said finger transfer means for moving said fingers in an advancing direction along said workpiece transfer path, said die actuating means for moving said dies to closed position while said finger shift means moves said fingers toward said stationary die progressively in that order so as to transfer said workpieces individually along said transfer path in said advancing direction from recess to recess.

4. In a machine for transferring workpieces progressively along a path of workpiece transfer between a series of workpiece operation stations, coating stationary and movable dies, a pair of coating workpiece gripping fingers, said dies and fingers having a plurality of workpiece embracing recesses equally spaced apart and located along the path of workpiece transfer, die actuating means for moving said movable dies between die open and closed positions back and forth along a die path intersecting said workpiece transfer path, finger actuating means for moving said fingers between workpiece gripping and released positions, finger transfer means for moving said fingers along said workpiece transfer path for transferring workpieces individually along said transfer path, finger shift means operable independently of said finger actuating means for moving said fingers away from said stationary die in response to die opening movement and for moving said fingers toward said stationary die in response to die closing movement while keeping said fingers in gripping position, said finger shift means including pivot means for permitting movement together of said fingers in said die path relative to said stationary die and including controlled biasing means for biasing said fingers about said pivot means away from said stationary die so that die opening movement will move said fingers away from said stationary die and die closing movement will move them back again toward said stationary die, and control means actuating said finger actuating means to move said fingers to released position while said dies are in closed position, said finger transfer means to move said fingers backward along said workpiece transfer path, said finger actuating means to move said fingers to gripping position, said die actuating means to move said dies to open position while said finger shift means moves said fingers away from said stationary die, said finger transfer means for moving said fingers in an advancing direction along said workpiece transfer path, and said die actuating means for moving said dies to closed position while said finger shift means moves said fingers toward said stationary die progressively in that order so as to transfer said workpieces individually along said transfer path in said advancing direction from recess to recess.

5. In a machine for transferring workpieces progressively along a path of workpiece transfer between a series of workpiece operation stations, two coating dies, a pair of coating workpiece gripping fingers, said dies and fingers having a plurality of workpiece embracing recesses equally spaced apart and located along the path of workpiece transfer, die actuating means for moving at least one of said dies between die open and closed positions back and forth along a die path inter-

secting said workpiece transfer path, finger actuating means for moving said fingers simultaneously between workpiece gripping and released positions, said finger actuating means including a finger support member to which each finger is pivotally connected at spaced apart points remote from said recesses and including meshing gear means carried by said fingers at said pivots for simultaneously moving said fingers between said positions, finger transfer means for moving said fingers along said workpiece transfer path for transferring workpieces individually along said transfer path, and control means actuating said finger actuating means to move said fingers to released position while said dies are in closed position, said finger transfer means to move said fingers backward along said workpiece transfer path, said finger actuating means to move said fingers to gripping position, said die actuating means to move said dies to open position, said finger transfer means for moving said fingers in an advancing direction along said workpiece transfer path, and said die actuating means for moving said dies to closed position progressively in that order so as to transfer said workpieces individually along said transfer path in said advancing direction from recess to recess.

6. In a machine for transferring workpieces progressively along a path of workpiece transfer between a series of workpiece operation stations, two coacting dies, a pair of coacting workpiece gripping fingers, said dies and fingers having a plurality of workpiece embracing recesses equally spaced apart and located along the path of workpiece transfer, die actuating means for moving at least one of said dies between die open and closed positions back and forth along a die path intersecting said workpiece transfer path, finger actuating means for moving said fingers between workpiece gripping and released positions, said finger actuating means including a finger support member to which each finger is pivotally connected remote from said recesses and including a fluid actuated cylinder and piston motor operatively connected at opposite ends to said fingers for moving them between workpiece gripping and released positions, finger transfer means for moving said fingers along said workpiece transfer path for transferring workpieces individually along said transfer path, and control means actuating said finger actuating means to move said fingers to released position while said dies are in closed position, said finger transfer means to move said fingers backward along said workpiece transfer path, said finger actuating means to move said fingers to gripping position, said die actuating means to move said dies to open position, said finger transfer means for moving said fingers in an advancing direction along said workpiece transfer path, and said die actuating means for moving said dies to closed position progressively in that order so as to transfer said workpieces individually along said transfer path in said advancing direction from recess to recess.

