April 27, 1965 A. R. KULL 3,180,123

WORK TRANSFER MECHANISM FOR FORGING PRESSES AND THE LIKE

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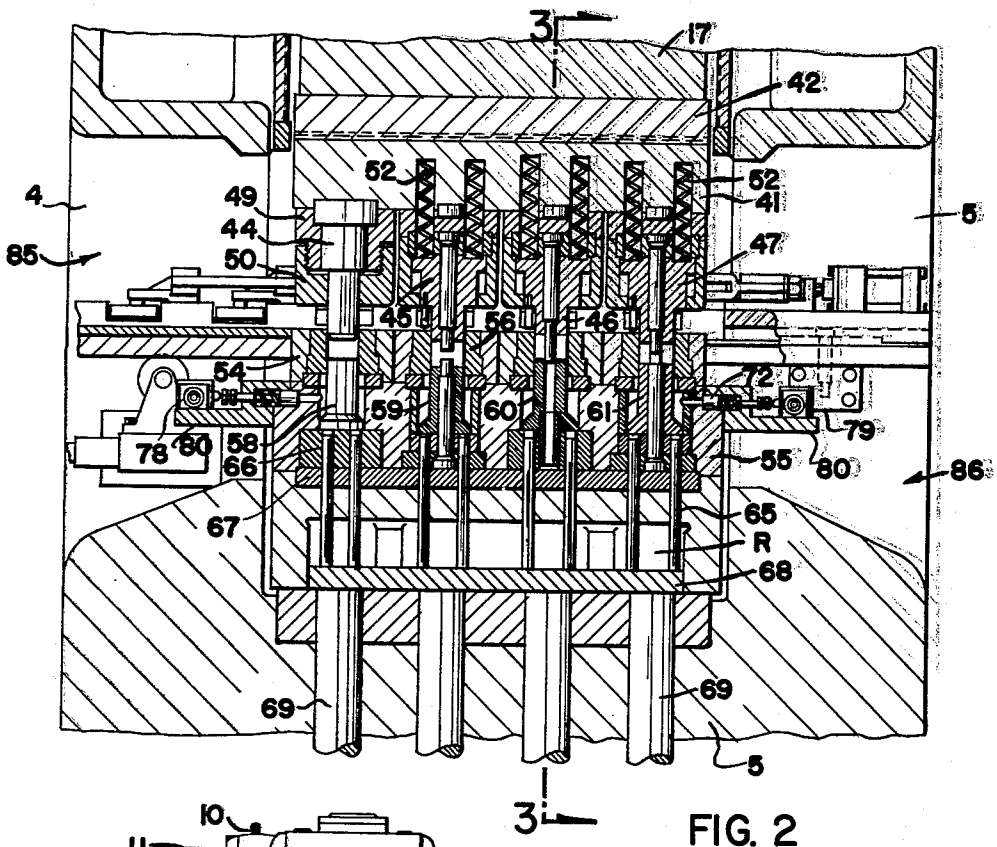

FIG. 2

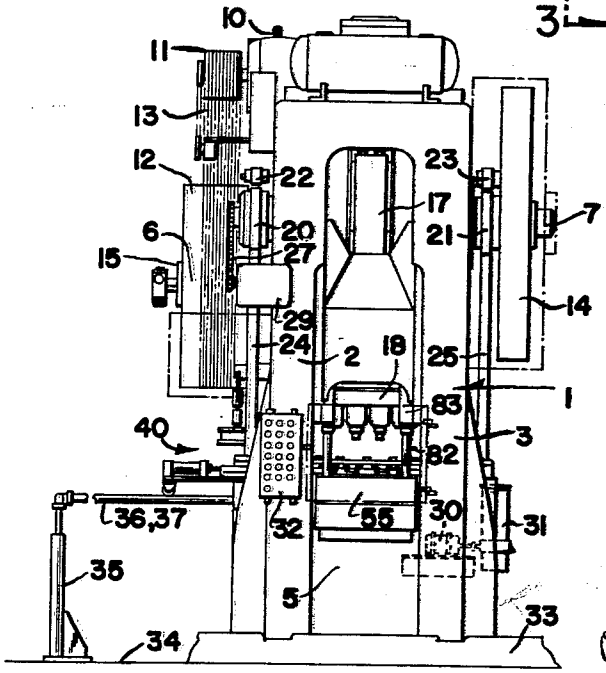

FIG. 1

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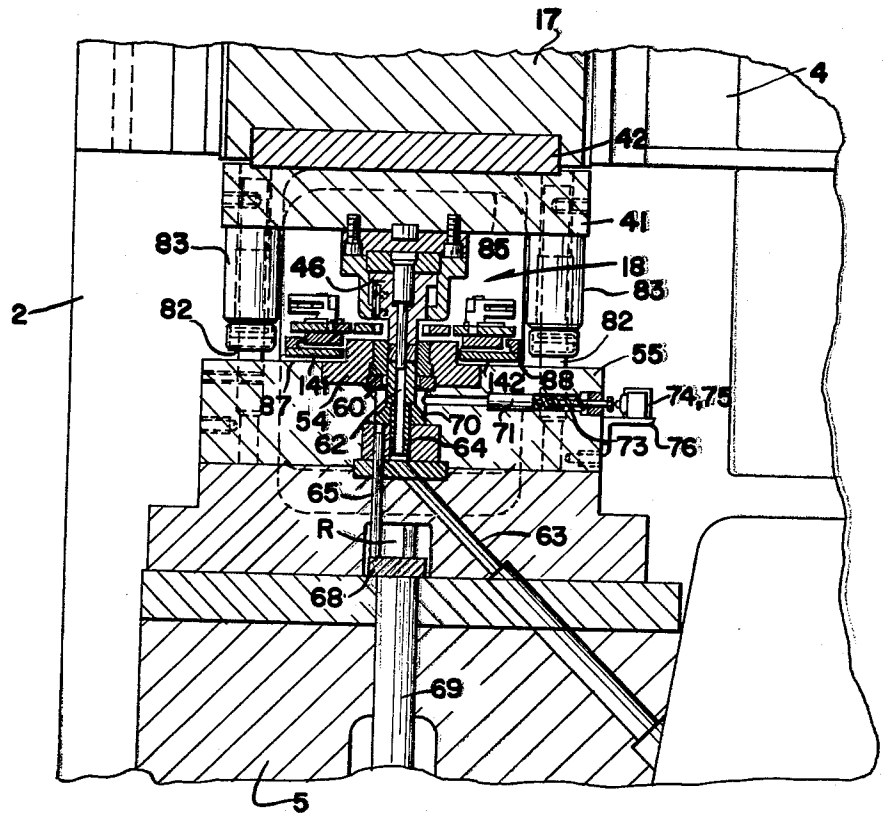
FIG. 3



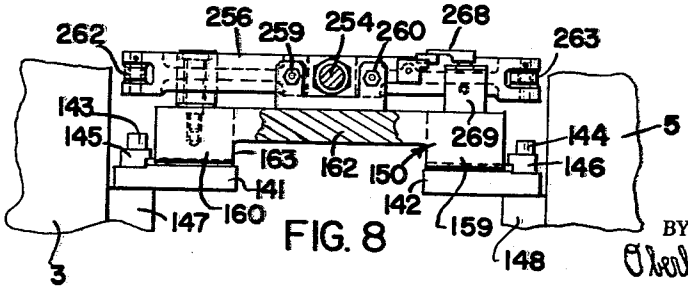


FIG. 8

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WORK TRANSFER MECHANISM FOR FORGING PRESSES AND THE LIKE

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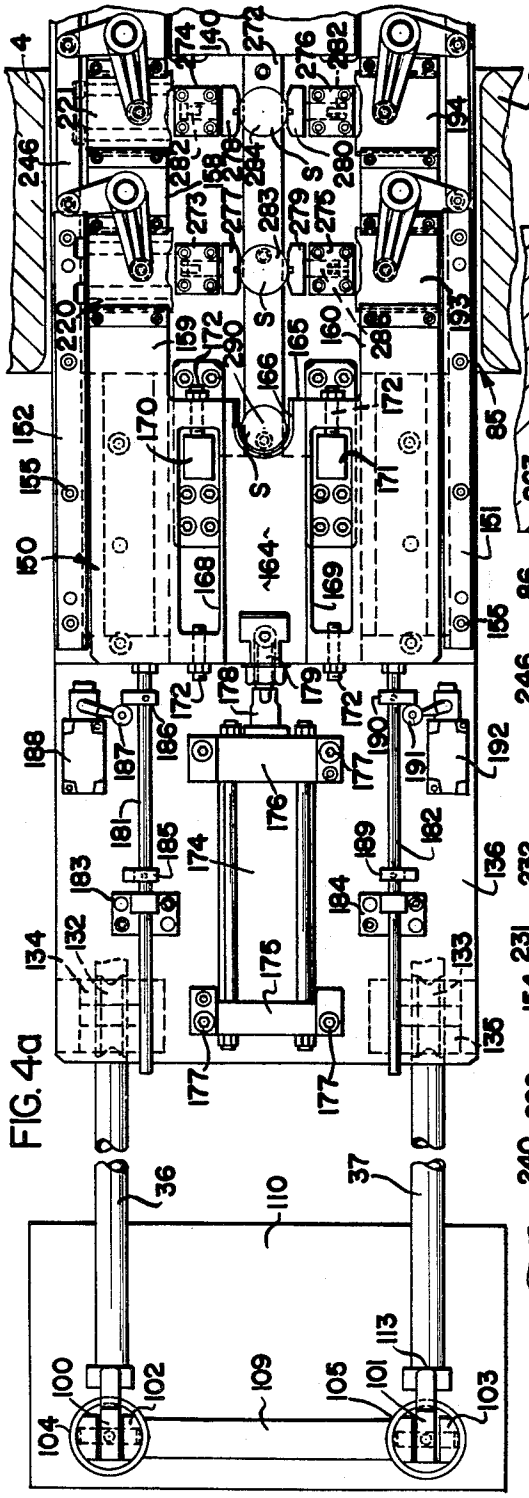

