

May 29, 1945.

K. T. NORRIS

2,377,097

MULTIPLE SHEET METAL STAMPING PRESS

Filed May 15, 1944

2 Sheets-Sheet 1

Fig. 1.

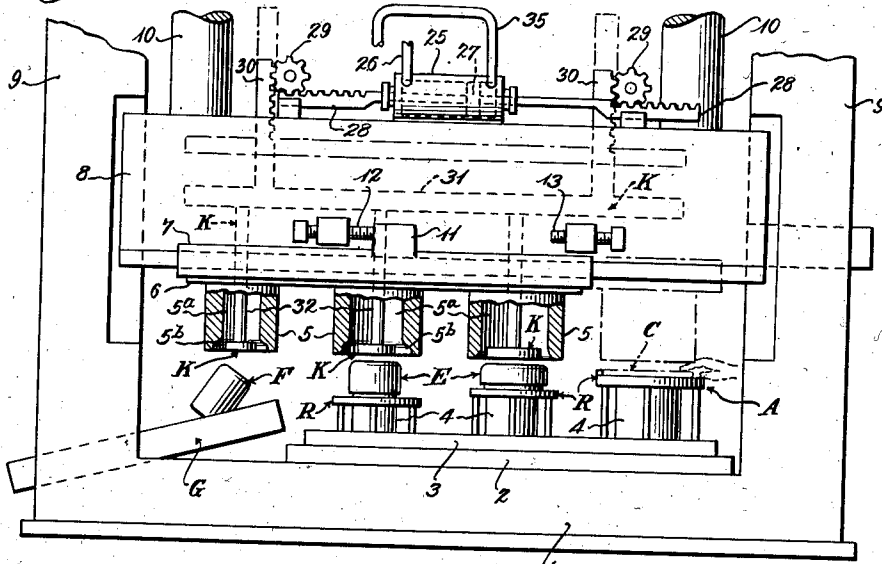


Fig. 2.

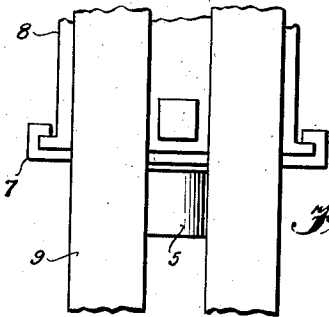
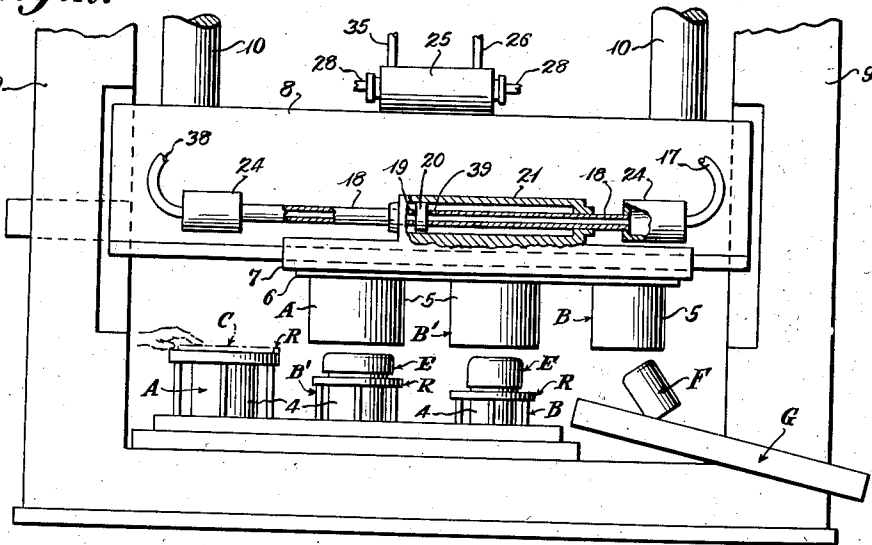


Fig. 3.