7. In a machine for transferring workpieces progressively along a path of workpiece transfer between a series of workpiece operation stations, two coacting dies, a pair of coacting workpiece gripping fingers, said dies and fingers having a plurality of workpiece embracing recesses equally spaced apart and located along the path of workpiece transfer, die actuating means for moving at least one of said dies between die open and closed positions back and forth along a die path intersecting said workpiece transfer path, finger actuating means for moving said fingers simultaneously between workpiece gripping and released positions, said finger actuating means including a finger support member to which each finger is pivotally connected at spaced points remote from said recesses, including meshing gear means carried by said fingers at said pivots for simultaneously moving said fingers between said positions, and including a fluid actuated cylinder and piston motor operatively connected at opposite ends to said fingers for moving them between workpiece gripping and released positions, finger transfer

means for moving said fingers along said workpiece transfer path for transferring workpieces individually along said transfer path, and control means actuating said finger actuating means to move said fingers to released position while said dies are in closed position, said finger transfer means to move said fingers backward along said workpiece transfer path, said finger actuating means to move said fingers to gripping position, said die actuating means to move said dies to open position, said finger transfer means for moving said fingers in an advancing direction along said workpiece transfer path, and said die actuating means for moving said dies to closed position progressively in that order so as to transfer said workpieces individually along said transfer path in said advancing direction from recess to recess.

8. In a machine for transferring workpieces progressively along a path of workpiece transfer between a series of workpiece operation stations, two coacting dies, a pair of coacting workpiece gripping fingers, said dies and fingers having a plurality of workpiece embracing recesses equally spaced apart and located along the path of workpiece transfer, die actuating means for moving at least one of said dies between die open and closed positions back and forth along a die path intersecting said workpiece transfer path, finger actuating means for moving said fingers between workpiece gripping and released positions, finger transfer means for moving said fingers along said workpiece transfer path for transferring workpieces individually along said transfer path, said finger transfer means including a fluid actuated cylinder and piston motor having opposite ends operatively connected to said fingers and fixed relative to at least one of said dies, and control means actuating said finger actuating means to move said fingers to released position while said dies are in closed position, said finger transfer means to move said fingers backward along said workpiece transfer path, said finger actuating means to move said fingers to gripping position, said die actuating means to move said dies to open position, said finger transfer means for moving said fingers in an advancing direction along said workpiece transfer path, and said die actuating means for moving said dies to closed position progressively in that order so as to transfer said workpieces individually along said transfer path in said advancing direction from recess to recess.

9. In a machine for transferring workpieces progressively along a path of workpiece transfer between a series of workpiece operation stations, two coacting dies, a pair of coacting workpiece gripping fingers, said dies and fingers having a plurality of workpiece embracing recesses equally spaced apart and located along the path of workpiece transfer, die actuating means for moving at least one of said dies between die open and closed positions back and forth along a die path intersecting said workpiece transfer path, finger actuating means for moving said fingers between workpiece gripping and released positions, finger transfer means for moving said fingers along said workpiece transfer path for transferring workpieces individually along said transfer path, and control means actuating said finger actuating means to move said fingers to released position while said dies are in closed position, said finger transfer means to move said fingers backward along said workpiece transfer path, said finger actuating means to move said fingers to gripping position, said die actuating means to move said dies to open position, said finger transfer means for moving said fingers in an advancing direction along said workpiece transfer path, and said die actuating means for moving said dies to closed position progressively in that order so as to transfer said workpieces individually along said transfer path in said advancing direction from recess to recess, both of said dies being cut away a distance greater than the transverse dimension of a finished workpiece in the form of a bottom open recess having at least a portion thereof spaced in said advancing direction from

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the last die recess a distance corresponding to the spacing of said recesses and adapted to have at least one of the recesses of said fingers aligned therewith at the advanced end of said workpiece transfer path so that a finished workpiece is discharged from the machine by gravity through said discharge recess at the end of the advance movement of said fingers along said workpiece transfer path.

10. In a machine for transferring workpieces progressively along a path of workpiece transfer between a series of workpiece operation stations, two coacting dies, a pair of coacting workpiece gripping fingers, said dies and fingers having a plurality of workpiece embracing recesses equally spaced apart and located along the path of workpiece transfer, die actuating means for moving at least one of said dies between die open and closed positions back and forth along a die path intersecting said workpiece transfer path, finger actuating means for moving said fingers along said die path between workpiece gripping and released positions, finger transfer means for moving said fingers along said workpiece transfer path for transferring workpieces individually along said transfer path, each of said dies having a slot aligned and connected with the other and extending along the die path, said fingers being slidably held in said slots with dies closed for lateral support while said slots permit said actuating and transfer movement, and control means actuating said finger actuating means to move said fingers to released position while said dies are in closed position, said finger transfer means to move said finger backward along said workpiece transfer path, said finger actuating means to move said fingers to gripping position, said die actuating means to move said dies to open position, said finger transfer means for moving said fingers in an advancing direction along said workpiece transfer path, and said die actuating means for moving said dies to closed position progressively in that order so as to transfer said workpieces individually along said transfer path in said advancing direction from recess to recess.