FIG. 4a

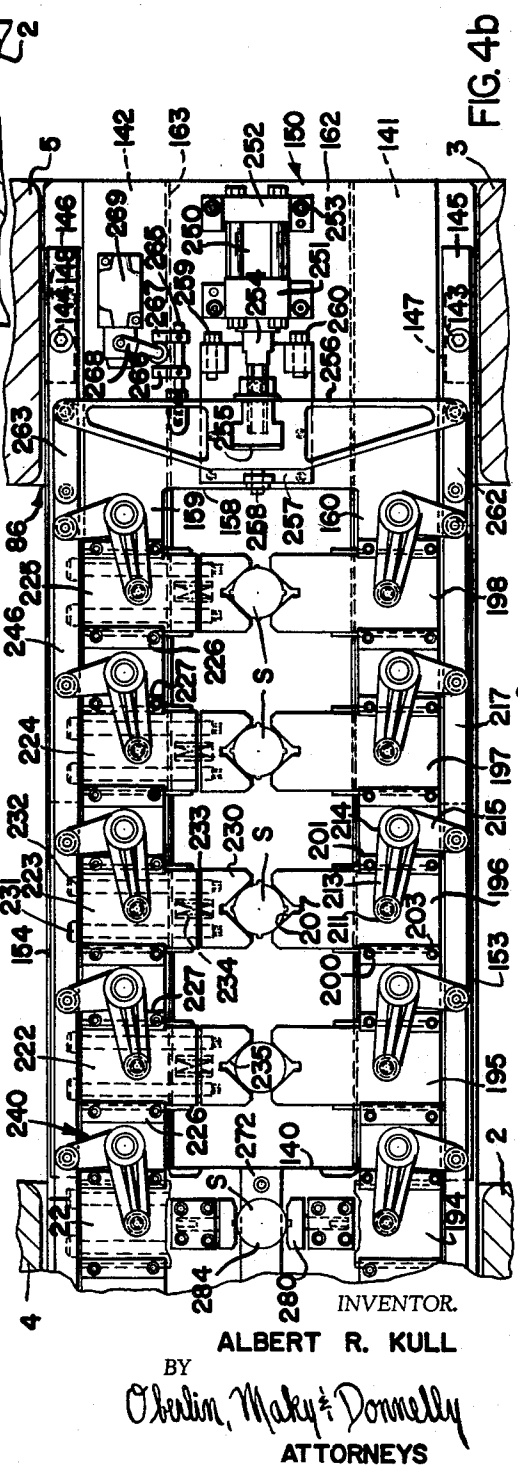

FIG. 4b

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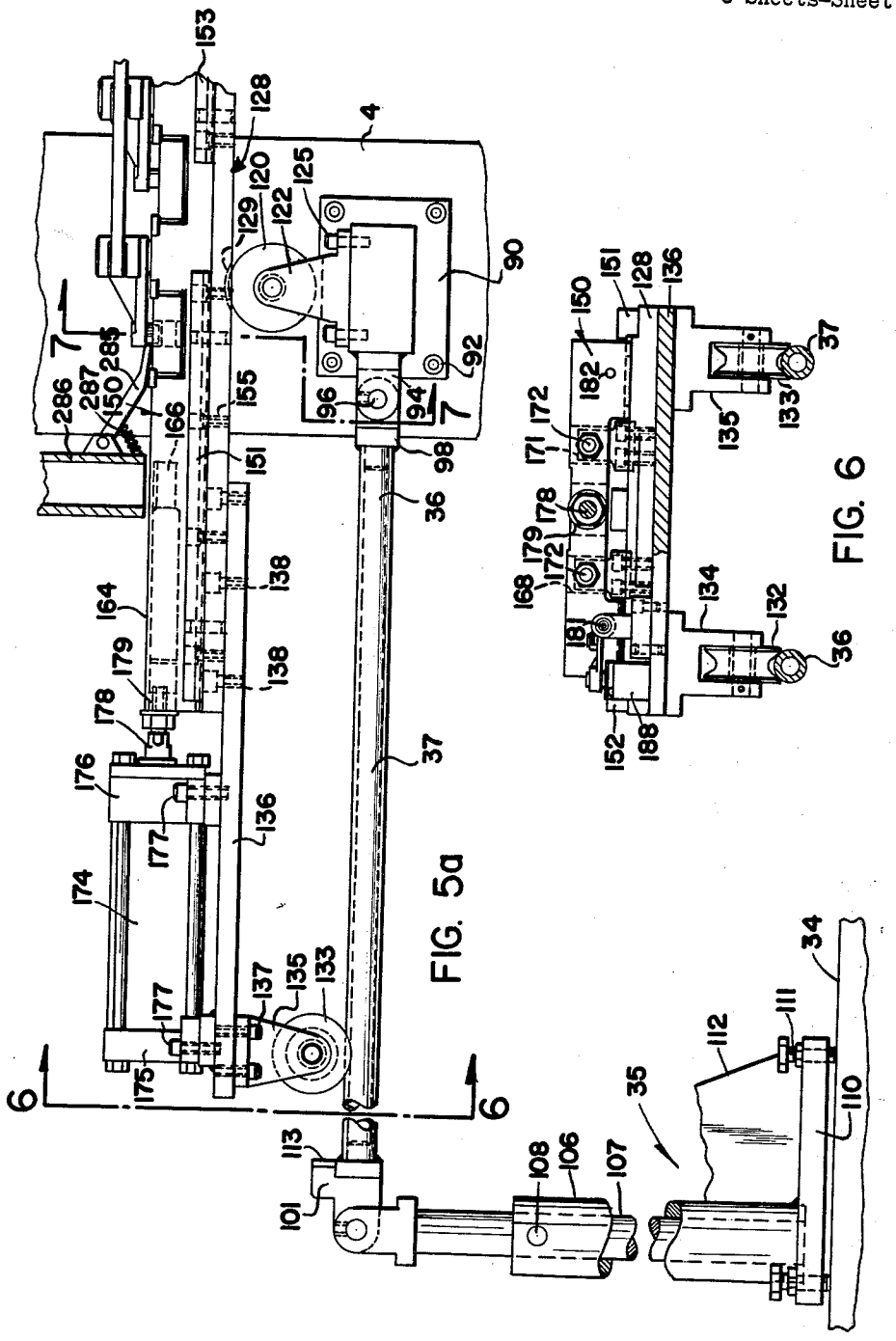

FIG. 5a

FIG. 6

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WORK TRANSFER MECHANISM FOR FORGING PRESSES AND THE LIKE

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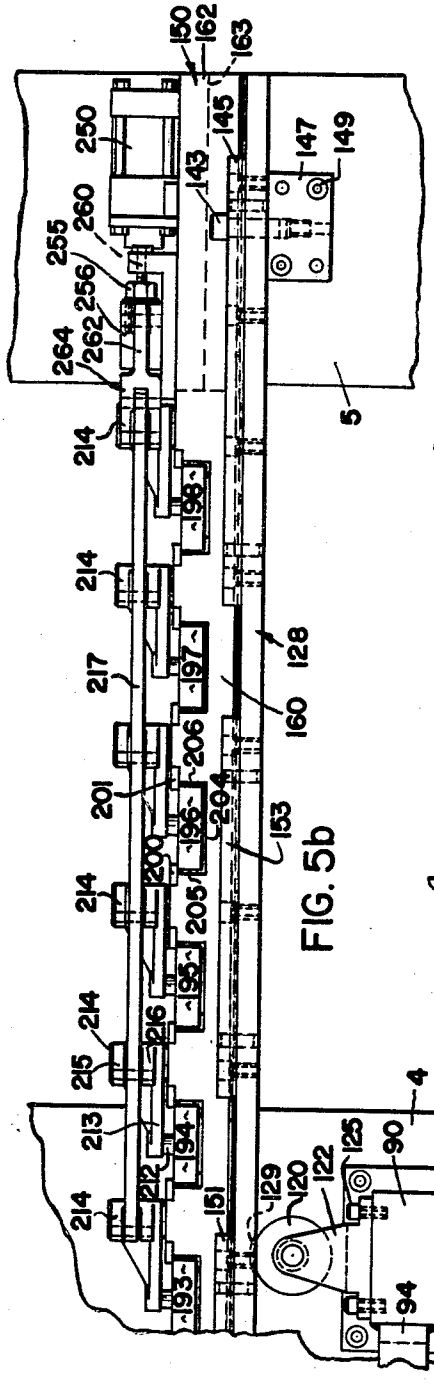