Inventor

Kenneth T. Norris

By Luther L. Mack

Attorney

May 29, 1945.

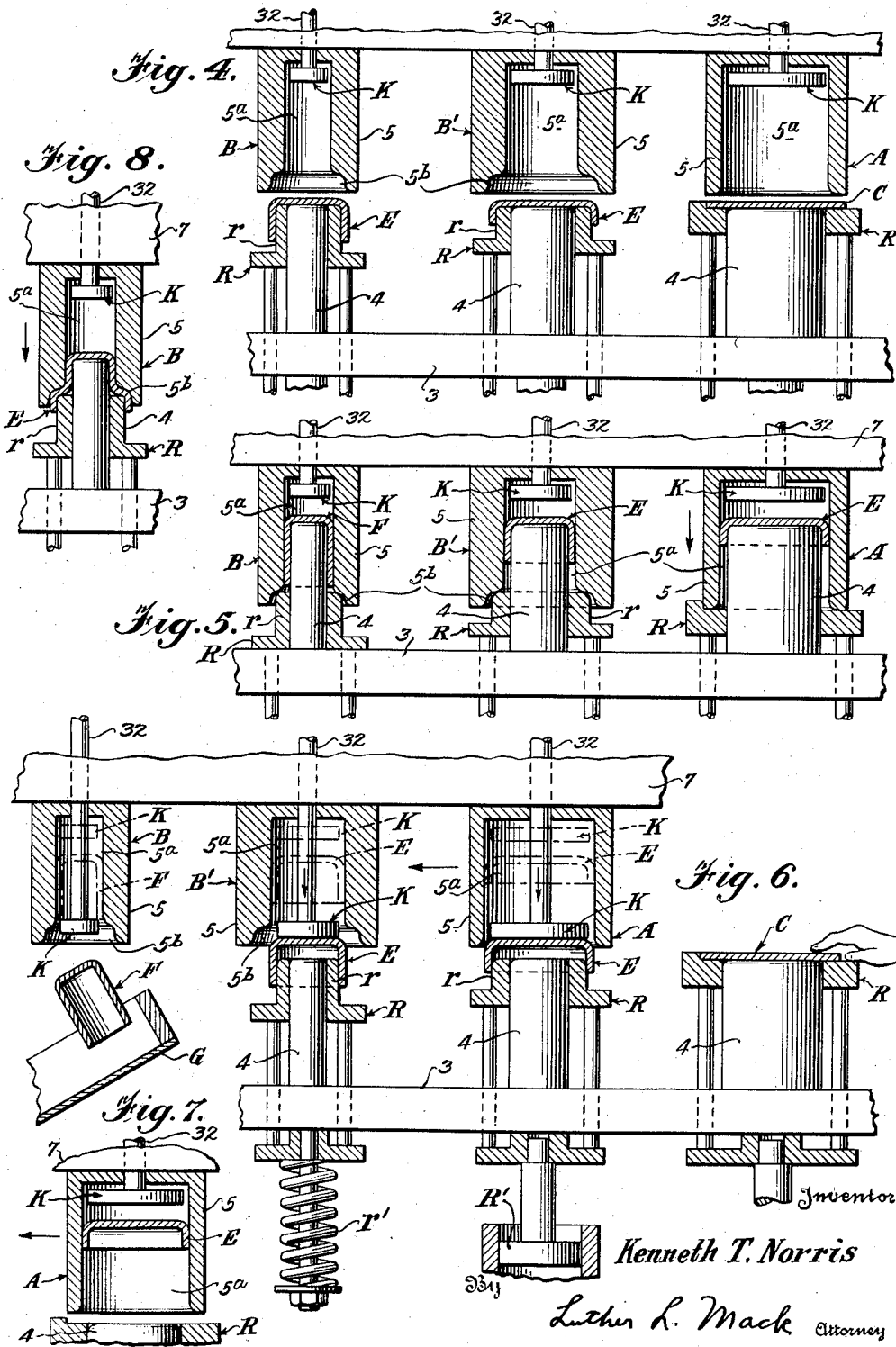
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2 Sheets-Sheet 2



Inventor
Kenneth T. Norris
Luther L. Mack Attorneys

UNITED STATES PATENT OFFICE

2,377,097

MULTIPLE SHEET METAL STAMPING PRESS

Kenneth T. Norris, San Marino, Calif.