11. In a machine for transferring workpieces progressively along a path of workpiece transfer between a series of workpiece operation stations, coacting stationary and movable dies, a pair of coacting workpiece gripping fingers, said dies and fingers having a plurality of workpiece embracing recesses equally spaced apart and located along the path of workpiece transfer, die actuating means for moving said movable dies between die open and closed positions back and forth along a die path intersecting said workpiece transfer path, finger actuating means for moving said fingers between workpiece gripping and released positions, finger transfer means for moving said fingers along said workpiece transfer path for transferring workpieces individually along said transfer path, said finger transfer means including an expansible and contractible power means having opposite ends respectively operatively connected to said fingers and fixed relative to said stationary die, finger shift means operable independently of said finger actuating means for moving said fingers away from said stationary die in response to die opening movement and for moving said fingers toward said stationary die in response to die closing movement while keeping said fingers in gripping position, said finger shift means including one of said ends on said power means having a pivot means for permitting movement together of said fingers in said die path relative to said stationary die and including controlled biasing means for biasing said fingers about said pivot means away from said stationary die so that die opening movement will move said fingers away from said stationary die and die closing movement will move them back again toward said stationary die, and control means actuating said finger actuating means to move said fingers to released position while said dies are in closed position, said finger transfer means to move said fingers backward along said workpiece transfer path, said finger actuating means to move said fingers

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to gripping position, said die actuating means to move said dies to open position while said finger shift means moves said fingers away from said stationary die, said finger transfer means for moving said fingers in an advancing direction along said workpiece transfer path, and said die actuating means for moving said dies to closed position while said finger shift means moves said fingers toward said stationary die progressively in that order so as to transfer said workpieces individually along said transfer path in said advancing direction from recess to recess.

12. In a forging machine for transferring workpieces progressively along a path of workpiece transfer between a series of workpiece operation stations, two coacting dies, a pair of coacting workpiece gripping fingers, said dies and fingers having a plurality of workpiece embracing recesses equally spaced apart and located along the path of workpiece transfer, die actuating means for moving at least one of said dies between die open and closed positions back and forth along a die path intersecting said workpiece transfer path, finger actuating means for moving said fingers between workpiece gripping and released positions, finger transfer means for moving said fingers along said workpiece transfer path for transferring workpieces individually along said transfer path, a header slide, means operable in timed relationship with the movement of said dies for moving said header slide along a line to strike said workpieces when said dies are closed, and control means actuating said finger actuating means to move said fingers to released position while said dies are in closed position, said finger transfer means to move said fingers backward along said workpiece transfer path, said finger actuating means to move said fingers to gripping position, said die actuating means to move said dies to open position, said finger transfer means for moving said fingers in an advancing direction along said workpiece transfer path, and said die actuating means for moving said dies to closed position progressively in that order so as to transfer said workpieces individually along said transfer path in said advancing direction from recess to recess, said control means including cam means carried by said header slide, and including trip means actuated by said cam means in timed sequence by movement of said header slide and operatively connected to said finger actuating and transfer means.

13. In a forging machine for transferring workpieces progressively along a path of workpiece transfer between a series of workpiece operation stations, two coacting dies, a pair of coacting workpiece gripping fingers, said dies and fingers having a plurality of workpiece embracing recesses equally spaced apart and located along the path of workpiece transfer, die actuating means for moving at least one of said dies between die open and closed positions back and forth along a die path intersecting said workpiece transfer path, finger actuating means for moving said fingers between workpiece gripping and released positions, said finger actuating means including a fluid actuated cylinder and piston motor operatively connecting said fingers for moving them between workpiece gripping and released positions, finger transfer means for moving said fingers along said workpiece transfer path for transferring workpieces individually along said transfer path, said finger transfer means including a fluid actuated cylinder and piston motor having opposite ends respectively operatively connected to said finger support member and fixed relative to at least one of said dies, a header slide, means operable in timed relationship with the movement of said dies for moving said header slide along a line to strike said workpieces when said dies are closed, and control means actuating said finger actuating means to move said fingers to released position while said dies are in closed position, said finger transfer means to move said fingers backward along said workpiece transfer path, said finger actuating means to move said fingers to gripping position, said die actuating means to move said dies to open position, said finger transfer means for moving said fingers

in an advancing direction along said workpiece transfer path, and said die actuating means for moving said dies to closed position progressively in that order so as to transfer said workpieces individually along said transfer path in said advancing direction from recess to recess, said control means including cam means carried by said header slide, valve means actuated by said cam means in timed sequence by movement of said header slide and operatively connected between a pressure fluid source and said fluid actuated cylinders.