FIG. 5b

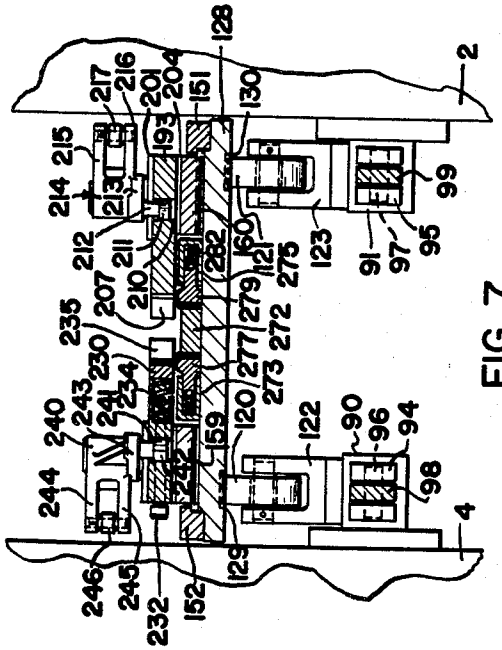

FIG. 7

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WORK TRANSFER MECHANISM FOR FORGING PRESSES AND THE LIKE

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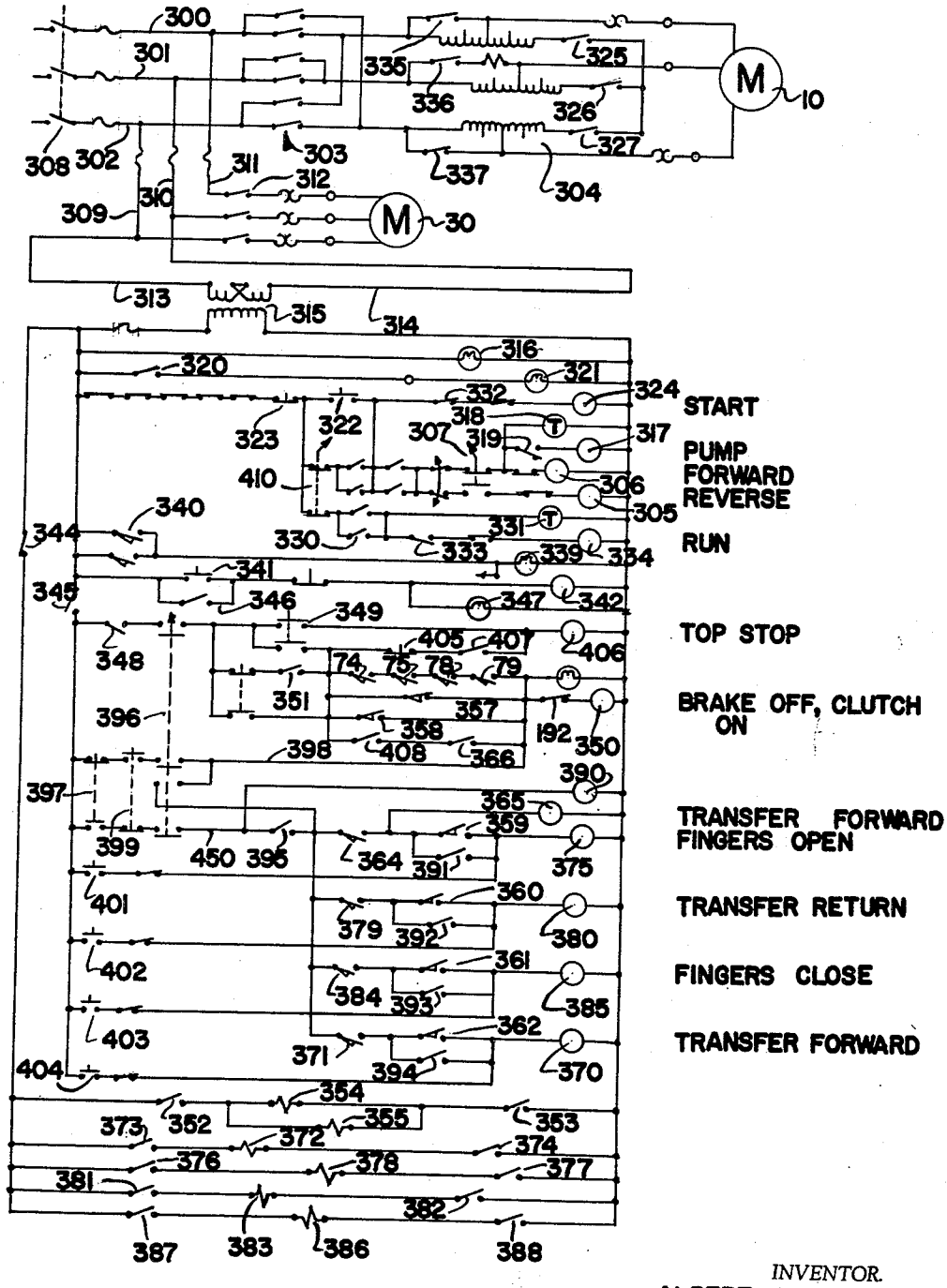

FIG. 9

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3,180,123

WORK TRANSFER MECHANISM FOR FORGING PRESSES AND THE LIKE

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Filed Oct. 12, 1962, Ser. No. 230,063
21 Claims. (Cl. 72—22)

This invention relates generally, as indicated, to a work transfer mechanism for forging presses and the like and more particularly to a forging press and transfer mechanism therefor which will enable high speed automatic production of forgings in a multi-operation forging press.

In forging presses, symmetrical forgings such as gear blanks, rotors, rock drills, etc., are produced from blanks of round or round cornered stock sheared to length and upended between the dies. For example, coining, extruding, piercing and sizing operations can be accomplished on a single forging press, but the workpiece must be transfered from one station to the next. Work gripping tongs are sometimes employed manually to transfer the work from one station to the next. The resultant finish compares favorably with hammer forgings, and the dimensions are even closer, not being subject to the influence of chilled flash, as when repeated finishing blows are struck. Flash can sometimes be entirely avoided by entering the top die into the bottom impression at each station totally confining the stock. Mechanical ejectors may then be employed in both the top and bottom die impressions to position the work to be gripped and transferred to the next station. The workpiece must, of course, be transfered and positioned very accurately for otherwise an improperly formed workpiece will be obtained and additionally, damage to the dies may result. It is then apparent that the rate of production obtained in such a multi-station forging operation is dependent upon how fast the workpieces can be gripped after the forging blow and trnasferred to the next station and released properly in position prior to the next forging blow. This transfer of the workpieces can only be accomplished when the dies are open and the workpiece has been ejected from the bottom impression especially where the workpiece is totally confined in the bottom impression by the top die entering thereinto.

It is accordingly a principal object of the present invention to provide a forging press and transfer mechanism therefor which will obtain accurate high speed production forgings in a multi-station forging operation.

A further principal object of the present invention is the provision of a transfer mechanism for forging presses which will firmly grip and transfer the workpieces from one forging station to the next in timed relation to the operation of the press.

Still another principal object is the provision of a work transfer mechanism for forging presses which can readily be installed on or removed from conventional forging presses.

A further object is the provision of a work transfer mechanism for forging presses which will firmly yet resiliently grip the workpieces transferring them from one forging station to the next in timed relation to the operation of such press.

A yet further object is the provision of such transfer mechanism and forging press incorporating many safety features precluding damage to the dies.

A still further object is the provision of a work transfer mechanism for forging presses in a multi-station forging operation which will permit the press to run continuously.

Other objects and advantages of the present invention

will become apparent as the following description proceeds.

To the accomplishment of the foregoing and related ends, the invention, then, comprises the features hereinafter fully described and particularly pointed out in the claims, the following description and the annexed drawings setting forth in detail a certain illustrative embodiment of the invention, this being indicative, however, of but one of the various ways in which the principle of the invention may be employed.

In said annexed drawings:

FIG. 1 is a front elevation of a forging press and transfer mechanism therefor in accordance with the present invention;

FIG. 2 is a fragmentary enlarged vertical section taken longitudinally through the dies of the forging press;

FIG. 3 is a similar vertical section taken substantially on the line 3—3 of FIG. 2;

FIG. 4*a* is an enlarged top plan view partially broken away of the forging press transfer mechanism;

FIG. 4*b* is a broken continuation of such transfer mechanism with the dies of the forging press not being shown for clarity of illustration;

FIG. 5*a* is a side elevation partially broken away of such transfer mechanism as seen from the bottom of FIG. 4*a*;

FIG. 5*b* is a broken continuation of FIG. 5*a* as seen from the bottom of FIG. 4*b*, again with the dies of the forging press omitted for clarity of illustration;

FIG. 6 is a fragmentary vertical section taken substantially on the line 6—6 of FIG. 5*a* with the air cylinders broken away for clarity of illustration;

FIG. 7 is a vertical section taken substantially on the line 7—7 of FIG. 5*a*;

FIG. 8 is a fragmentary end elevation of such transfer mechanism with the air cylinder broken away and partially in section as seen from the right in FIGS. 4*b* and 5*b*; and

FIG. 9 is a schematic wiring diagram illustrating more clearly the operation of such transfer mechanism and forging press.

Referring now to the annexed drawings and more particularly to FIG. 1, there is illustrated a forging press and transfer mechanism in accordance with the present invention. Such forging press comprises an integral solid steel bed frame 1 having four oversized columns 2, 3, 4 and 5. (See also FIGS. 2 through 8.) The bed frame 1 includes a base 5 in which the bottom dies are mounted and bearings are provided in such frame for a flywheel or back shaft, the axis of which is shown at 6, and a main or crank shaft 7. A motor 10 mounted on the top of the bed frame 1 drives a multi groove V-belt pulley 11 which in turn rotates a flywheel 12 with V-belts 13 or the like being trained about both. The flywheel drives the back shaft which extends across the back of the machine driving a pinion engaged with the gear 14 mounted on the main or eccentric shaft 7. An air operated clutch and brake assembly may be employed in connection with the flywheel as shown at 15 to engage and disengage the drive from the motor to the crank shaft.

The crank shaft is provided with a centrally disposed eccentric on which is mounted a pitman connected by a wrist pin to the ram 17. Dies shown generally at 18 are mounted on such ram for vertical movement in this manner toward and away from the dies in the base 5. Cams 20 and 21 may be provided on the main shaft 7 with followers 22 and 23 mounted on rocker arms actuating links 24 and 25 to operate kickers in the bottom dies to eject the workpieces from the die impressions. The shaft 7 is also employed through a chain drive 27

to operate a rotary cam limit switch 29 mounted on the column 2. A motor 30 may also be provided driving a lubrication pump 31 maintaining the various working parts well lubricated. A control panel 32 also mounted on the column 2 may be provided to regulate the operation of the machine. The bed frame 1 of the machine may be mounted in a special support base 33 mounted on the plant floor 34. Also mounted on the floor 34 spaced from the bed frame 1 is a stand 35 supporting the distal ends of tubular rails 36 and 37 supporting for convenient insertion and removal from the press frame, the transfer mechanism 40 of the present invention. With the exception of the transfer mechanism 40 and the appurtenant interlocking controls, the forging press illustrated is generally conventional and may, for example, be any of the forging presses manufactured by The Ajax Manufacuring Company of Cleveland, Ohio, ranging in sizes from 500 to 10,000 tons capacity.