Application May 15, 1944, Serial No. 535,712

17 Claims. (Cl. 113—46)

This invention relates to and has for its primary purpose, the provision of a novel and highly efficient die stamping press which is superior to presses heretofore used in point of increased production and an appreciable saving in labor, time and cost of operation, also reliability and performance, by reason of causing the work to be transferred by the female dies, instead of manually, from one set of male and female dies to another and progressively throughout a series of such sets of simultaneously operated dies of differing characteristics as to size and form, in accordance with my invention.

Another purpose of the invention is to provide a press for forming metal articles of elongated size, wherein the work is successively formed in a plurality of progressive stages by a series of sets of die members, for gradually drawing the metal into final form, and in which the female dies are simultaneously actuated to perform a drawing operation and temporarily retain the work after drawing, are shifted and operated to transfer the work to adjacent male dies (the completed work from the female die of the final die being discharged from the machine), and are then returned to their original position for another simultaneous drawing operation. Thus, each blank will be successively drawn and partially formed at different stages for the production of an article of desired shape and size and then discharged from the finishing set of dies at the same time the incompleting work of each of the other sets is transferred to the male die of the set next adjacent thereto, as aforesaid.

A further purpose is to provide a press of the character described wherein the operator feeds the work or blank only to the first set of dies, the other work feeding operations to successive dies being accomplished in a predetermined series of steps by the shifting of the female dies themselves.

An additional purpose of the invention is to provide a press of the character described which is particularly designed for drawing objects of tubular or hollow cross section of the type requiring one or more redraw operations in addition to the first drawing operation. In this connection, it is important to note that I have built and successfully operated a press of the character described, which has drawn hundreds of thousands of aluminum articles of tubular cross section requiring ten sets of dies and a like number of drawing operations per article, with greater efficacy and at a lower cost than heretofore possible in the art.

Another purpose of my invention is to provide an improved press of the character described, in which an appreciable economy of construction, operation and production is brought about by arranging and operating female drawing dies and cooperating male dies or punches so that in the normal operation of the press it is only necessary to simultaneously raise the corresponding female dies of each set above the mating male dies or punches of said sets sufficiently to clear said punches and permit the female dies with the work supported therein to be shifted for transferring the work to the male dies of adjacent sets, as hereinbefore pointed out; as compared to drawing dies heretofore used wherein it is necessary to separate the dies from the punches a distance greater than the length of the work in order to manually or otherwise remove the work and likewise replace it on another male die for redrawing.

My invention, therefore, comprehends the provision of a press embodying a plurality of sets of drawing dies preferably arranged with the male die members or punches spaced apart and fixed to a suitable base or bed while the female die members are correspondingly spaced in like center to center relation on a shiftable carriage mounted for horizontal reciprocation upon a ram member which is vertically movable relative to said bed, the flat blanks or discs of metal being fed one at a time to the initial die set and automatically transferred by the female dies, progressively, from set to set during the drawing cycle, to be ultimately knocked out of the final female die and discharged from the press.

With the foregoing and other objects in view, my invention consists in the particular construction or combination and relative arrangement of the parts and elements as shown in the accompanying drawings, described in the following specification and finally defined in the claims hereto appended. It is to be understood that minor changes as to size, proportion and arrangement of parts and elements of the invention may be made as required without departing from the spirit and scope of the invention as set forth in the claims hereof.

