April 14, 1964 E. F. HAMILTON 3,128,731

PRESS

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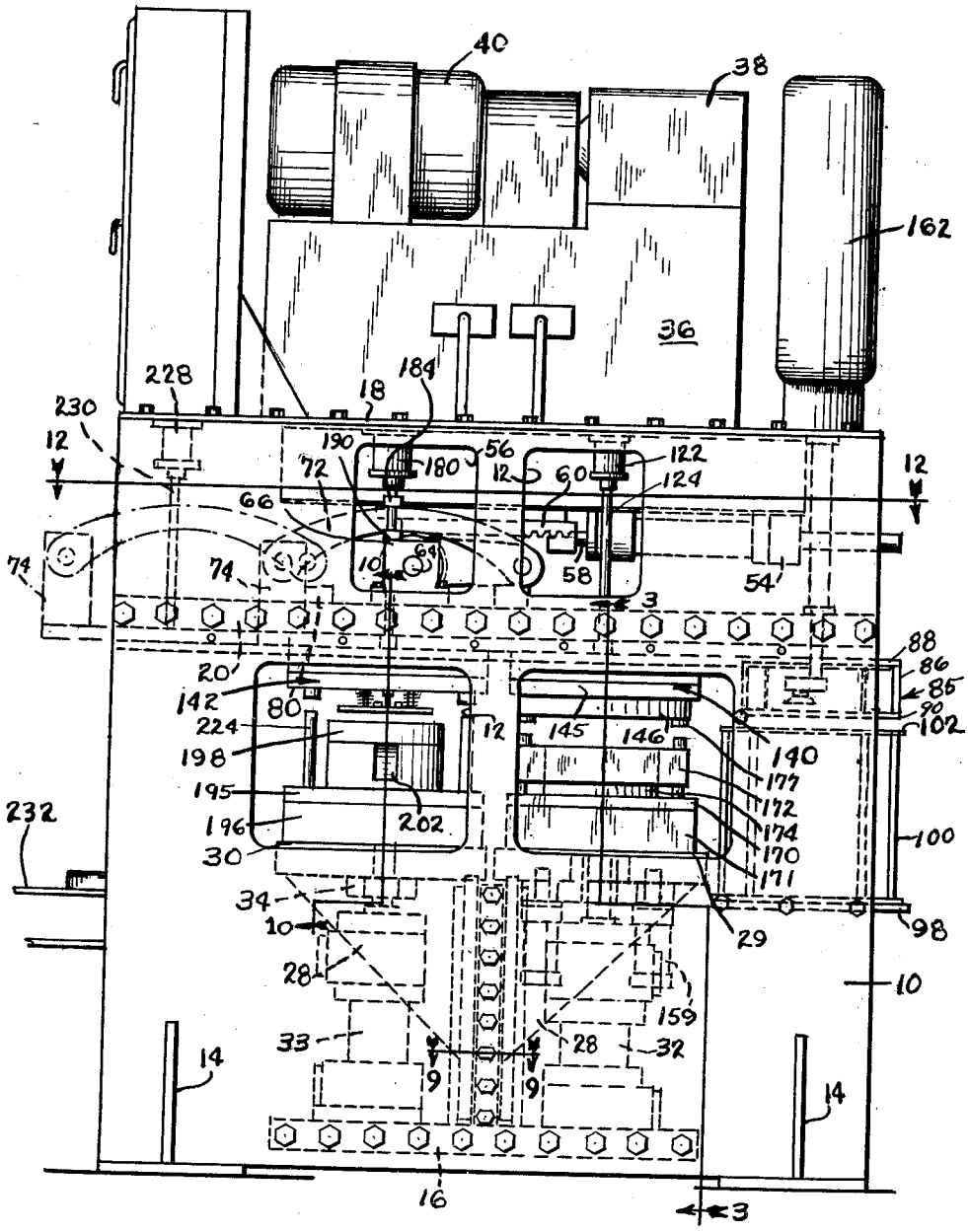
FIG. 1