Referring now additionally to FIGS. 2 and 3, the top dies 18 may be mounted on a bolster 41 secured to the face of the ram 17. An intermediate plate 42 may be provided between the base of the ram 17 and the bolster securing the bolster from movement in the plane of FIG. 3. It will, of course, be noted that the top dies and, of course, the ram are shown in their lowermost position in FIGS. 2 and 3 and at the opposite end of the stroke, the upper and lower dies will be substantially separated as shown in FIG. 1.

Reading from left to right in FIG. 2, the upper or male dies include a coining die 44, an extruding die 45, a piercing die 46 and a sizing die 47. The rigid coining die 44 is mounted in a shouldered sleeve 49 which is externally threaded to receive a tapped cap 50, both of which serve firmly to hold the die 44 to the bolster 41. The extruding, piercing and sizing dies 45 through 47 include centrally disposed rigidly mounted piercing portions surrounded by stripping portions each confined within a cap similar to the cap 50. Such stripping portions of the dies 45 through 47 are loaded by springs 52 and urged downwardly thereby. The stripping portions of such dies cooperate with the projecting piercing portions to form the upper die surface.

The bottom or female dies vertically aligned with the male dies are mounted in side-by-side blocks 54, each substantially identical in form, mounted on a bottom bolster 55. Within each such block 54, there is provided the annular die member 56 which confines the workpiece or slug as it is driven against the bottom die members 58, 59, 60 and 61 for the respective coining, extruding, piercing and sizing operations. The extruding die 59 and the sizing die 61 include upwardly rigidly projecting piercing members surrounded by relatively movable stripping members cooperating to form the bottom die surfaces. The bottom coining die member 58 completely encloses the bottom of the impression of the female coining die and the bottom piercing die 60 is provided with a vertically extending aperture 62 which communicates with an inclined passageway 63 as seen in FIG. 3 for removal of the slug formed by the center projection of the piercing die 46. A tube 64 projects into the female piercing die member 60 and serves as a central guide for the vertical movement thereof. All of the female or bottom die members are vertically movable in response to vertical movement of the ejector pins 65, there being three such ejector pins for each bottom die, which extend downwardly through the die blocks 66, plate 67 and the bottom of the bolster 55. The blocks 66 for the extruding and sizing dies are formed of two members to retain the central rigidly mounted piercing portion of the die in place. Such ejector pins are actuated by movement of the plate 68 which is mounted in recess R in the bottom portion of the bolster block 55. The plate 68 is raised and lowered in timed relation to the movement of the crank shaft 7 by means of the cam moved links 24 and 25 through ejector rods 69 projecting upwardly through the base 5 of the bed frame 1. Each of the die members 58 through 61 is mounted for movement in the top bolster block 55 and is provided with a flaring enlarged bottom portion as shown at 70. The flaring top surface of these enlargements acts as a cam to move horizontally microswitch actuating plungers 71 and 72 for the extruding and piercing, and coining and sizing dies, respectively. The plungers 71 are disposed at the back of the machine and extend through a compression spring 73 to actuate microswitches 74 and 75 mounted on brackets 76. The relatively shorter microswitch plungers 72 are mounted at the sides of the machine to actuate microswitches 78 and 79 mounted on brackets 80 for the coining and sizing operations, respectively. Thus there is provided a microswitch for each of the dies which will properly signal the elevation of the die members 58 through 61 elevating the stock to be gripped by the transfer mechanism of the present invention. If such dies fail to elevate, it usually means that one of the ejector pins 65 is broken. Not only do these ejector pins elevate the bottom dies to a position to be gripped by the transfer mechanism, but they also strip the workpieces which are totally confined in the bottom impression. Accordingly, powerful mechanical ejectors are provided in both the top and bottom dies stripping the workpieces therefrom.

Vertical adjustment of the lower dies can be obtained by a wedge in the lower die seat. Such adjustment means does not interfere at all with the accessibility at the back of the die seat and when backed off, permits the wedge to be rammed back from the front to relieve a stall. Accordingly, once the lower dies are brought into perfect match with the top punches or dies, the alignment remains undisturbed by adjustment of the bottom wedge. The bottom bolster is provided in the present invention with four projecting guide pins 82 at each corner thereof which project upwardly into depending sleeves 83 at the four corners of the top bolster with close tolerance maintaining proper alignment.

It is with the die tooling such as that shown in FIGS. 2 and 3 that the transfer mechanism of the present invention is to be employed. The bed frame 1 of the machine forms two windows 85 and 86 at each side of the dies through which the transfer mechanism 40 can readily be inserted into the machine. Also, with the die blocks 54 being recessed within the upper bolster member 55, there is formed two substantially horizontal guideways 87 and 88 readily to accommodate such transfer mechanism. Recessed head cap screws or the like will be employed to fasten the blocks 54 to the bolster 55 and similarly the bolster itself will be secured with cap screws recessed therein. This then leaves the two guideways substantially clear for insertion of the transfer mechanism.

Referring now additionally to FIGS. *4a*, *4b*, *5a*, *5b*, and FIGS. 6 through 9, the transfer removal rails 36 and 37 which facilitate the placement of the transfer mechanism within the machine are mounted on the insides of the frame columns 2 and 4. This mounting may be accomplished by brackets 90 and 91 which may be fastened to the insides of the columns by cap screws or the like 93. Clevises 94 and 95 may be welded to such brackets supporting pins 96 and 97 extending through extensions 98 and 99 of the tubular transfer removal rails 36 and 37, respectively.

The distal ends of such rails are similarly formed with projections 100 and 101, respectively which are pin-connected to clevises 102 and 103 mounted on the tops of the stand uprights 104 and 105. As seen in FIG. *5a*, each of the uprights includes an upwardly projecting tubular member 106 receiving a downwardly projecting rod 107 telescoping thereinto. A set screw, locking pin or the like 108 may be provided to obtain the proper vertical adjustment of the rods 107. Such rods are interconnected by a tubular frame member 109 to assure vertical movement in unison. Such upwardly projecting tubular members 106 are mounted on a support plate 110 pro-

vided with corner leveling screws indicated at 111. Web reinforcing plates 112 may be provided welded between the upwardly projecting tubular members 106 and the plate 110 to rigidify the stand. It is noted that the members 100 and 101 on the ends of the transfer removal rails 36 and 37 are provided with abutments shown at 113 in FIG. 5a limiting the movement of the transfer mechanism along such rails.

As seen in FIG. 1, such rails will normally extend to the side of the press a sufficient distance to enable the entire transfer mechanism to be moved out of the window 85 in the frame 1. As seen in FIGS. 6 and 7, particularly, the transfer mechanism is supported on four rollers for movement along the transfer removal rails 37. Rollers 120 and 121 are mounted on upstanding roller supports 122 and 123 in turn fastened to the tops of brackets 90 and 91, respectively by suitable fasteners shown at 124 in FIG. 5a. These upwardly projecting rollers engage the underside of the transfer table 128 which comprises the main supporting member for the transfer mechanism 40. Slight scallops 129 and 130 may be provided in such underside of the table to facilitate the proper placement of such transfer mechanism in the forging press.

Referring now to FIG. 6, the transfer table 128 and thus the transfer mechanism 40 is also supported by grooved rollers 132 and 133 mounted on depending brackets 134 and 135 respectively secured to the underside of the plate extension 136 of the table 128. Such brackets may be secured to such plate extension by suitable fasteners indicated at 137 and the extension itself may also be secured rigidly to the table by recessed cap screws or the like 138. As seen in FIGS. 4a, 4b, and 8, the transfer table 128 is bifurcated providing a central opening 140 dividing the table 128 into two longitudinally extending legs 141 and 142. These legs straddle the die blocks 54 and when the transfer mechanism is inserted into the machine, these legs will fit in the slideways 87 and 88 on either side of such blocks. The distal ends of the legs may be fastened by cap screws or the like 143 and 144 extending through gibs 145 and 146 into brackets 147 and 148 secured by fasteners 149 to the insides of the columns 3 and 5 of the frame 1. Thus with the removal of the screws 143 and 144, the entire transfer mechanism 40 may be pulled out of the press frame with the table and its plate extension 136 being supported on the rollers 120, 121, and 132, 133, respectively. The transfer mechanism can as easily be inserted into the machine simply sliding it along on the rollers until the rollers 120 and 121 drop into the scalloped portions on the bottom surface of the table 128 and the screws 143 and 144 may then be secured in place.

Slidably mounted on the table 128 is a transfer slide 150 held to such table for such sliding movement by gibs 151, 152, 153, 154 and the aforementioned gibs 145 and 146. Such gibs are held to the edges of the table 128 by means of suitable fasteners such as the illustrated cap screws 155. Such transfer slide is provided with an enlarged central opening 158, partially seen in FIG. 4b, forming two elongated legs 159 and 160 which substantially correspond to and overlie the legs 142 and 141 of the table. Thus the transverse dimension of the opening 158 is only slightly larger than the transverse opening 140 in the table 128. The legs 159 and 160 are connected at the right as seen in FIGS. 4b and 5b and also FIG. 8 by an arched bridge portion 162 forming an inverted channel 163 which will clear the die blocks 54 when the transfer mechanism is pulled from the press.