In the drawings:

Fig. 1 is a fragmentary front elevation of a press embodying my invention, in part schematic;

Fig. 2 is a fragmentary rear elevation of the press shown in Fig. 1, also partly schematic;

Fig. 3 is a fragmentary left end elevation of the press shown in Fig. 2.

Fig. 4 is a schematic fragmentary view par-

tially in section showing the plurality of sets of die members ready for simultaneous operation with a flat blank on the punch of the first set of dies for initial drawing thereof, and with partially drawn work positioned on the remaining punches ready to be redrawn;

Fig. 5 is a schematic view similar to Fig. 4, but showing the die members and work in their relative positions at the end of a drawing stroke.

Fig. 6 is a schematic view similar to Fig. 4, but showing the upper or female die members shifted to the left of the position shown in Figs. 4 and 5, for transferring the work of each set of dies to the male or lower die next adjacent thereto, the work pieces being shown in dotted lines to indicate their position while retained in the upper dies, and in full lines to indicate the action of the knock-out means to effect said transfer;

Fig. 7 is a fragmentary view partly in section of one of the dies, showing the manner in which an upper die retains the work after stamping, whereby the work may be transferred; and

Fig. 8 is a fragmentary view partly in section through one set of dies and the work showing the manner in which the drawing operation takes place.

There is shown in the accompanying drawings, for the purpose of illustrating one embodiment of my invention, a multiple die press for making articles of tubular cross section but it is to be understood and it will be apparent from the following description that my invention may be embodied in other types of presses and dies.

As here shown, the press bed 1 is provided with a bolster 2 and die shoe 3 on which a plurality of male die members or punches 4 are affixed in upright position for cooperation with a series of female die members 5 supported on a die shoe 6 carried by a laterally slidable carriage 7 mounted on a ram member 8 guided by the press end frame portions 9, 9. The male and female die members 4 and 5, respectively, are laterally spaced apart correspondingly in rows for initially engaging a blank and thereafter successively engaging the partially formed articles throughout a progressing series of cycles to and including the final die set. Each of these sets is of a different size and obviously may, if desired, be made to change the shape or form of the work. In the present case, the die sets are successively reduced in diameter from right to left, as viewed in Fig. 1. The first set of dies A at the right end of the row performs the initial drawing operation on the blank C which is fed thereto manually, but of course may be machine fed if desired. The last set B at the end of the row finishes the particular product of the press, and a set of dies B' (Fig. 4) performs an intermediate drawing operation. The number of sets of dies B' between the sets A and B can be varied to meet the requirements of a given stamping job. Thus, the sets of dies are designed to collectively form a tubular article of given size or form, but it is apparent that any dies, which by their collective effect on a given blank will produce a given-shaped article, could be used within the concept of my invention.

It will be noted that all of the dies 5 have main cavities 5a and all except the initial die 5 have countercavities 5b, into which cavities the partially formed pieces of work E extend, and into which countercavities the skirts r of rings R extend when the punches 4 and dies 5 are positioned as shown in Fig. 5. Also, the rings R may be urged upwardly toward the dies 5 as by compress-

sion springs r' or pressure influenced pistons R' as shown in Fig. 6.

When the drawing stroke occurs, the work flows out or is guided by the pressure rings R as the female dies descend in relation to the punches 4, as clearly seen in Fig. 8.

There is friction between the drawn work and the female dies 5 as well as between the drawn work and the punches 4, and the tensioned rings R are adapted upon retraction of the female dies 5 to strip the work from the punches 4 so that such work may be retained by the female dies 5 for transfer to a succeeding forming position.