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PRESS

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FIG. 4

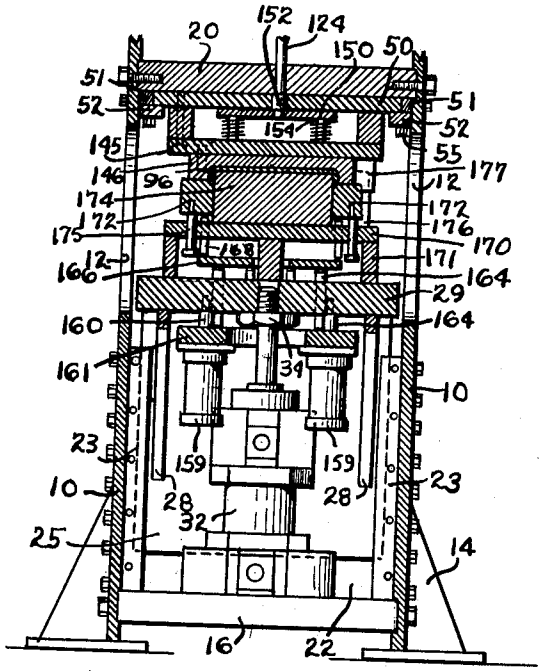

FIG. 2

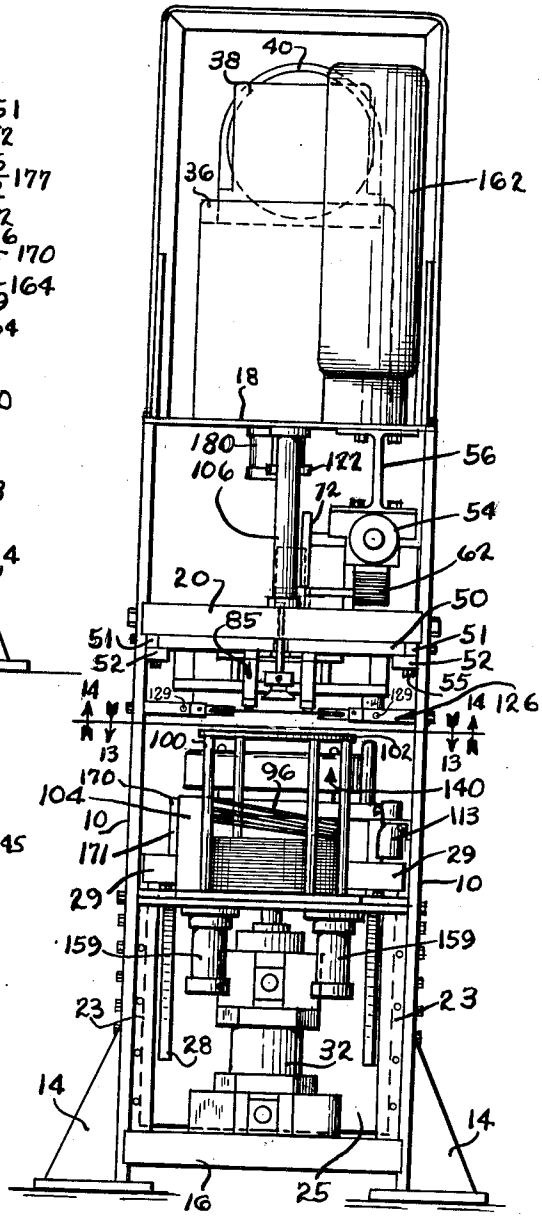

FIG. 3

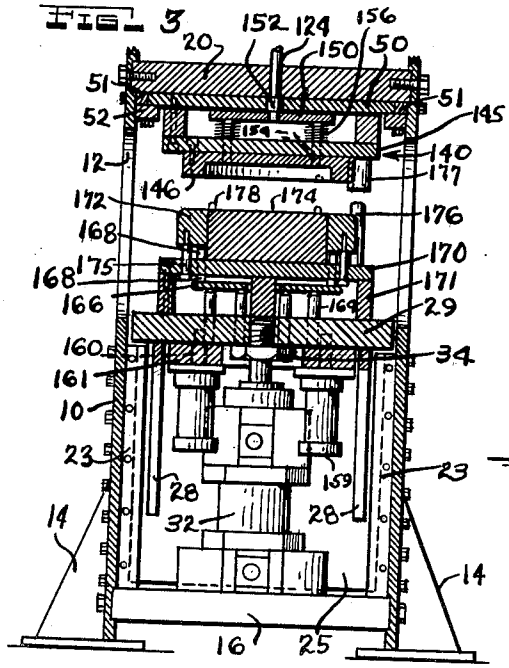

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FIG. 5

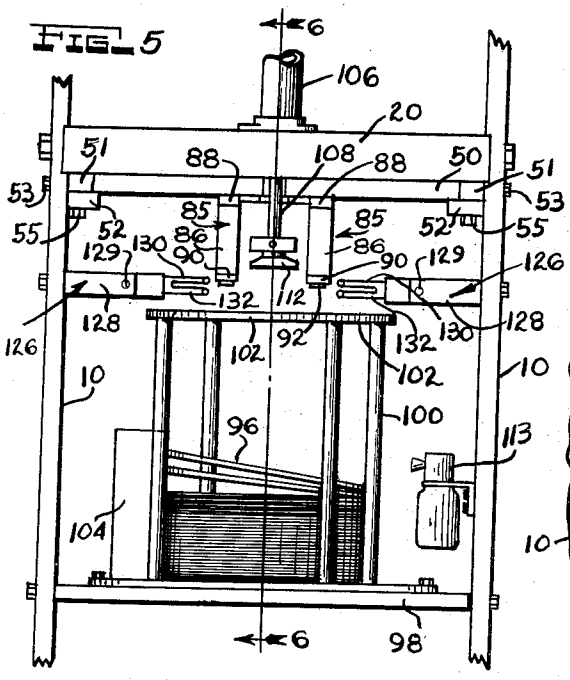
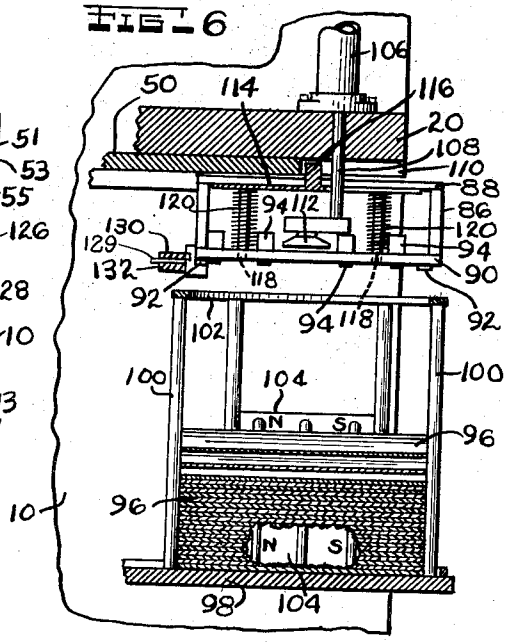