At the opposite end of the transfer slide as seen in FIG. 4a, the legs 159 and 160 are connected by a bridge portion 164. The opening 158 of the transfer slide at this end extends considerably beyond the opening 140 in the table 128 and terminates in a wall 165 (see again FIG. 4a) provided with a centrally disposed semi-circular stock receiving recess 166. In addition to the opening 158, there are provided two elongated parallel openings 168 and 169 in the bridge portion 164 of the transfer slide 150. Projecting upwardly through the openings are transfer slide stop blocks 170 and 171, respectively, secured to the top of the table 128. Adjustable stop screws 172 are secured in each end of each of the openings 168 and 169 accurately to control the extent of movement of the slide 150 on the table 128.

Movement of the transfer slide with respect to the transfer table is obtained by means of a pneumatic piston-cylinder assembly 174, the ends 175 and 176 of which are mounted on the shelf extension 136 of the table 128 by means of the screw fasteners 177. The rod 178 of the piston-cylinder assembly 174 is adjustably connected to the bridge 164 of the transfer slide 150 by means of the T-slot nut shown at 179. Extension of the rod 178 will then move the slide 150 to the right as seen, for example, in FIG. 4a until the stop screws 172 at the left of the slots 168 and 169 contact the stop blocks 170 and 171. Similarly, retraction of the rod 178 will move the transfer slide to the position shown in such figure.

The pneumatic cylinder 174 may, for example, have a 6½ inch stroke with a 3¼ inch diameter, cushioned at both ends. However, the stop screws 172 may be set to limit the movement of the transfer slide precisely to but 6 inches.

As seen in FIG. 4a, projecting from the transfer slide parallel to the cylinder 174 are two limit switch trip rods 181 and 182 secured at one end to the transfer slide and slidably passing through respective guides 183 and 184 mounted on the shelf 136. Adjustable dogs 185 and 186 are secured to the rod 181 adapted to engage roller operator 187 of limit switch 188 mounted on the shelf 136. The spacing of the dogs 185 and 186 will be such that the limit switch 188 will indicate the end positions of the transfer slide 150. Dogs 189 and 190 on the rod 182 both engage roller operator 191 of limit switch 192 also mounted on such shelf 136 and the spacing of these dogs may be somewhat greater than the spacing of the dogs 185 and 186. This limit switch 192 then can be employed as a safety limit switch to stop the press in the event of overtravel due to failure of the stop blocks 170 and 171. Ordinarily, such stop blocks will be flame hardened to preclude wear or other failure.

It can now be seen that the transfer slide is mounted for horizontal reciprocation on the transfer table through a precisely determined stroke which will be exactly equal to the distance between the four forging stations shown in FIG. 2. Mounted for transverse sliding movement on the leg 160 of the transfer slide are six solid stock engaging fingers 193, 194, 195, 196, 197 and 198. In FIGS. 4a and 4b, the fingers 193 and 194 are shown broken away. Each of the solid fingers 193 through 198 is substantially identical in form and such fingers are mounted in recessed transverse channels in the leg 160 of the transfer slide 150. Each of such fingers is confined in its respective transverse channel by means of overlying gibs 200 and 201 secured to the top of the leg 160 by the fasteners shown at 203. As seen more clearly in FIG. 5b, each of the solid fingers 193 through 198 is provided with a bottom liner 204 and side liners 205 and 206. Each of the solid fingers is also provided with a V-notch 207 on the inwardly projecting end thereof adapted to engage the stock S and maintain the same aligned with the center line of the finger. By each finger, the stock will be engaged at two substantially circumferentially spaced areas of vertical line contact firmly engaging such stock.

Each of the gripping fingers 193 through 198 is provided with a slightly elongated slot 210 extending longitudinally of the slide to receive a roller 211 projecting downwardly on shaft 212 at the distal end of one leg 213 of a bell crank 214, there, of course, being one such bell crank for each of the fingers 193 through 198. Such

bell cranks are mounted for oscillatory movement on the top of the leg 160 just to the right of the respective driven gripping fingers. As seen in FIG. 7, the opposite leg of each such bell crank is bifurcated providing an upper portion 215 and a lower portion 216 straddling and pin-connected to a longitudinally extending operating link 217. It can now be seen that longitudinal reciprocation of the link 217 will oscillate the bell cranks 214 in unison about their aligned pivot axes on the top of the leg 160 of the transfer slide 150 moving the solid fingers 193 through 198 in unison transversely of the transfer slide.

On the rear leg 159 of the transfer slide 150, there is similarly provided six finger slide blocks 220, 221, 222, 223, 224 and 225 mounted in recessed channels extending transversely of such leg and aligned with the solid fingers 193 through 198, respectively. Such finger blocks may each be confined in such channels by gibs 226 and 227 and bottom and side liners will also be provided. In FIGS. 4*a* and 4*b*, the finger blocks 220 and 221 are shown broken away but it will be understood that these fingers are substantially identical in form to the finger blocks 222 through 225. Each of the rear fingers or the fingers on the rear leg 159 of the transfer slide is provided with a finger insert 230 which is held to the respective finger block by two elongated fasteners 231 and 232 passing freely therethrough. A relatively small clearance shown at 233 is provided between the insert 230 and the respective finger block and a compression spring 234 is interposed therebetween. Such compression springs then resiliently urge the finger inserts 230 toward the opposed solid fingers 193 through 198, with such resilient movement being limited by the elongated fasteners 231 and 232. Such inserts 230 are provided with the V-notches 235 which correspond to the notches 207 in the solid fingers so that the stock or workpiece S will be gripped firmly between such inserts and the solid fingers at four circumferentially spaced line contact points.

Movements of the finger blocks 220 through 225 and thus the finger inserts 230 resiliently mounted on the distal ends thereof is obtained by means of six bell cranks 240 which are allochirally identical in form to the bell cranks 214. Each of the finger blocks 220 through 225 is provided with a slightly elongated slot 241 extending longitudinally of the slide in which is mounted a roller 242 projecting downwardly from the leg 243 of the bell crank 240. The opposite leg is bifurcated to provide upper and lower legs 244 and 245 straddling an operating link 246 which extends parallel to the operating link 217. Such bell cranks 240 are mounted on the top of the rear leg 159 adjacent the respective finger blocks and it can now be seen that longitudinal reciprocation of the link 246 will oscillate such rear bell cranks 240 in unison about their aligned respective axes to reciprocate transversely the finger blocks 220 through 225 and, of course, the respective finger inserts 230 toward and away from the stock S. Oilite sleeve bearings may be provided at all of the pivots of such finger operating mechanism.

Longitudinal reciprocation of the front and rear links 217 and 246 is obtained by a pneumatic piston-cylinder assembly 250 mounted on the bridge portion 162 of the transfer slide. The ends 251 and 252 of such piston-cylinder assembly may be fastened directly to such portion of the transfer slide by the fasteners shown at 253. The projecting rod 254 of such assembly is adjustably connected at 255 to a yoke 256 by means of a T-slot nut. Such yoke 256 extends transversely of the transfer slide and is mounted on a stop block 257 provided with adjustable stop screws 258 on one side and 259 and 260 on the opposite side limiting precisely the stroke of such piston-cylinder assembly and thus the movement of the yoke. The outer ends of the yoke are pivotally connected to links 262 and 263, the opposite ends of which are clevised as shown at 264 in FIG. 5*b* and connected to the respective operating links 217 and 246. The piston-cylinder assembly 250 may, for example, have a two inch bore and a one inch stroke with the stop screws 258, 259 and 260 limiting the movement of the yoke to approximately ¾ of an inch. This movement will, however, be sufficient to obtain approximately one inch of movement of the front and rear gripping fingers so that the fingers when opened will readily clear the workpieces and the dies in their closed position seen in FIG. 3 as the transfer slide is indexed by the piston-cylinder assembly 174. The yoke 256 may be provided with a limit switch trip rod 265 having dogs 266 and 267 thereon enclosing the roller operator 268 of limit switch 269 which will indicate the end positions of the gripping fingers.

As seen more clearly in FIGS. 4*a* and 4*b*, the opening 158 in the transfer slide 150 extends considerably beyond the opening 140 in the transfer table. In this portion of the table exposed by the opening 158, there is provided a centrally positioned flame hardened stock support rail 272 which extends from beneath the semi-circular recess 166 in the transfer slide in its retracted position to the edge of the opening 140 in the transfer table. This rail is then fixed in the window 85 of the bed frame 1 when the transfer mechanism 40 is in position. Mounted on each side of the rail 172 on the table 128 are four idle position grip block supports 273, 274, 275 and 276. These supports are mounted directly beneath the finger blocks 220, 221 and the solid fingers 193 and 194, respectively. In each such block support, there is provided an idle position grip block as shown at 277, 278, 279 and 280 provided with stems 281 fitting in bores in the respective blocks. Compression springs 282 are situated between the ends of the bores and such stems resiliently urging such grip blocks outwardly toward the rail 272. These grip blocks will then properly maintain the stock S in the idle positions shown at 283 and 284 within the window 85 of the frame 1. If desired, a finger 285 may additionally be provided engaging the tops of the stock S in such idle positions (see FIG. 5*a*) mounted on a loading tube 186 which is vertically aligned with the semi-circular recess 166 in the bridge portion 164 of the transfer slide 150 when retracted. A spring 287 may be employed resiliently to hold such finger against the tops of such workpieces to maintain them properly aligned and in position when not gripped by the respective gripping fingers.