In carrying out my invention, any conventional or suitable means can be employed for effecting operation of the press in the following manner:

With the press loaded as shown in Fig. 4 so that the first set of dies A contains a blank C in position to be initially drawn, the successive sets B', B loaded with partially formed work E, the ram 8 is actuated by rods 10, 10 associated with conventional power cylinders and conventional and/or suitable control means therefor (not shown) to simultaneously effect the down or working stroke of the female dies 5, as indicated in Fig. 8, until at the end of the stroke, as shown in Fig. 5, the forming operation of each set is completed, the stroke of the dies 5 being equal but each set of dies producing work of a different diameter and length. As here shown, but three reductions are simultaneously made, but I have successfully operated a press having ten sets of dies and making a like number of reductions per simultaneous working stroke of the dies. After the completion of the down stroke, the ram 8 is actuated to lift the dies 5 with the work retained therein to the position shown by the dotted lines in Fig. 6 and full lines in Fig. 7, until the dies are sufficiently raised, say 1/2 inch or less above the male die members or punches 4, to permit of shifting of the female dies 5. This up stroke is followed by a lateral shifting of the carriage 7 on the ram 8 to the position shown in Figs. 1, 2 and 6, whereby the dies 5 and the work therein are positioned to permit of the transfer of the work of the starting set A to the male die or punch 4 of the intermediate set B' and so on with the die 5 of each set advancing the work for deposit onto the male die of the next set, the die 5 of finishing set B at this time disposing the finished work F to the left of its associated male die in position to be discharged from the press onto a chute G, as shown in Figs. 1, 2 and 6.

The carriage 7 is limited in the aforementioned movement on the ram 8 by the engagement of a lug 11 on said carriage with the end of a threaded and adjustable stop 12 mounted on the front of said ram. The movement of the carriage 7 in the opposite direction is limited by the engagement of the lug 11 with the end of a similar threaded stop 13, as will appear more fully hereinafter.

Following the shifting of the carriage 7 toward the left, as viewed in Fig. 1, a work ejecting or knock-out means K operates for commonly ejecting or stripping the work from the female die members 5, whereby the work E will gravitate into position overlying the punches 4 and be supported as shown in full lines in Fig. 6, by the yieldable work holding or pressure rings R, the finished work F gravitating from the press onto a take-off chute G. The knock-out means K is then retracted.

When this transfer and ejection of the work has taken place, the carriage 7 is returned to

its initial position with the dies 5 positioned as shown in Fig. 4, the operator feeding a fresh blank into position, thereby placing the press in readiness for another forming operation, which operation follows the return movement of the carriage 7 and dies 5. The return movement of the carriage 7 on the ram 8 is limited by the engagement of the lug 11 with the end of the stop 13.

Inasmuch as this invention primarily embraces a new arrangement and mode of operation of sets of dies for the purposes hereinbefore stated, rather than a particular press, the accompanying drawings show such arrangement and mode of operation in detail, but illustrate only diagrammatically the operating mechanisms and other elements of the press, and only to such extent as deemed necessary to fully show how the invention may be carried out. The operating mechanisms may be controlled by any suitable means, so long as the cycle of operation aforescribed is carried out. Thus, the ram 8 is but partly shown and may include the rods or plungers 10, shown in Figs. 1 and 2, which are operated by hydraulic cylinders, not shown, to effect their up and down strokes and which cylinders obviously can be controlled by any suitable hydraulic cylinder control means, also not shown, within the skill of the art.

The horizontal reciprocation of the carriage 7 on the ram 8, within the limits determined by the stops 12 and 13, may be effected by means of a cylinder 21 (Fig. 2) fixed to and movable with the carriage 7 and containing a piston 20 mounted upon a hollow rod 18 suitably fixed on the back of the ram 8 by mountings 24, 24. Operating fluid under pressure for effecting movement of the carriage 7 toward the right, as viewed in Fig. 2, is admitted into the cylinder 21 through the right end of the hollow rod 18, said fluid being supplied by line 17. This fluid passes through an opening 39 in the rod 18 formed adjacent one side of the piston 20 in the cylinder 21. Inasmuch as the piston 20 and rod 18 are fixed, fluid entering the cylinder 21 through the opening 39 will cause the cylinder to move to the right in Fig. 2, so as to shift the carriage 7 and dies 5 correspondingly into the position shown in Figs. 1, 2 and 6, whereby the work in each female die 5 will be positioned to the left of its companion male die or punch 4, as viewed in Figs. 1 and 6, and over the male die or punch of the next set to the left, save for the finished work F' in the die of the finishing set B, which work is positioned to drop into chute G upon ejection by the strippers or knock-outs K, the operating mechanism of which will now be described.