FIG. 6



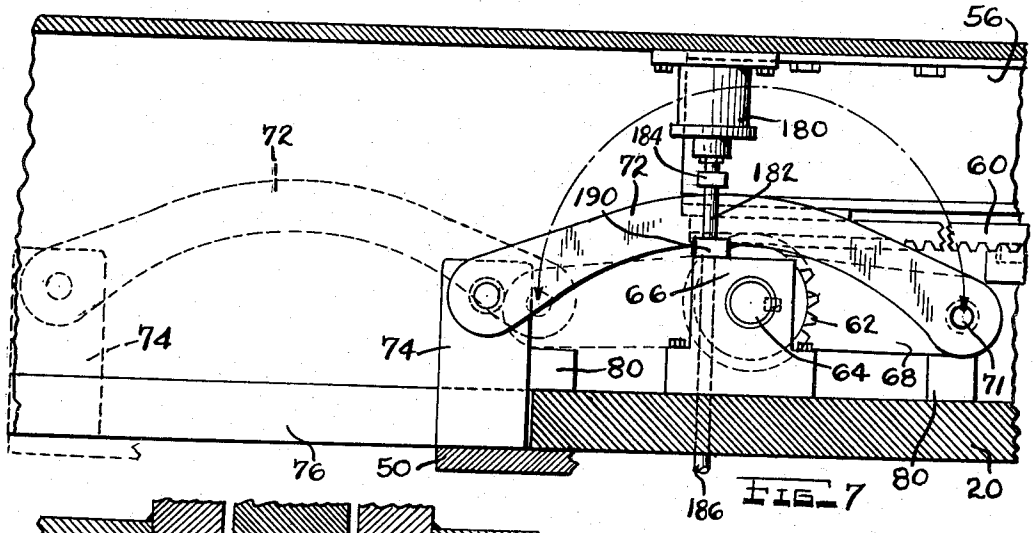


FIG. 7

FIG. 9

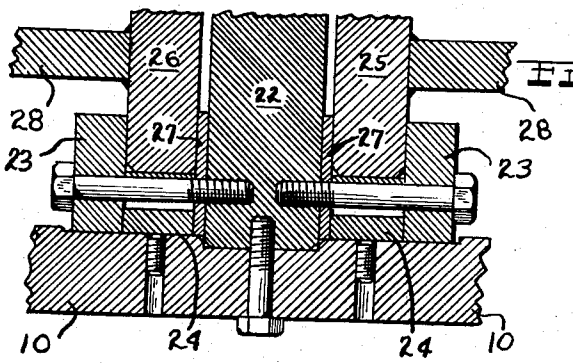


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FIG. 10

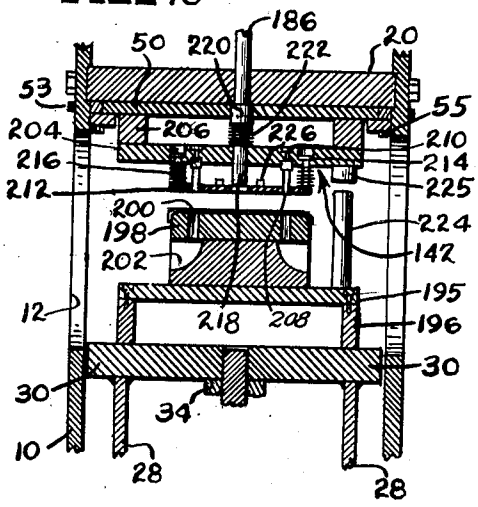

FIG. 11

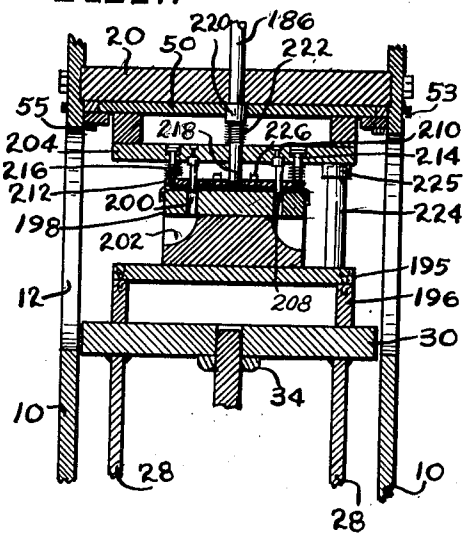

FIG. 8

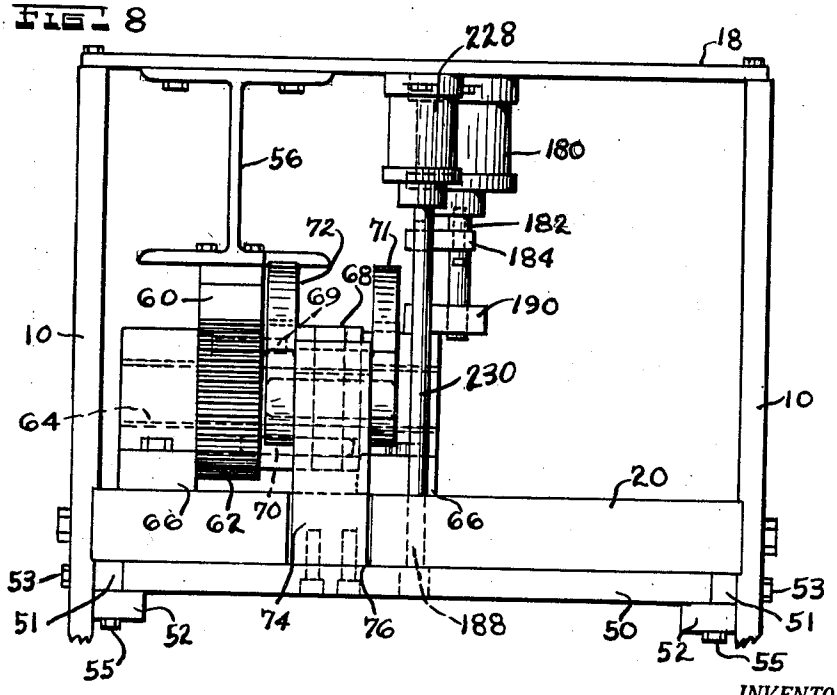

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FIG. 12

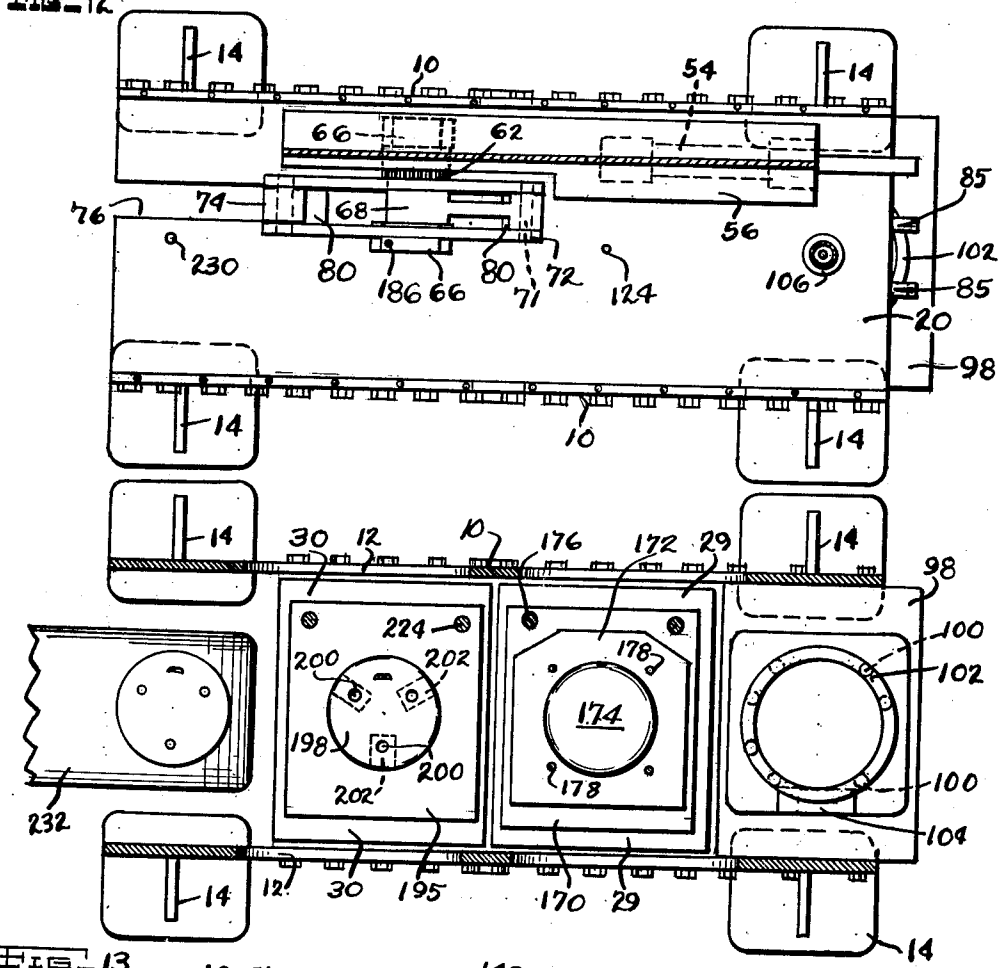

FIG. 13

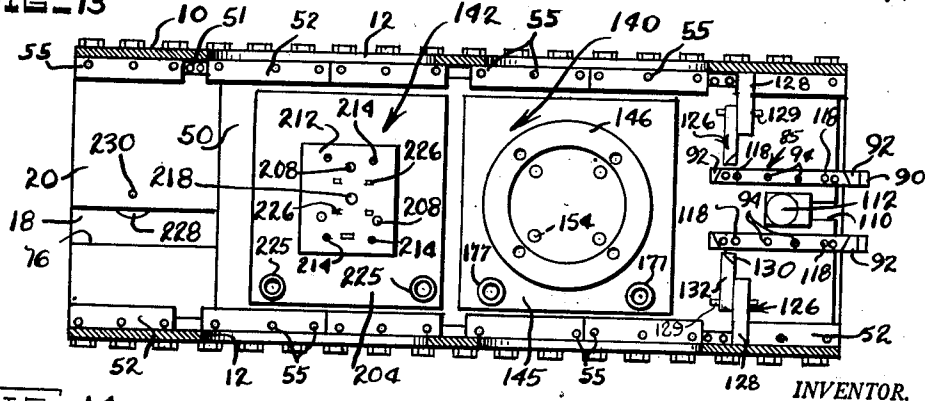

FIG. 14

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3,128,731

PRESS

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Filed June 2, 1960, Ser. No. 33,595
26 Claims. (Cl. 113—43)

This invention relates to a press, and more particularly to a press for performing one or more work steps on metal work-pieces.

It is an object of my invention to provide a metal-working press which is adapted to perform one or more work steps on a metal work-piece, which can simultaneously perform a plurality of such work steps on a plurality of work-pieces, which will automatically transfer said work-pieces from one of said work steps to another, which is adapted to automatically pick up the work-piece blanks and discharge the finished work-pieces, which will require a minimal amount of labor to operate, and which will be extremely safe for an operator to use.

In the preferred form of my invention, there is provided a supporting frame comprising a pair of upright members rigidly interconnected at their upper and lower ends by a cover plate and bed respectively. A top plate is mounted on said uprights between said cover plate and the bed and carries a longitudinally movable slide on its lower face. The slide is longitudinally movable with respect to the bed and top plate by a ram conveniently mounted on the cover plate. Desirably, said ram is connected to the slide through a linkage arrangement whereby said slide is moved through reciprocating sliding movements of a predetermined length.

The bed carries a plurality of power cylinders, each of which is adapted to move a platen vertically with respect to the slide. The vertical movements of the platens toward and away from the slide are guided by guide means mounted on the supporting frame above the bed. Conveniently, each of the platens is movable independently of the other by its power cylinder and is adapted to carry a die movable therewith.

A plurality of work-piece holders are mounted on the lower face of the slide for movement therewith. Preferably, a vertically movable pick-up member is mounted on the cover plate adjacent one end thereof and is adapted to pick up work-piece blanks and place them on the work-piece holder adjacent one end of the slide for thus feeding the work-pieces into the press. The other work-piece holders on the slide comprise a plurality of dies adapted to mate with the dies carried on the platens so that when the two sets of dies are disposed in alignment, and the dies on the platens are moved upwardly into an operative position, a work step may be performed on each of the work-pieces interposed between the two sets of dies.