It can now be seen that stock, which may comprise small cylindrical pieces of metal, may be stacked in the loading tube 286 with the bottom one dropping into the load station shown at 290 in the semi-circular recess 166 in the transfer slide on top of the rail 272 in the transfer table. With the gripping fingers retracted by the retraction of the piston-cylinder assembly 250, the workpiece can then be moved forward by extension of the cylinder 174 to place such workpiece at the first idle position 283. As the slide 150 moves forwardly, it will force the workpiece between the grip blocks 277 and 279 compressing the springs 282 and such blocks in cooperation with the finger 285 will hold such workpiece at the first idle position. The cylinder 174 is then retracted to permit the next workpiece to drop into the load station 290 from the loading tube 286. The fingers are now moved toward each other by reason of the extension of the cylinder 250 and the workpiece at the first idle station 283 will be gripped firmly therebetween. When such has occurred, the cylinder 174 will again be extended now moving the workpiece to the second idle station while simultaneously moving the next workpiece to the first idle station. Again, the workpiece will be gripped between the grip blocks 278 and 280 to be maintained at the second idle position when the fingers release the stock by retraction of cylinder 250. With such fingers retracted and the workpieces in the idle stations 283 and 284, the slide is again retracted by the cylinder 174 to receive the next workpiece at the load station. The fingers then again grip the first mentioned workpiece to move it forwardly as the slide is extended

to the first coining operation between the coining dies. As the ram descends, the coining punch 44 will come down driving the stock properly positioned by the fingers into the female impression performing the coining operation. The fingers are opened and the slide retracted so that after such operation, the kicking fingers 65 will elevate the die 58 elevating the workpiece to position the workpiece to be again gripped by the fingers to be moved to the next station. This process will, of course, be repeated and the finished workpiece may then be discharged through the window 86 into a waiting bin.

Control circuit

The main motor 10 may, for example, be a 50 H.P. squirrel cage motor operating from 220/440, 3 phase, 60 cycle current supplied through main lines 300, 301 and 302 connected to each other through forward and reverse switching circuits 303 and to the windings of starting transformer 304. Alternate start switches from top to bottom may be energized by the reverse and forward relays 305 and 306 controlled by two position selector switch 307. A disconnect switch 308 will, of course, first be closed to provide the requisite current. Branch lines 309, 310 and 311 lead to start switches 312 for the pump motor 30. Lines 313 and 314 connected to lines 309 and 210, respectively, lead to the windings of a control transformer 315 for the control circuit of the present invention. When the disconnect switch 308 is closed, a "power on" signal lamp 316 will normally be energized. A pump starter 317 will be energized at intervals by a timer 318 opening and closing switch 319. In addition to the switches 312, such starter also closes switch 320 to energize signal lamp 321 to show the operator that the pump motor is running.

The main motor may be started and stopped through push button switches 322 and 323 and a plurality of serially connected overload switches normally closed to energize starter 324 closing start switches 325, 326 and 327 in the starting transformer 304. The direction of the motor will have been chosen by the switch 307 and either of the forward or reverse relays will now close one of the switches 330 to energize timer 331, which, when it times out, will open the switch 332 and close switch 333, the latter energizing run relay 334 to close switches 335, 336 and 337 to set the starting transformer 304 for a run condition. A signal lamp 339 controlled by microswitches 340 will be employed to warn the operator of failure in the lubricating system so that the machine may be brought to a stop.

Now to start the automatic feeding of the workpieces to the press, the operator will normally close push button switch 341 energizing relay 342 to close switches 344, 345 and the holding circuit 346 around the push button 341. A signal light 347 will be provided indicating that automation power is now on. When air is supplied to the transfer and finger cylinders 174 and 250 respectively, a pressure switch 348 will be closed preparing a circuit for the effective energization of the cycle start switch 349. The automatic cycle of the machine can now be instituted by depressing the cycle start button 349 energizing relay 350 which closes contacts 351, 352 and 353. The contacts 351 complete a hold circuit around the push button switch 349 and the contacts 352 and 353 energize solenoids 354 and 355 releasing the brake and operating the clutch respectively, to start rotation of the press eccentric shaft 7 and, of course, vertical movement of the ram. As will be recalled from FIG. 1, rotation of the eccentric shaft 7 drives through chain 27 rotary cam limit switch 29. Such rotary limit switch actuates limit switch contacts 357, 358, 359, 360, 361 and 362. Each of these switch contacts will then be closed for a portion of the rotation of the eccentric shaft. Limit switches 74, 75, 78 and 79, which are in series with each other and which are in parallel with the limit switch contact 357, will normally be closed from 225° to 285° of eccentric shaft rotation. These switches are closed by the ejector pins and if a pin breaks, the corresponding limit switch does not close and the relay 350 will then be deenergized stopping the press and transfer immediately.

If the transfer is not moved forward at 315° of eccentric shaft rotation, the contacts 364 of limit switch 188 will remain open and transfer forward relay 365 will not be energized. Normally open relay switch 366 will then not close and again the relay 350 will be deenergized stopping the press and transfer. With transfer forward relay 370 energized by the closing of the contacts 371 of the limit switch 269 indicating the fingers having been shut, solenoid 372 is actuated by the closing of contacts 373 and 374 to move the transfer forward closing the contacts 364. With the eccentric at 137° of rotation, the limit switch 359 closes energizing fingers open relay 375 which closes contacts 376 and 377 energizing solenoid 378, opening the transfer fingers.

With the fingers at open position, the contacts 379 are closed and with the eccentric shaft at 160° of rotation, limit switch 360 closes energizing the transfer return relay 380. This relay closes contacts 381 and 382 to energize solenoid 383 to retract the cylinder 174 returning the transfer to its retracted position shown in FIGS. 4*a* and 4*b*.

The transfer in returned position closes contacts 384 of limit switch 188 and with the eccentric shaft at 230° of rotation and with the ejector pins up, switch 361 closes energizing fingers close relay 385. Solenoid 386 is then actuated by the closing of contacts 387 and 388 extending the cylinder 250 to close the transfer fingers. When the fingers have reached their closed position, the limit switch contacts 371 will be closed and with the shaft at 255° of rotation ensuring removal of the top dies from the frame path, switch 362 closes energizing transfer forward relay 370 again to energize the solenoid 372 to move the transfer forward repeating the above cycle.

A relay 390 when energized will close normally open contacts 391, 392, 393 and 394 bypassing the rotary limit switch contacts 359, 360, 361 and 362 respectively so that the transfer mechanism can be cycled sequentially by switches 364, 379, 384 and 371. The normally open contact 395 closed by the relay 390 prevents energization of such relay when the selector switch 396 is in "auto" position. The selector switch 396 has an "auto" position for either automatic cycle or manual cycle of the press and transfer and a manual inch position for either press inch or transfer inch. In such latter position, push button switch 397 may be employed for inching of the transfer mechanism by energizing the relay 390 and such inching continues until the push button 397 is released. Press inching is prevented by the opening of the circuit through line 398. Push button 399 obtains inching of the press mechanism by energizing the relay 350 and inching continues until such push button 399 is released. Transfer inching is then prevented by opening the circuit through the line 400.

Push button 401 manually opens the fingers by energizing relay 375 which actuates solenoid valve 378. Push button 402 manually returns the transfer by energizing relay 380 which actuates solenoid 383. Push button 403 closes the fingers by energizing relay 385 actuating solenoid valve 386. Finally, push button 404 moves the transfer forward by energizing relay 370 actuating solenoid 372. At any time, the press may be stopped and, of course, the transfer also at 315° of rotation of the eccentric shaft by depressing the top stop button 405 energizing top stop relay 406. Such relay controls holding switch 407 and switch 408 controlling the relay 350 operating the clutch and brake of the machine. It can now be seen that a complete manual overriding control for the automatic cycle of the machine is provided should such be desired or at any time become necessary.

The cycle of operation of the machine is, of course, timed with the rotational movement of the eccentric shaft

by means of the shaft position responsive limit switches 357 through 362. By means of contacts 357, closed from 10 to 240° of eccentric shaft rotation, the eccentric shaft will be beyond dead center of 360° and the cycle start push button 349 can then energize relay 350. The contacts 358 close a timing gap in the eccentric shaft rotation between limit switches 74, 75, 78 and 79, which will signal an ejector pin malfunction, and the transfer forward relay 365 which closes contacts 366 in parallel with such switch 358. Limit switch contacts 359 through 362 sequence the transfer on automatic cycle. Finally, limit switch contacts 192 in series with the brake and clutch relay 350 open to stop the press and transfer in the case of transfer overtarvel. Reference may be had to FIG. 4*a* for the position of this limit switch.

Operation

Briefly recapitulating the automatic cycle of operation for the present invention, it will be seen that with the following starting conditions obtained, the press will function completely automatically:

(1) disconnect switch 308 is turned on;

(2) push button switch 322 is actuated starting the press motor;

(3) the air supply to the transfer and finger cylinders is on closing the pressure switch 348 and air supply is also turned on to the clutch and brake solenoid valves 354 and 355;

(4) air supply is turned on to control solenoid valves 372, 378, 383 and 386;

(5) selector switch 410 is moved to the run position, the other position being a jog position;

(6) selector switch 307 is turned to the forward position; and

(7) selector switch 396 is turned to the "auto" position.

The automatic cycle may then be commenced by actuating push button 349 which energizes relay 350 through limit switch 357. The relay 350 completes a hold circuit around such push button 349 and also energizes solenoids 354 and 355 releasing the brake and operating the clutch to start rotation of the press eccentric shaft and ram. Rotation of such shaft actuates the limit switch contacts 357 through 362. With the workpieces positioned in the loading tube 286 and one within the semi-circular recess 166 of the transfer, relay 370 will be energized by limit switch 371 and solenoid valve 372 is actuated extending cylinder 174 moving the transfer forward which in turn closes limit switch 364 and with the eccentric shaft at 137° of rotation, limit switch 359 will be closed energizing relay 375 actuating solenoid 378 to open the fingers by retracting the cylinder 250.