14. In a forging machine for transferring workpieces progressively along a path of workpiece transfer between a series of workpiece operation stations, coacting stationary and movable dies, a pair of coacting workpiece gripping fingers, said dies and fingers having a plurality of workpiece embracing recesses equally spaced apart along a line in aligned position and located along the path of workpiece transfer, die actuating means for moving said movable dies between die open and closed positions back and forth along a die path intersecting said workpiece transfer path, finger actuating means for moving said fingers along said die path simultaneously between workpiece gripping and released positions, said finger actuating means including a finger support member to which each finger is pivotally connected at spaced apart points remote from said recesses, including meshing gear means carried by said fingers at said pivots for simultaneously moving said fingers between said positions, and including a fluid actuated cylinder and piston motor operatively connected at opposite ends to said fingers for moving them between workpiece gripping and released positions, finger transfer means for moving said fingers along said workpiece transfer path for transferring workpieces individually along said transfer path, each of said dies having a slot aligned and connected with the other and extending along the die path, said fingers being slidably held in said slots with dies closed for lateral support while said slots permit said actuating and transfer movement, said finger transfer means including a fluid actuated cylinder and piston expansible and contractable motor having opposite ends respectively operatively connected to said finger support member and fixed relative to said stationary die, finger shift means operable independently of said finger actuating means for moving said fingers away from the line connecting said recesses and away from said stationary die in response to die opening movement and for moving said fingers toward said line and said stationary die in response to die closing movement while keeping said fingers in gripping position, said finger shift means including one of said ends on said transfer motor having a pivot means for permitting movement together of said fingers in said die path relative to said stationary die and including controlled biasing means for biasing said fingers about said pivot means away from said stationary die so that die opening movement will move said fingers away from said stationary die and die closing movement will move them back again toward said stationary die, a header slide, means operable in timed relationship with the movement of said movable die for reciprocating said header slide along a straight line intersecting said transfer path to strike said workpieces when said dies are closed, and control means actuating said finger actuating means to move said fingers to released position while said dies are in closed position, said finger transfer means to move said fingers backward along said workpiece transfer path, said finger actuating means to move said fingers to gripping position, said die actuating means to move said dies to open position while said finger shift means moves said fingers away from said stationary die, said finger transfer means for moving said fingers in an advancing direction along said workpiece transfer path, and said die actuating means for moving said dies to closed position while said finger shift means moves said fingers toward said stationary die progressively in that order so as to transfer said workpieces individually along said transfer path in said ad-

vancing direction from recess to recess, said control means including cam means carried by said header slide, valve means actuated by said cam means in timed sequence by reciprocation of said header slide and operatively connected between a pressure fluid source and said fluid actuated cylinders of said finger actuating and transfer means, both of said dies being cut away a distance greater than the transverse dimension of a finished workpiece in the form of a bottom open recess having at least a portion thereof spaced in said advancing direction from the last die recess a distance corresponding to the spacing of said recesses and adapted to have at least one of the recesses of said fingers aligned therewith at the advanced end of said workpiece transfer path so that a finished workpiece is discharged from the machine by gravity through said discharge recess at the end of the advance movement of said fingers along said workpiece transfer path.

15. In a machine for transferring workpieces progressively along a path of workpiece transfer between a series of workpiece operation stations, coacting stationary and movable dies, a pair of coacting workpiece gripping fingers, said dies and fingers having a plurality of workpiece embracing recesses equally spaced apart and located along the path of workpiece transfer, die actuating means for moving said movable dies between die open and closed positions back and forth along a die path intersecting said workpiece transfer path, finger actuating means for moving said fingers between workpiece gripping and released positions, finger transfer means for moving said fingers along said workpiece transfer path for transferring workpieces individually along said transfer path, finger shift means operable independently of said finger actuating means for moving said fingers away from said stationary die into a released location in response to die opening movement and for moving said fingers toward said stationary die into a restrained location in response to die closing movement while keeping said fingers in gripping position, said finger shift means including pivot means for permitting movement together of said fingers in said die path relative to said stationary die and including controlled spring biasing means for biasing said fingers about said pivot means for moving said fingers in at least one direction between said locations relative to said stationary die so that die opening movement will move said fingers away from said stationary die and die closing movement will move them back again toward said stationary die, and control means actuating said finger actuating means to move said fingers to released position while said dies are in closed position, said finger transfer means to move said fingers backward along said workpiece transfer path, said finger actuating means to move said fingers to gripping position, said die actuating means to move said dies to open position while said finger shift means moves said fingers away from said stationary die, said finger transfer means for moving said fingers in an advancing direction along said workpiece transfer path, and said die actuating means for moving said dies to closed position while said finger shift means moves said fingers toward said stationary die progressively in that order so as to transfer said workpieces individually along said transfer path in said advancing direction from recess to recess.

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