The slide is longitudinally movable to move each of the work-piece holders from a position overlying its respective die carried on one of the platens to a position overlying the next adjacent die. Knockout members are conveniently mounted on the cover plate and are movable through the planes of the top plate and slide for ejecting the work-pieces from the work-piece holders to dispose said work-pieces on the dies carried on the platens. One such knockout member is mounted on the cover plate adjacent the discharge end of the press for ejecting the finished work-piece from the work-piece holder adjacent said discharge and when the slide is moved into a position to dispose its discharge end outwardly beyond the longitudinal extent of the bed.

Other objects and features of my invention will become apparent from the more detailed description which follows and from the accompanying drawings, in which:

FIG. 1 is a side elevation of a press embodying my invention;

FIG. 2 is an end elevation of the press shown in FIG. 1;

FIG. 3 is a fragmentary vertical section taken on the line 3—3 of FIG. 1, and showing the draw die assembly;

FIG. 4 is a vertical section similar to FIG. 3, but showing the draw die assembly in closed position;

FIG. 5 is an enlarged fragmentary end elevation of the pick-up assembly;

FIG. 6 is a vertical section taken on the line 6—6 of FIG. 5;

FIG. 7 is a side view of the slide linkage for effecting a longitudinal movement of said slide;

FIG. 8 is an enlarged end view of the slide linkage arrangement shown in FIG. 7;

FIG. 9 is an enlarged horizontal section taken on the line 9—9 of FIG. 1;

FIG. 10 is a fragmentary vertical section taken on the line 10—10 of FIG. 1, and showing the piercing die assembly;

FIG. 11 is a vertical section similar to FIG. 10, but showing the piercing die assembly in closed position;

FIG. 12 is a horizontal section taken on the line12—12 of FIG. 1;

FIG. 13 is a horizontal section taken on the line 13—13 of FIG. 2; and

FIG. 14 is a horizontal section taken on the line 14—14 of FIG. 2.

In the embodiment of my invention illustrated in the drawings, I show a metal-working press having four stations: a pick up station, a drawing station, a piercing station, and a discharge station. It is to be understood, however, that this setup is merely for purposes of illustration, and that these work stations may be changed as desired. It is also possible, of course, to employ only one metal-working station without departing from the spirit and scope of the invention.

As shown in the drawings, my press comprises a supporting frame having a pair of parallel side plates 10 conveniently provided with windows 12, and mounted on a plurality of ground-engageable supporting feet 14. The pair of side plates 10 are rigidly interconnected and cross-braced adjacent their lower ends by a bed 16 keyed and belted thereon. As shown in FIG. 1, the bed 16 has a shorter length than the side plates 10 and is thus longitudinally centered with respect to said side plates. The upper ends of the plates 10 are interconnected and cross-braced by a cover plate 18 bolted thereon. The pair of plates 10 are further interconnected and cross-braced by a top plate 20 interposed between the bed 16 and cover plate 18, and rigidly keyed and bolted to the opposed inner faces of the plates 10.

As explained, the press shown in the drawings is adapted to perform two different work steps on a workpiece. To perform these two work steps, I provide two die assemblies supported above the bed 16 and vertically movable with respect to said bed. To this end, I provide a center brace 22 rigidly connected to the opposed inner faces of the side plates 10 and extending upwardly from the bed 16. Conveniently, as shown in FIG. 9, the brace 22 is keyed and bolted to each of the side plates 10. A pair of adjustable gibs 23 and 24 are mounted on the brace and each side plate adjacent each end of said brace and upon each of its opposed faces. The gibs 23 and 24 act in combination with the opposed faces of the brace 22 to form two sets of guides for a pair of vertically movable slides 25 and 26. Conveniently, bearings 27 are interpoesd between brace 22 and the slides 25 and 26 adjacent each of the gibs 23. As shown in FIG. 9, each of the slides 25 and 26 is provided with a pair of outwardly projecting braces 28 which, together with the slides 25 and 26 are connected to a pair of platens 29 and 30 parallel to the bed 16. The platens 29 and 30 are independently

movable of each other with their respective slides and braces by a pair of hydraulic cylinders 32 and 33 mounted on the bed 16, with their upwardly projecting rams threadably received in their respective platens 29 and 30, and retained therein by lock nuts 34. Conveniently, the cylinders 32 and 33 are actuated by a conventional hydraulic system mounted on the cover plate 18 and comprising a reservoir 36 of oil supplied under pressure to the cylinders 32 and 33 by a pump 38 driven by a motor 40. Thus, each of the platens 29 and 30 is movable independently of the other by its respective cylinder 32 or 33 so that each of the two work steps may be carried out independently of the other. Each of the platens carries a die adapted to be moved into operative position against a mating die upon actuation of the cylinders 32 or 33 as will be more fully explained hereinafter.

If it is desired to perform additional work steps on the work-pieces, the side plates and their interconnecting bed and cover and top plates are lengthened and an additional brace 22, or braces, together with its associated slides, are mounted on the side plates to thus support additional platens and die assemblies. Conversely, where only one work step is to be performed a discharge chute may be disposed on the platen 30 and the cylinder 33 is disconnected from the oil reservoir 36.

In order to move the work-pieces through the press, I provide a slide 50 slidably carried against the underside of the top plate 20 by pairs of longitudinally extending gibs 51 and 52. As shown in FIG. 8, the gibs 51 and 52 are adjustably mounted on the top plate 20 by the bolts 53 and 55 for adjusting both the lateral and vertical positioning of the slide with respect to the top plate. The slide 50 is movable longitudinally of the press by means of a hydraulic cylinder 54 supported from the cover plate 18 on an I-beam 56 offset from the longitudinal axis of the press. The ram 58 of the cylinder 54 is rigidly connected to a gear rack 60 slidably mounted on the lower face of the beam 56 and having its teeth presented downwardly to mesh with a pinion 62 keyed onto an axle 64 journaled in a pair of bearing blocks 66 mounted on the upper face of the top plate 20. As shown in FIG. 8, the pinion 62 is rigidly connected to a link arm 68 keyed onto the axle 64 and interconnected to the pinion 62 as by bolts and dowel pins 69 and 70 respectively. The outwardly disposed end of the link arm 68 is pivotally connected to one end of a pair of links 72, as at 71, with the opposite ends of said links being pivotally connected to a slide block 74 rigidly mounted on the slide 50 adjacent its discharge end. As shown in FIG. 12, the top plate 20 is provided with an inwardly extending slot 76 adjacent one of its ends which guides the longitudinal movements of the slide block 74 during the longitudinal sliding movements of the slide 50.

Thus, as indicated in FIG. 7, actuation of the cylinder 54 to extend its ram 58 causes the gear rack 60 to rotate the pinion 62 to cause the link arm 68 to pivot the pair of links 72 upwardly and to the left as viewed in FIG. 7. This movement of the links 72 causes the slide block 74 to move the slide 50 to the left as shown in FIG. 7 so that its discharge end is disposed outwardly beyond the longitudinal extent of the side plates 10. Conversely, retraction of the ram 58 causes the linkage arrangement to move the slide 50 into the full line position illustrated in FIG. 7. Conveniently, a pair of stop blocks 80 are mounted on the upper face of the top plate 20 to limit the swinging movements of the link arm 68, and thus limit the sliding movements of the slide 50. For reasons that will become more apparent hereinafter, the pivotal connection 71 between the link arm 68 and the pair of links 72 is disposed below the axis of the axle 64 when the slide 50 is moved into the full and dotted line positions illustrated in FIG. 7, to thus releasably lock the slide in both its normal operative position in which it lies within the longitudinal extent of the top plate 20, as shown in FIG. 14, and its work-discharge position shown in dotted line in FIG. 1.