With the fingers now at open position, limit switch 379 will be closed and with the eccentric shaft at 160° of rotation, limit switch 360 closes energizing relay 380 retracting cylinder 174 by energization of solenoid valve 383. The transfer in its return position closes limit switch 384 and with the shaft at 230° of rotation, limit switch 361 closes energizing relay 385 actuating solenoid 386, now extending cylinder 250 closing the transfer fingers. The fingers in the closed position actuate limit switch contacts 371 and with the eccentric shaft at 255° of rotation, contacts 362 are closed again energizing the transfer forward relay 370. Thus with one complete cycle of the transfer mechanism, the workpiece will have been moved from the load position 290 to the first idle position 283 seen in FIG. 4*a*. Upon the next cycle, it will move to the second idle position 284 and then into the first or coining operation of the forging press seen in FIG. 4*b*. In such first operating position, the workpiece will be driven down into the bottom coining die and after the coining operation, it will be elevated by the ejector pins to be positioned again to be gripped by the gripping fingers. The workpiece will then be moved through the extruding, piercing, and sizing operations by successive cycle of the transfer mechanism, with each cycle occurring during one complete revolution of the eccentric shaft 7. The limit switches 74, 75, 78 and 79 are closed by the four ejector pins and if the pin breaks, the corresponding limit switch will not close and therefore the relay 350 will be deenergized stopping the press and transfer immediately. Moreover, if the transfer is not in its forward or right hand position as seen in FIGS. 4 and 5, at 315° of eccentric shaft rotation, the limit switch 354 does not energize the relay 375. Also, normally open switch 366 energized by relay 365 does not close and the relay 350 is then deenergized, stopping the press and transfer.

It can now be seen that the work will be fed continuously from the loading chute 286 and indexed forward a distance equal to the distance between the working stations each time the eccentric shaft 7 revolves. The work will then be fed first to the two idle stations and then successively to the four working stations and finally discharged from the machine. Accordingly, with the transfer mechanism and forging press of the present invention, automatic high speed production of items such as alternator rotors can be obtained even with the workpiece being completely enclosed within the bottom or female dies.

Other modes of applying the principle of the invention may be employed, change being made as regards the details described, provided the features stated in any of the following claims or the equivalent of such be employed.

I, therefore, particularly point out and distinctly claim as my invention:

1. In a forging press of the type having an upstanding frame, an eccentric shaft mounted in said frame for rotation about a horizontal axis, a ram vertically movable in response to rotation of said shaft, a set of top dies carried by said ram for vertical reciprocation therewith, a set of bottom dies mounted on said frame vertically aligned with the respective dies carried by said ram and cooperating to forge workpieces therebetween; a transfer mechanism for transferring workpieces to successive cooperating dies comprising a table mounted on said frame adjacent said bottom dies, a horizontally reciprocable slide mounted on said table, a plurality of pairs of fingers mounted on said slide adapted to be opened and closed in unison, said pairs of fingers being horizontally spaced in the same relation as said dies, and means to reciprocate said slide and thus said fingers in one direction when said fingers are closed, and in the opposite direction when said fingers are opened, means to feed a workpiece to said fingers thus to be successively fed through the dies of said forging press, and means operative to ensure the reciprocation of said slide in timed relation to the rotation of said eccentric shaft, and a piston-cylinder assembly for reciprocating said slide, and a single piston-cylinder assembly mounted on said slide for movement therewith for opening and closing said fingers.

2. A forging press as set forth in claim 1 including an opening in said table surrounding said bottom dies, an opening in said slide corresponding to the opening in said table and forming front and rear legs on said slide straddling said bottom dies, said fingers being mounted in said front and rear legs of said slide for transverse opening and closing movement.

3. A forging press as set forth in claim 1 including a drive motor driving said eccentric shaft, a brake and clutch mechanism for such drive for said shaft, ejector means driven in timed relation to the rotation of said shaft operative to elevate such workpieces from said bottom dies to position the same to be gripped by said fingers when closed, and means responsive to the failure of said ejector means to deenergize said brake and clutch means to stop rotation of said shaft.

4. In a forging machine of the type having a frame, a drive shaft mounted in said frame for rotation about a horizontal axis, a ram driven for reciprocation by said drive shaft, a set of dies carried for movement by said ram, a set of corresponding dies mounted on said frame cooperating with said ram dies to forge workpieces there-

between, a transfer mechanism for transferring workpieces successively to cooperating dies comprising a table mounted on said frame including a pair of legs straddling said dies, a slide mounted on said table for reciprocation, an opening in said slide surrounding said dies, a plurality of pairs of fingers mounted on said slide and adapted to project into said opening to grip workpieces therebetween, means operative to open and close said fingers in unison, means responsive to the opening of said fingers and to the rotative position of said shaft to reciprocate said slide in one direction, and means responsive to the closing of said fingers and to the rotative position of said shaft to reciprocate said slide in the opposite direction.

5. A foregoing press as set forth in claim 4 wherein said means operative to open and close said fingers in unison comprises a piston-cylinder assembly mounted on said slide, a yoke connected to said piston-cylinder assembly for movement thereby, operating links connected to the opposite ends of said yoke, bell cranks for each finger mounted on said slide adjacent thereto, said operating links being connected to said bell cranks whereby reciprocation of said yoke will oscillate said bell cranks, said bell cranks being connected to said fingers whereby oscillation of said bell cranks will reciprocate said fingers.

6. A forging press as set forth in claim 5 including transversely extending ways in said slide adjacent said opening accommodating said fingers for transverse reciprocation, one of each pair of said fingers being solid with the opposite finger of each pair having a spring loaded tip whereby such workpieces will be resiliently gripped therebetween.

7. In a multi-operation forging press of the type having an upstanding frame, a vertically movable ram, dies mounted on said ram, and bottom dies mounted on the base of said frame cooperating with the dies on said ram to forge workpieces therebetween; a transfer mechanism comprising a table mounted on said frame surrounding said bottom dies, a slide mounted on said table for horizontal shuttling movement, an elongated opening in said slide enclosing said dies, a semi-circular recess in one end of such opening, a horizontal slideway beneath such recess a loading tube extending closely above such recess and in one position of said slide adapted to deposit a workpiece into such recess and onto said slideway, means operative horizontally to shuttle said slide, and inwardly directed transversely movable workpiece engaging projections on said slide operative to index such workpiece from said slideway through such frame and between said dies for such forging operations as said slide is shuttled back and forth.

8. A transfer mechanism for vertical forging presses and the like comprising a table, a slide mounted on said table, means operative horizontally to reciprocate said slide, an opening in said slide, pairs of work engaging fingers mounted on said slide and extending transversely into said opening, means to open and close said fingers in response to the horizontal position of said slide, a bell crank for each of said fingers mounted on said slide, means operative to oscillate said bell cranks in unison, and means connecting each said finger and the respective bell crank for movement transversely of said slide in response to such oscillation of said bell cranks.

9. In a forging press of the type having an unstanding frame, an eccentric shaft mounted in said frame for rotation about a horizontal axis, a ram vertically movable in response to rotation of said shaft, a set of top dies carried by said ram for vertical reciprocation therewith, a set of bottom dies mounted on said frame vertically aligned with the respective dies carried by said ram and cooperating to forge workpieces therebetween; a transfer mechanism for transferring workpieces to successive cooperating dies comprising a table mounted on said frame adjacent said bottom dies, a horizontally reciprocable slide mounted on said table, a plurality of pairs of fingers mounted on said slide adapted to be opened and closed in unison, said pairs of fingers being horizontally spaced in the same relation as said dies, and means to reciprocate said slide and thus said fingers in one direction when said fingers are closed, and in the opposite direction when said fingers are opened, means to feed a workpiece to said fingers thus to be successively fed through the dies of said forging press, means operative to ensure the reciprocation of said slide in timed relation to the rotation of said eccentric shaft, and rail means mounting said table for insertion in and removal from said press.

10. In a forging press of the type having an upstanding frame, an eccentric shaft mounted in said frame for rotation about a horizontal axis, a ram vertically movable in response to rotation of said shaft, a set of top dies carried by said ram for vertical reciprocation therewith, a set of bottom dies mounted on said frame vertically aligned with the respective dies carried by said ram and cooperating to forge workpieces therebetween; a transfer mechanism for transferring workpieces to successive cooperating dies comprising a table mounted on said frame adjacent said bottom dies, a horizontally reciprocable slide mounted on said table, a plurality of pairs of fingers mounted on said slide adapted to be opened and closed in unison, said pairs of fingers being horizontally spaced in the same relation as said dies, and means to reciprocate said slide and thus said fingers in one direction when said fingers are closed, and in the opposite direction when said fingers are opened, means to feed a workpiece to said fingers thus to be successively fed through the dies of said forging press, means operative to ensure the reciprocation of said slide in timed relation to the rotation of said eccentric shaft, means responsive to the reciprocation of said slide in said one direction when said fingers are closed and to the rotative position of said shaft to open said fingers, and means responsive to the opening of said fingers and to the rotative position of said shaft to reciprocate said slide in the opposite direction with said fingers thus opened.

11. In a forging press of the type having an upstanding frame, an eccentric shaft mounted in said frame for rotation about a horizontal axis, a ram vertically movable in response to rotation of said shaft, a set of top dies carried by said ram for certical reciprocation therewith, a set of bottom dies mounted on said frame vertically aligned with the respective dies carried by said ram and cooperating to forge workpieces therebetween; a transfer mechanism for transferring workpieces to successive cooperating dies comprising a table mounted on said frame adjacent said bottom dies, a horizontally reciprocable slide mounted on said table, a plurality of pairs of fingers mounted on said slide adapted to be opened and closed in unison, said pairs of fingers being horizontally spaced in the same relation as said dies, and means to reciprocate said slide and thus said fingers in one direction when said fingers are closed, and in the opposite direction when said fingers are opened, means to feed a workpiece to said fingers thus to be successively fed through the dies of said forging press, means operative to ensure the reciprocation of said slide in timed relation to the rotation of said eccentric shaft, means responsive to the reciprocation of said slide in said opposite direction with said fingers open and to the rotative position of said shaft to close said fingers, and means responsive to the closing of said fingers and to the rotative position of said shaft to reciprocate said slide in said one direction with said fingers thus closed.