As shown in FIGS. 5 and 6, I mount a work-piece holder on the lower face of the slide 50 at the end of the slide opposite the slide block 74. As shown, the work-piece holder projects outwardly beyond the end of the slide, and comprises a pair of laterally spaced brackets 85, each of which constitutes a rectangularly shaped frame including end members 86 interconnected by top and bottom members 88 and 90 respectively. As shown, a plurality of depending fingers 92 are mounted on the members 90 in positions to engage the edges of a work-piece 96 at a plurality of points around its periphery to thus position said work-piece with respect to the brackets. A plurality of permanent magnets 94 are also mounted on the members 90 to hold a work-piece on the brackets 85 between the depending fingers 92.

Conveniently, the work-pieces 96 are stacked at one end of the supporting frame on a platform 98 rigidly mounted on the opposed inner faces of the side plates 10. A plurality of guide posts 100 project upwardly from the platform 98 and are interconnected at their upper ends by a ring 102 to thus hold the work-pieces 96 in stacked position. In order to separate the work-pieces 96 to facilitate their removal from the stack, I mount a magnet 104 on the platform 98. Said magnet has its north and south poles oriented in the positions illustrated to thus separate the work-pieces and thereby overcome the tendency of said work-pieces to stick together.

As shown in FIG. 6, the work-pieces 96 are picked up and deposited on the brackets 85 by a hydraulic cylinder 106 mounted on the top plate 20 with its ram 108 being vertically movable through an opening in the top plate 20 and a longitudinally extending slot 110 formed in the pick-up end of the slide 50. A suction cup 112 is mounted on the lower end of the ram 108 and upon downward movement of the ram 108 engages and holds the uppermost work-piece 96 upon the lower end of the ram. As the ram 108 is moved upwardly, the work-piece is carried upwardly by the suction cup 112 and is deposited on the brackets 85, said work-piece being held on the brackets by the magnets 94. Continued upward movement of the ram 108 after the work-piece is placed on the brackets 85 will of course break the suction between the cup 112 and the work-piece to thus permit said work-piece to be retained on the bracket 85. An oil film, conveniently supplied from an atomizing gun 113 mounted on one of the side plates 10, is sprayed onto the work-pieces as they are raised by the ram 108. By spraying the work-pieces as they are being raised, the film can be applied to both faces of said work-piece.

To remove the work-piece 96 from the brackets 85, I provide a knockout plate 114 having an upwardly projecting stud 116, and supported upon a plurality of pins 118 carried in openings formed in the bracket members 90. The knockout plate 114 is biased upwardly to dispose the lower ends of the pins 118 above the lower faces of the brackets 85 by a plurality of coil springs 120 carried on the pins 118 and interposed between the knockout plate 114 and the upper face of the bracket members 90.

The plate 114 and pins 118 are moved downwardly to knock the work-piece 96 off of the brackets 85 by means of a knockout cylinder 122 mounted on the lower face of the cover plate 18, as shown in FIG. 1. The cylinder 122 has a downwardly extending ram 124 movable through openings in the top plate 20 and slide 50, when the slide is moved to the left as viewed in FIG. 1, to bear against the knockout plate stud 116 to force the knockout plate 114 and its pins downwardly for ejecting the work-piece 96 from the brackets 85. As shown in FIG. 1, the cylinder 122 is mounted on the cover plate 18 inwardly from the end of the press with its ram 124 in vertical alignment with the center of the platen 29 for ejecting the work-piece from the brackets 85 onto the die assembly mounted on said platen.

In order to prevent the brackets 85 from carrying more than one of the work-pieces 96 into the press at a time, I mount a pair of stripping arms 126 on the inner faces of the side plates 10. As shown in FIGS. 5 and 6, the arms 126 are identical in construction, and each comprises a mounting block 128 rigidly connected to one of the side plates 10 and pivotally connected, as at 129, to a pair of inwardly extending fingers 130 and 132 whose inner ends are disposed adjacent the path of movement of the brackets 85 whereby a work-piece 96 carried upon said brackets will be moved through the space between said pair of fingers. Conveniently, the two sets of fingers 130 and 132 are vertically swingable through a predetermined angle about the axes 129 lying in a common plane so that said fingers will receive and pass the edges of a slightly bent work-piece. As shown in FIG. 6, the upper finger 130 projects forwardly beyond the lower finger 132 so that if a second or third work-piece is carried on the brackets 85, these extra work-pieces will be thrown downwardly rather than upwardly as the brackets are moved past the arms 126.

As shown in FIG. 14, a pair of die assemblies 140 and 142 are mounted in longitudinally spaced relation on the lower face of the slide 50 in positions to overlie the platens 29 and 30 when said slide is disposed in the full line position illustrated in FIG. 1. Conveniently, each of the die assemblies 140 and 142 comprises a female die adapted to hold a work-piece 96 so that upon movement of the slide 50 to the left as viewed in FIG. 1, the die 140 will be moved with said slide to dispose the work-piece carried therein over the platen 30, while the die 142 will be moved out of its position overlying the platen 30 to a position beyond the extent of said platen. In this manner, the pair of dies 140 and 142 together with the pair of brackets 85 constitute a plurality of work-piece holders for moving the work-pieces through the press upon longitudinal movement of the slide 50 to the left as viewed in FIG. 1.

In the embodiment shown in the drawings, the first work step performed on the work-pieces is a drawing operation, and the female die 140 thus comprises a punch pad 145 rigidly mounted on the lower face of the slide 50 in spaced relation thereto and supporting a downwardly presented draw die 146. A vertically movable knockout plate 150 is carried above the punch pad 145 and is provided with a stud 152 projecting upwardly from the plate 150 through an opening in the slide 50. As shown in FIG. 3, a plurality of pins 154 extend downwardly from the plate 150 and through aligned openings formed in the punch pad 145 and draw die 146. The knockout plate 150 is biased upwardly against the lower slide face by a plurality of coil springs 156 carried on the pins 154 and acting between said plate and the punch pad 145.

A mating male die is carried on the platen 29 and is movable therewith into operative engagement with the female die 142 to perform a work step on a work-piece interposed therebetween. To this end, a plurality of cylinders 159 are mounted on the platen 29 and are vertically movable therewith by the cylinder 32. Each of the cylinders 159 has an upwardly projecting ram 160 threadably received in the lower face of said platen, with the bodies of said cylinders being rigidly mounted onto a plate 161 normally carried against the lower face of the platen 29. The several cylinders 159 are connected in parallel and are actuated by an air-on-oil supply tank 162 mounted on the cover plate 18. A check valve and pressure release valve are mounted in the line between the several cylinders and the tank 162.

As shown in FIG. 3, the male die assembly mounted on the platen 29 comprises a plurality of pressure pins 164 supported on the plate 161 and projecting upwardly through openings in the platen 29. A pressure pad 166 is carried on the upper ends of the pins 164, and is provided with a plurality of upwardly projecting pins 168 vertically slidable in openings formed in a die shoe 170 carried about the platen on risers 171. The pins 168 support a draw ring 172 vertically movable above the plane of the die shoe and disposed about a punch 174 mounted on the die shoe and movable therewith. The vertical movement of the draw ring 172 with respect to the punch 174 and die shoe 170 is limited by a plurality of bolts 175 mounted on the lower face of the draw ring and slidably received in openings in the die shoe.

As shown in FIG. 3, the upper and lower die assemblies are slidably interconnected by a pair of guide posts 176 mounted on the die shoe 170 and having their upper ends adapted to be slidably received in bushings 177 mounted on the lower face of the punch pad 145. As will be understood, the upper ends of the guide posts 176 are received in the bushings 177 as the lower die assembly is moved upwardly to thus guide the punch 174 into the draw die 146. However, when the platen 29 is in its lowered position the upper ends of the guide posts 176 will be withdrawn from the bushings to permit the female die 140 to move longitudinally with the slide 50.

Thus, to perform a drawing step on one of the work-pieces 96, the slide 50 is moved to the left as viewed in FIG. 1 to dispose the carrier brackets 85, carrying one of said blanks, in vertical alignment with the male die assembly carried on the platen 29. With the slide in such position, the knockout cylinder 122 is actuated to cause its ram 124 to eject the work-piece from the brackets in the manner previously described, said work-piece upon ejection from the brackets 85 falling onto the upper faces of the punch 174 and draw ring 172. Conveniently, a plurality of locator buttons 178 are provided on the upper face of the draw ring 172 to receive and retain the work-piece in the proper position thereon. With the work-piece thus disposed between the male and female die assemblies, the cylinder 32 is actuated to raise the platen 29 and the die assembly carried thereon upwardly toward the female die assembly 140. During the initial raising of the platen 29, the oil pressure on the cylinders 159 will cause said cylinders to hold the plate 161 against the platen 29 so that the entire male die assembly moves upwardly as a unit. This upward movement of the die assembly is guided by the slide 25 moving upwardly in the guides formed by the gibs 23 and 24 and the brace 22, and by the upper ends of the guids posts 176 sliding in the bushings 177.

After the male die assembly has been raised sufficiently to position the work-piece 96 against the lower face of the draw die 146, continued upward movement of said male die assembly causes the draw ring 172 to be retained in a fixed vertical position with the punch 174 moving upwardly within the draw die 146 to draw the work-piece against said draw die. As the punch 174 moves upwardly with respect to the draw ring 172, the pins 168 and 164 cause the rams 160 of the cylinders 159 to be extended to thus separate the plate 161 from the platen 29. Extension of the rams 160 causes the pressure relief valve between the cylinders 159 and the tank 162 to open so that punch 174 acts against the inherent resistance of the work-piece 96 and the resistance of the pressure on the cylinders 159.

To withdraw the male die assembly from the drawn work-piece, the cylinder 32 is actuated to move said male die assembly downwardly. The punch 174, the die shoe 170, and the platen 29 are moved downwardly by the cylinder 32, to thus carry the several cylinders 159 in a like downward direction. As the punch is moved downwardly, the pressure release valve acting between the cylinders 159 and their oil supply tank 162 is closed, with the pressurized oil in said tank opening the check valve to the cylinders 159 whereby their rams 160 are actuated to move the plate 161 and the platen 29 toward each other to thus move the draw ring 172 vertically with respect to the punch 174 to dispose their upper faces in a generally coplanar relationship. The downward move-

ment of the male die assembly is guided by the slide 25 moving in the gibs 23 and 24.

As a result of the drawing operation, the work-piece will be press-fit into the draw die 146 and will thus be retained in the female die 140 so that said female die serves as a work-piece holder for transferring the drawn work-piece to the next work station. To effect such a transfer, the slide is moved to the left as viewed in FIG. 1 to dispose the female die 140 in vertical alignment with a male die assembly mounted on the platen 30. During such movement of the slide 50, a new work-piece will be carried by the brackets 85 into vertical alignment with the male die assembly carried on the platen 29, and ejected onto said male die assembly by the knockout cylinder 122. When the die 140 is disposed in vertical alignment with the platen 30, the work-piece press-fit in said die is ejected therefrom by a knock-out cylinder 180 mounted on the lower face of the cover plate 18.

As shown in FIGS. 7 and 8, the cylinder 180 is mounted on the plate 18 within the longitudinal extent of the links 72. Thus, the ram 182 of the cylinder 180 is provided with a bridge 184 rigidly connected to a vertically extending rod 186. Upon actuation of the cylinder 180, the vertical movement of the ram 182 is transferred to the rod 186 by means of the bridge 184 to cause said rod to move through aligned openings in the bearing block 66, the top plate 20, and the slide 50 to engage an upwardly presented stud 152 on the knockout plate 150. Such downward movement of the rod 186 moves the knockout plate 150 downwardly with respect to its associated draw die 146 so that the pins 154 slide in their draw die openings to engage and eject the drawn work-piece from the female die 140 onto the male die assembly carried on the platen 30. Conveniently, the ram 182 extends downwardly below the bridge 184 and is slidably carried in a guide 190 projecting outwardly from the bearing block 66 to guide the reciprocating movements of the ram 182. After the knockout cylinders 180 and 122 have ejected the work-pieces from the female die 140 and the brackets 85 respectively, their rams are withdrawn upwardly out of the plane of the slide 50 to permit said slide to be moved into its full line position shown in FIG. 1 in which the female die assembly 140 again overlies the male die assembly carried on the platen 29. Upon upward movement of the rams 124 and 182 the knockout plates 114 and 150 are moved back upwardly against the slide 50 by the springs 120 and 156 respectively.

As shown in FIGS. 10 and 11, the second metal-working step performed on the work-pieces moving through the press illustrated is a piercing operation, which is performed by the female die assembly 142, and a male die assembly mounted on the platen 30 actuated by the cylinder 33. As shown, the male die assembly comprises a die shoe 195 mounted above the platen 30 on risers 196. The die shoe 195 supports a die 198 having a plurality of openings 200 formed therein and disposed above a plurality of knockout slots 202. The upper face of the die 198 is contoured to mate with the drawn work-piece, so that upon ejection of the drawn work-piece from the female draw die 140, said work-piece will be located on the male die assembly by the die 198.

The female piercing die assembly 142 comprises a punch pad 204 mounted in spaced relation to the lower face of the slide 50 on mounting blocks 206. A plurality of piercing punches 208 are mounted on the punch pad 204, as by bolts 210, and extend downwardly from the lower face of the punch pad 204 for reception in the openings 200 upon upward movement of the platen 30. The punches 208 extend downwardly through a vertically movable stripper plate 212 suspended from the punch pad 204 on a plurality of bolts 214 slidably mounted in the punch pad 204. The stripper plate 212 is spring-biased downwardly from the punch pad 204 by a plurality of coil springs 216 carried on the bolts 214 and interposed between the opposed faces of the stripper plate 212 and punch pad 204. Conveniently, the punch pad 204 also supports a vertically extending knockout rod 218 having its lower end projecting downwardly toward the stripper plate 212 and its upper end extending upwardly through an opening formed in the slide 50. As shown in FIG. 10, the upper end of the knockout rod 218 is expanded, as at 220, and is releasably maintained in its opening in the slide 50 by a coil spring 222 received on the knockout rod 218 and acting between the expanded upper end 220 of said rod and the upper face of the punch pad 204.

Thus, to perform a piercing step on one of the drawn work-pieces, the slide 50 is moved to the left as viewed in FIG. 1 to dispose the female die 140, carrying one of the drawn work-pieces, in vertical alignment with the male piercing die assembly carried on the platen 30. With the slide in such position, the knockout cylinder 180 is actuated to cause the rod 186 to eject the work-piece from said die onto the piercing die 198, said work-piece being seated thereon due to the mating contours of the drawn piece and said die.

The slide is thus returned to the right as viewed in FIG. 1 and with the work-piece thus disposed between the male and female die assembly, the cylinder 33 is actuated to raise the platen 30 and the die assembly thereon upwardly toward the female die assembly 142. This upward movement of the male die assembly toward the female die assembly 142 is guided by the slide 26 moving upwardly in the guides formed by the gibs 23 and 24 and the brace 22. Further guiding is provided by a pair of guide posts 224 extending upwardly from the die shoe 195 and slidably received in a pair of downwardly extending bushings 225 mounted on the lower face of the punch 204.

As the die 198 is moved upwardly by the cylinder 33, it forces the drawn work-piece against the stripper plate 212 to force said plate upwardly against the biasing action of the springs 216. This upward movement of the die 198 causes the punches 208 to pierce the work-piece carried on said die as indicated in FIG. 11. During such piercing, the punches 208 are received in the die openings 200 and the metal pierced from the work-piece falls downwardly through the openings 200 and knockout slots 202.