12. In a forging press of the type having an upstanding frame, an eccentric shaft mounted in said frame for rotation about a horizontal axis, a ram vertically movable in response to rotation of said shaft, a set of top dies carried by said ram for vertical reciprocation therewith, a set of bottom dies mounted on said frame vertically aligned with the respective dies carried by

said ram and cooperating to forge workpieces therebetween; a transfer mechanism for transferrring workpieces to successive cooperating dies comprising a table mounted on said frame adjacent said bottom dies, a horizontally reciprocable slide mounted on said table, a plurality of pairs of fingers mounted on said slide adapted to be opened and closed in unison, said pairs of fingers being horizontally spaced in the same relation as said dies, and means to reciprocate said slide and thus said fingers in one direction when said fingers are closed, and in the opposite direction when said fingers are opened, means to feed a workpiece to said fingers thus to be successively fed through the dies of said forging press, means operative to ensure the reciprocation of said slide in timed relation to the rotation of said eccentric shaft, and an opening in said table adapted to accommodate said bottom dies, said opening providing said table with front and rear legs adapted to straddle said bottom dies, an opening in said slide corresponding to the opening in said table forming on said slide front and rear legs corresponding to the legs of said table, bridge means interconnecting the legs of said slide at the opposite ends thereof, said bridge means and legs of said slide surrounding said dies, the bridge means at one end of said slide being arched to clear said bottom dies as said table and thus said slide is pulled laterally from said press.

13. A transfer mechanism for forging presses and the like of the type having a drive shaft, a ram driven by said drive shaft, a set of dies carried by said ram and a set of dies cooperating with said ram dies operative to forge workpieces therebetween, said transfer mechanism comprising a table adapted to be mounted on such press adjacent such dies, a slide mounted on said table for reciprocation, a plurality of pairs of fingers mounted on said slide adapted to be opened and closed in unison, means to reciprocate said slide and thus said fingers in one direction when said fingers are closed and in the opposite direction when said fingers are open, means to feed a workpiece to said fingers thus to be successively fed through the dies of such press as such slide is reciprocated back and forth, said slide including a central opening adapted to surround such dies, said fingers being paired on each side of said opening, ways provided in said slide accommodating said fingers for transverse movement toward and away from each other, means mounted on said slide for movement therewith to open and close said fingers in unison, and means to shift such workpieces into position between said dies comprising a pair of idle stations, rail means mounted on said table adapted to support said workpieces in such idle stations, and means operative to retain resiliently such workpieces in such idle stations when not gripped by said fingers.

14. A transfer mechanism for forging presses and the like of the type having a drive shaft, a ram driven by said drive shaft, a set of dies carried by said ram and a set of dies cooperating with said ram dies operative to forge workpieces therebetween, said transfer mechanism comprising a table adapted to be mounted on such press adjacent such dies, a slide mounted on said table for reciprocation, a plurality of pairs of fingers mounted on said slide adapted to be opened and closed in unison, means to reciprocate said slide and thus said fingers in one direction when said fingers are closed and in the opposite direction when said fingers are open, means to feed a workpiece to said fingers thus to be successively fed through the dies of such press as such slide is reciprocated back and forth, and rail means, means mounting said table and thus said slide on said rail means for removal from such press.

15. A transfer mechanism for forging presses and the like of the type having a drive shaft, a ram driven by said drive shaft, a set of dies carried by said ram and a set of dies cooperating with said ram dies operative to forge workpieces therebetween, said transfer mechanism comprising a table adapted to be mounted on such press adjacent such dies, a slide mounted on said table for reciprocation, a plurality of pairs of fingers mounted on said slide adapted to be opened and closed in unison, means to reciprocate said slide and thus said fingers in one direction when said fingers are closed and in the opposite direction when said fingers are open, means to feed a workpiece to said fingers thus to be successively fed through the dies of such press as such slide is reciprocated back and forth, and a piston-cylinder assembly for opening and closing said fingers, bell cranks operatively connected to each finger and to said piston-cylinder assembly for moving the fingers of each pair toward and away from each other in unison.

16. A transfer mechanism for forging presses and the like of the type having a drive shaft, a ram driven by said drive shaft, a set of dies carried by said ram and a set of dies cooperating with said ram dies operative to forge workpieces therebetween, said transfer mechanism comprising a table adapted to be mounted on such press adjacent such dies, a slide mounted on said table for reciprocation, a plurality of pairs of fingers mounted on said slide adapted to be opened and closed in unison, means to reciprocate said slide and thus said fingers in one direction when said fingers are closed and in the opposite direction when said fingers are open, means to feed a workpiece to said fingers thus to be successively fed through the dies of such press as such slide is reciprocated back and forth, a piston-cylinder assembly for reciprocating said slide, means responsive to the reciprocation of said slide in one direction to open said fingers, means responsive to the opening of said fingers to reciprocate said slide in the opposite direction, means responsive to the reciprocation of said slide in said opposite direction to close said fingers, and means responsive to the closing of said fingers to shift said slide in said one direction.

17. A transfer mechanism for forging presses and the like of the type having a drive shaft, a ram driven by said drive shaft, a set of dies carried by said ram and a set of dies cooperating with said ram dies operative to forge workpieces therebetween, said transfer mechanism comprising a table adapted to be mounted on such press adjacent such dies, a slide mounted on said table for reciprocation, a plurality of pairs of fingers mounted on said slide adapted to be opened and closed in unison, means to reciprocate said slide and thus said fingers in one direction when said fingers are closed and in the opposite direction when said fingers are open, means to feed a workpiece to said fingers thus to be successively fed through the dies of such press as such slide is reciprocated back and forth, and means responsive to overtravel of said slide in either direction operative to stop operation of such press.

18. In a multi-operation forging press of the type having an upstanding frame, a vertically movable ram, dies mounted on said ram, and bottom dies mounted on the base of said frame cooperating with the dies on said ram to forge workpieces therebetween; a transfer mechanism comprising a table mounted on said frame surrounding said bottom dies, a slide mounted on said table for horizontal shuttling movement, an elongated opening in said slide enclosing said dies, a semi-circular recess in one end of such opening, a loading tube extending closely above such recess in one position of said slide adapted to deposit a workpiece in such recess, means operative horizontally to shuttle said slide, inwardly directed transversely movable workpiece engaging projections on said slide operative to index such workpiece through such frame and between said dies for such forging operations as said slide is shuttled back and forth, said projections comprising pairs of fingers having V-shape work engaging notches in the ends thereof, means operative to open and close said pairs of fingers in unison, and means responsive to the opening and closing of said fingers and the vertical

position of said ram to actuate said means horizontally to shuttle said slide.

19. In a forging press of the type having an upstanding frame, an eccentric shaft mounted in said frame for rotation about a horizontal axis, a ram vertically movable in response to rotation of said shaft, a set of top dies carried by said ram for vertical reciprocation therewith, a set of bottom dies mounted on said frame vertically aligned with the respective dies carried by said ram and cooperating to forge workpieces therebtween; a transfer mechanism for transferring workpieces to successive cooperating dies comprising a table mounted on said frame adjacent said bottom dies, a horizontally reciprocable slide mounted on said table, a plurality of pairs of fingers mounted on said slide adapted to be opened and closed in unison, said pairs of fingers being horizontally spaced in the same relation as said dies, and means to reciprocate said slide and thus said fingers in one direction when said fingers are closed, and in the opposite direction when said fingers are opened, means to feed a workpiece to said fingers thus to be successively fed through the dies of said forging press, means operative to ensure the reciprocation of said slide in timed relation to the rotation of said eccentric shaft, and rail means mounted on said press parallel to said table, upstanding roller means mounted on said press adapted to engage and support said table for horizontal movement, roller means mounted on the underside of said table adapted to engage said rail means for horizontal movement, said roller means cooperating to support said table for horizontal movement to and from said press when said top and bottom dies are vertically opened.

20. In a forging press of the type having an upstanding frame, an eccentric shaft mounted in said frame for rotation about a horizontal axis, a ram vertically movable in response to rotation of said shaft, a set of top dies carried by said ram for vertical reciprocation therewith, a set of bottom dies mounted on said frame vertically aligned with the respective dies carried by said ram and cooperating to forge workpieces therebetween; a transfer mechanism for transferring workpieces to successive cooperating dies comprising a table mounted on said frame adjacent said bottom dies, a horizontally reciprocable slide mounted on said table, a plurality of pairs of fingers mounted on said slide adapted to be opened and closed in unison, said pairs of fingers being horizontally spaced in the same relation as said dies, and means to reciprocate said slide and thus said fingers in one direction when said fingers are closed, and in the opposite direction when said fingers are opened, means to feed a workpiece to said fingers thus to be successively fed through the dies of said forging press, means operative to ensure the reciprocation of said slide in timed relation to the rotation of said eccentric shaft, rail means mounted on said press and extending horizontally therefrom, a stand supporting the distal end of said rail means, and roller means supporting said table with respect to said rail means for movement of said table and thus said slide to and from said press when said top and bottom dies are vertically opened.

21. A transfer mechanism for vertical forging presses and the like comprising a table, a slide mounted on said table, means operative horizontally to reciprocate said slide, an opening in said slide, pairs of work engaging fingers mounted on said slide and extending transversely into said opening, means to open and close said fingers in response to the horizontal position of said slide, and means mounting said table for horizontal movement into and out of such forging press.

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