With the work-piece pierced, the cylinder 33 is actuated to lowert he platen 30, and thus the die 198, out of engagement with the female die assembly 142. As the die 198 is moved downwardly, the stripper plate 212 is also moved downwardly under the action of the springs 216 until the lower ends of the punches 208 lie above the lower face of said stripper plate. The drawn and pierced work-piece is retained against the lower face of said stripper plate by a plurality of magnets 226 mounted thereon. While I have described the brackets 85 and the die assembly 142 as having magnets for holding work-pieces thereon, it is to be understood that any convenient holding means such as suction cups, pivotal fingers, etc. may be employed, as desired. With the work-piece thus retained on the stripper plate 212 movement of the slide 50 to the left as viewed in FIG. 1 will cause the female die assembly to be moved outwardly beyond the longitudinal extent of the bed 16, and into a position underlying a knockout cylinder 228 mounted on the lower face of the cover plate 18 adjacent the discharge end of the press. The cylinder 228 has a downwardly extending ram 230 movable through an opening in the top plate 20 and engageable with the expanded upper end 220 of the knockout rod 218 when the slide is moved to the left as viewed in FIG. 1. Downward movement of the ram 230 causes the knock-out rod 218 to move through an opening in the stripper plate 212 to thus eject a finished work-piece from the

press and onto a conveyer 232 carried between the side plates 10.

Thus, the operation of the press illustrated in the drawings may be briefly described as follows: With the slide 50 disposed in the full line position shown in FIG. 1, the male draw die and piercing die assemblies carried on the platens 29 and 30 respectively are moved upwardly by the cylinders 32 and 33 into operative engagement with their respective female dies 140 and 142 to perform drawing and piercing operations on the work-pieces 96 in the manner previously described. During such work steps, the cylinder 106 is actuated to force its ram 108 downwardly so that the suction cup 112 will pick up one of the work-pieces 96 from the stack of work-pieces and place said work-piece on the brackets 85. As the work-piece is being moved upwardly from the stack to said brackets, the spray gun 113 will deposit a thin coating of oil on said work-piece. After the two sets of dies have performed their respective work steps on the work-pieces, and with a new work-piece disposed on the brackets 85, the ram 54 is actuated to cause the gear rack 60 and linkage 68–72 to move the slide 50 to the left, as viewed in FIG. 1, so that the brackets 85 overlie the draw die assembly carried on the platen 29; the female die 140 overlies the male piercing die assembly carried on the platen 30, and the female die 142 overlies the conveyer 232. The cylinders 122, 180, and 228 are then actuated to eject the work-pieces from the brackets 85, female die 140, and female die 142 respectively to thus position a work-piece blank on the male draw die assembly carried on the platen 29; a drawn work-piece on the male piercing die assembly carried on the platen 30, and a finished work-piece on the conveyor 232. With the work-pieces thus ejected, the cylinders 112, 150, and 228 are actuated to move their rams upwardly, and the slide is returned to its full line position shown in FIG. 1 by the ram 54. As the slide 50 is returned to the position shown in full line in FIG. 1, the links 72 are pivoted into a position such that their pivotal interconnection 71 to the link arm 68 lies below the axis of the axle 64 to thus releasable lock the slide 50 in its operative position with the female dies 140 and 142 overlying their respective male dies, and the pick up and work step sequence is again repeated.

I claim as my invention:

1. A metal-working press, comprising a supporting frame, a bed and top plate fixedly mounted on the frame in vertically spaced relation, a slide carried on the underside of the top plate and longitudinally movable with respect to the bed in a fixed horizontal plane, a first set of dies carried on a plurality of rams mounted on the bed for vertically moving said dies with respect to the slide, a second set of dies mounted on the slide and adapted to mate with said first set of dies, means for actuating said rams for moving said first set of dies selectively and independently with respect to each other and with respect to said second set of dies into operative engagement with said second set of dies to effect a plurality of work steps on work-pieces interposed between the two sets of dies when the slide is moved into position to dispose the two sets of dies in vertical alignment, each of the dies in said second set being adapted to hold a work-piece above said first set of dies whereby movement of the slide will cause each of the dies in said second set to move the work-piece carried therein from a position overlying its mating die in the first set of dies to a position overlying an adjacent die in said first set of dies, and means mounted in a fixed position above the plane of said top plate and movable between a retracted position above the plane of said slide and an extending position projecting through said top plate and slide to eject the work-pieces from said second set of dies, the die in the second set of dies adjacent one end of the slide moving its work-piece beyond the extent of the bed during the slide movements for ejection of the finished work-piece from the press by said means.

2. A metal-working press, comprising a supporting frame, a bed and top plate fixedly mounted on the frame in vertically spaced relation, a slide carried on the underside of said top plate and longitudinally movable with respect to the bed, a plurality of longitudinally spaced work stations comprising mating male and female dies supported from said bed and slide respectively, means for selectively and independently moving each of said male dies with respect to each other and with respect to said female dies toward its mating female die to effect a work step on a work-piece interposed therebetween, each of said female dies being adapted to hold a work-piece above the male dies and movable with said slide for simultaneously advancing the work-pieces from one work station to another, means mounted in a fixed position above the plane of said top plate and movable between a retracted position above the plane of said slide and an extended position projecting through said top plate and slide to eject the work-pieces from the female dies, said means ejecting the finished work-piece from the female die adjacent the discharge end of the slide upon movement of the slide to position said female die beyond the extent of the bed, and means for moving said slide longitudinally with respect to the bed.

3. A metal-working press, comprising a supporting frame having a bed and top plate fixedly mounted thereon in spaced vertical relation, a slide slidably carried on the underside of the top plate and having pick-up and discharge ends, means for moving said slide longitudinally with respect to the bed and top plate in a fixed horizontal plane, a first set of longitudinally spaced dies supported from the bed, a plurality of longitudinally spaced work-piece holders mounted on the slide and movable therewith to and from positions overlying the first set of dies, a plurality of said work-piece holders constituting a second set of dies, means for vertically moving said first set of dies selectively and independently with respect to each other and with respect to said second set of dies into operative engagement with said second set of dies to effect work steps on work-pieces interposed therebetween when the slide is moved into position to dispose the two sets of dies in vertical alignment, and means mounted in a fixed position above the plane of said top plate and movable between a retracted position above the plane of said slide and an extended position projecting through openings formed in said top plate and slide for ejecting the work-pieces from their holders, said openings in said top plate and slide being disposed in vertical alignment when said slide is moved into a position to dispose the work-piece holder adjacent the discharge end of said slide beyond the extent of the bed.

4. A metal-working press as set forth in claim 3 in which said slide is slidably carried against the underside of the top plate on longitudinally extending gibs extending along the lateral and lower faces of said slide, said gibs being adjustable to adjust the lateral and vertical positioning of the slide with respect to the top plate.

5. A metal-working press as set forth in claim 3 in which the work-piece holder adjacent the pick-up end of the slide comprises a pair of depending laterally spaced brackets having a plurality of depending longitudinally spaced fingers fixedly mounted thereon and engaging the edges of a work-piece for retaining said work-piece in a fixed position thereon, and a plurality of magnets on said brackets engaging and holding a work-piece thereon between said fingers.

6. A metal-working press as set forth in claim 3 with the addition that at least one transversely extending brace is mounted on the supporting frame adjacent its lower end, a pair of vertically movable slides slidably mounted on said brace, each of said slides supporting a platen carrying one of the dies in said first set of dies, and a power cylinder mounted on the bed under each of said platens

and connected thereto for moving said first set of dies toward and away from said second set of dies.

7. A metal-working press as set forth in claim 6 in which at least one of the dies carried on one of the platens comprises a punch rigidly interconnected to said platen for movement therewith, and a draw ring movable with and with respect to said platen, said draw ring being supported from a plate disposed below the platen and movable with respect to the platen by a plurality of power cylinders mounted on said plate and having their rams rigidly connected to the platen.

8. A metal-working press as set forth in claim 6 in which said pair of slides are disposed on the opposed sides of said brace, each of the slides in said pair of slides being mounted on the brace by vertically extending guides rigidly mounted on the brace adjacent the ends thereof.

9. A metal-working press as set forth in claim 6 in which each of said power cylinders is interposed between pairs of laterally spaced braces rigidly interconnecting the platens to their associated vertically movable slides.

10. A metal-working press, comprising a supporting frame, a bed, top plate, and cover plate fixedly mounted on said frame in vertically spaced relation, a slide carried on the underside of the top plate and having opposed pick-up and discharge ends, means for moving said slide longitudinally with respect to the bed and top plate, a first set of longitudinally spaced dies supported from the bed and selectively and independently vertically movable with respect to each other and to said slide, a work-piece holder rigidly mounted on the lower slide face adjacent its pick-up end and having means for holding a work-piece blank thereon, a ram mounted on the cover plate and vertically movable through openings in said top plate and slide and through the plane of said work-piece holder, said ram being adapted to pick up a work-piece and dispose it on said work-piece holder, a second set of longitudinally spaced dies rigidly mounted on the slide between its discharge end and said work-piece holder and adapted to mate with said first set of dies, each of the dies in said second set of dies being adapted to carry a work-piece and being movable with the slide to and from positions of alignment with their mating dies in said first set of dies whereby movement of the first set of dies toward the second set of dies when they are in alignment will effect work-steps on work-pieces interposed therebetween, and means mounted on the cover plate and movable between a retracted position above the plane of said top plate and an extended position projecting through the planes of the top plate and slide to eject the work-pieces from the second set of dies and said work-piece holder onto said first set of dies, said means ejecting the finished work-piece from the press when the die in the second set of dies adjacent the discharge end of the slide is moved beyond the extent of the bed.

11. A metal-working press as set forth in claim 10 in which a work-piece supporting platform is mounted on the supporting frame in alignment with said vertically movable ram and with said work-piece holder when said slide is moved to dispose said mating first and second sets of dies in alignment whereby said ram upon its downward stroke will pick up a work-piece from said platform and will deposit said work-piece on the work-piece holder upon its upward stroke.

12. A metal-working press as set forth in claim 11 in which said platform is provided with a plurality of guide posts for holding a plurality of work-pieces in a stacked position, and means on said platform urging said plurality of work-pieces into vertically spaced relation to each other.

13. A metal-working press as set forth in claim 10 in which means are provided for applying a thin coating of oil to the work-pieces as they are moved from the platform to the work-piece holder by said ram.

14. A metal-working press as set forth in claim 10 in which a plurality of magnets are mounted on said work-piece holder for holding a work-piece thereon, and said ram has suction means on its lower end for holding a work-piece thereon.

15. A metal-working press as set forth in claim 10 with the addition that a pair of vertically spaced fingers are mounted on each of the opposed sides of the supporting frame adjacent the path of movement of said work-piece holder with the slide, the fingers in each pair of said fingers being spaced apart a distance slightly greater than the thickness of a single work-piece and operatively associated with said work-piece holder for removing all work-pieces more than one carried on said work-piece holder.

16. A metal-working press as set forth in claim 15 in which said pairs of fingers are vertically swingable through a predetermined angle, the axes about which said pair of fingers swing lying in a common horizontal plane.

17. A metal-working press as set forth in claim 10 in which said means for moving the slide comprises a power cylinder supported from the cover plate and having a ram connected to a gear rack longitudinally movable upon actuation of said cylinder, a pinion mounted on the top plate and meshing with said gear rack, and a pivotal linkage interconnected between the slide and the pinion for moving said slide longitudinally upon rotation of said pinion.

18. A metal-working press as set forth in claim 10 in which said means for moving the slide comprises a power cylinder supported from said cover plate and driving a gear rack in mesh with a pinion mounted on said top plate, a link arm connected at one of its ends to said pinion for rotation therewith and pivotally connected at its opposite end to a pair of links pivotally connected to the slide, said link arm being rotatable into a position to dispose its pivotal connection to the pair of links below the plane of its axis of rotation when the slide is moved into an operative position to dispose said first and second sets of dies in alignment for releasably locking said slide in operative position.

19. A metal-working press as set forth in claim 18 in which means are mounted on said top plate for limiting the rotational movements of said link arm.

20. A metal-working press as set forth in claim 18 in which said pair of links are pivotally connected to a slide block rigidly mounted on said slide for moving said slide longitudinally upon pivotal movement of said pair of links, said slide block being slidably carried in a longitudinally disposed slot formed in the top plate.

21. A metal-working press comprising a supporting frame, a bed, top plate, and cover plate mounted on said frame in vertically spaced relation to each other, a slide slidably carried on the underside of the top plate and having pick-up and discharge ends, means for moving said slide longitudinally with respect to the bed and top plate, a first set of longitudinally spaced dies supported from the bed, a plurality of longitudinally spaced work-piece holders mounted on the slide, a plurality of said work-piece holders constituting a second set of dies each of which is adapted to mate with one of the dies in said first set, said slide moving said second set of dies to and from positions overlying their respective mating male dies, means selectively and independently moving said first set of dies with respect to each other and the second set of dies into operative engagment with said second set of dies to effect work step on work-pieces interposed therebetween when the slide is moved into position to dispose the two sets of dies in vertical alignment, and a plurality of power cylinders mounted on said cover plate and having rams vertically movable through the planes of the top plate and slide for ejecting the work-pieces from their holders.

22. A metal-working press as set forth in claim 21 in which one of said power cylinders is mounted on said cover plate in general vertical alignment with each of the dies in said first set of dies and adjacent one end of the cover plate.

23. A metal-working press as set forth in claim 21 in which said work-piece holders are provided with vertically movable knockout plates adapted to be disposed in engagement with the rams on said plurality of power cylinders for ejecting the work-pieces from said holders upon downward movement of said rams.

24. A metal-working press as set forth in claim 23 in which each of said knockout plates is normally spring-biased into engagement with the slide by a plurality of springs interposed between each of said plates and its respective work-piece holder.

25. In an apparatus for performing a plurality of work steps on a work-piece, a supporting frame, a slide carried in a fixed plane from said frame, means on said frame for reciprocating said slide longitudinally of the frame, and longitudinally spaced pairs of mating first and second members carried from said slide and frame respectively, each of said first members being adapted to releasably carry a work-piece, means for moving said second members selectively and independently with respect to each other and said first members into operative engagement with their mating first members to perform a plurality of work steps on the work-pieces interposed therebetween, said slide, upon movement of said second members out of operative engagement with said first members, being movable to move each of said first members from a position of alignment with its mating second member to a position of alignment with the next adjacent second member with the work-piece in each of said first members being moved therewith, the first member adjacent one end of the slide moving its work-piece beyond the longitudinal extent of said second members during the movement of said slide for ejection of the finished work-piece from the apparatus.

26. In an apparatus for performing a plurality of work steps on a work-piece, a supporting frame having a pair of opposed vertically extending side walls operatively interconnected by a horizontally disposed top plate and bed adjacent their upper and lower ends, respectively, and by one or more transversely extending braces projecting upwardly from said bed, a pair of vertically movable slides projecting outwardly over said bed from the opposite sides of each of said braces, slide means carried

along the underside of said top plate and longitudinally movable with respect to said pairs of slides, a plurality of longitudinally spaced first members mounted on said slide means and each adapted to releasably carry a work-piece, a plurality of second members mounted on said pairs of slides adapted to mate with said first members, power means mounted on said bed and operatively connected to each slide in each pair of slides for vertically moving the slides in said pairs of slides selectively and independently of each other and of said first members to cause said first and second members to perform a plurality of work steps on said work-pieces upon movement of said pairs of slides toward said slide means, said slide means, upon movement of said second members out of operative engagement with said first members, being movable to move each of said first members from a position of alignment with its mating second member to a position of alignment with the next adjacent second member with the work-piece in each of said first members being moved therewith, the first member adjacent one end of the slide means moving its work-piece beyond the longitudinal extent of said second members during the movement of said slide means for ejection of the finished work-piece from the apparatus, and means for moving said slide means.

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