After the carriage 7 and dies 5 have been shifted to the left, as shown in Figs. 1 and 6, fluid under pressure is admitted into a cylinder 25 fixed on the ram 8, from pipe 26 (Fig. 1) so as to shift the piston 27 to the right and likewise move a rack 28 connected with the piston and extending from opposite ends of the cylinder. This rack operates pinions 29 journaled on the ram and which mesh with vertical racks 30 on a horizontal knock-out operating head 31 vertically slidable on the ram. These pinions are rotated counterclockwise as seen in Fig. 1, and the racks 30 and the head 31 will be forced downwardly so that the knock-out rods 32 which may be connected or engaged to said head in any suitable manner will move downwardly and eject the work as shown in Figs. 1

and 6. This ejected work, save the finished work F', will drop onto the male die members 4 in readiness for redrawing thereof as hereinbefore pointed out, the finished work being discharged onto chute G as seen in Figs. 1, 2 and 6.

As the knock-out or ejecting operation is completed, fluid under pressure is admitted into the cylinder 25 through the pipe 35 so that the rack 28 moves to the left (Fig. 1) and thereby rotates the pinions 29 clockwise whereby to raise the racks 30, knock-out head 31 and knock-out rods 32, the latter assuming the position shown in dotted lines in Fig. 6. Manifestly, the fluid for actuating the piston 27 may be admitted and exhausted from the cylinder 25 through the pipes 26 and 35 by any conventional and/or suitable hydraulic cylinder control means (not shown).

At the completion of the up or return stroke of the knock-out mechanism fluid under pressure is admitted through line 38 (Fig. 2), fixed hollow rod 18, outlet 19 in said rod, and thence into the cylinder 21 on the carriage 7, whereby to move the cylinder 21 to the left, as viewed in Fig. 2, until the lug 11 engages the stop 13, and thereby return the carriage 7 and dies 5 to their starting position shown in Fig. 4. Here again, it will be manifest that the fluid admitted and exhausted from the cylinder 21 through the lines 17 and 38 to effect reciprocation of the carriage 7 may be controlled by any conventional and/or suitable hydraulic cylinder control means (not shown).

Before the carriage 7 and dies 5 are returned to starting position, the operator feeds a blank to the initial die or punch member 4 of the set of dies A, as aforesaid, and therefore when the carriage 7 and said dies complete the return shift they are in proper position to effect another down or drawing stroke so as to simultaneously draw the blank and redraw the partially drawn work upon downward movement of the ram 8, as aforescribed.

This application is a continuation-in-part of an application filed by me on the 2nd day of August, 1940, Serial No. 349,679.

I claim the following:

1. In a press for performing a series of drawing operations whereby a blank is drawn into a desired shape, the combination of: a stationary bed, a plurality of punches fixedly mounted in a row on said bed, a ram slidably mounted above said bed for vertical movement, a carriage slidably mounted on said ram for horizontal movement, a plurality of dies fixedly mounted on said carriage corresponding in number and complementary in character to said respective punches and having the same center to center spacing and alignment as the punches and adapted to retain the drawn work therein, said carriage having one limit of horizontal movement at which said dies are vertically aligned with their complementary punches, and another limit at which all but the last of said dies are vertically aligned with the next adjacent punches progressively in the series, means to vertically reciprocate said ram when said dies are aligned with their complementary punches for simultaneously performing a plurality of drawing operations, and means in association with said dies to strip the drawn work from said dies to deposit it on the progressively adjacent punches when said dies are aligned with said punches.

2. In a press for performing a series of drawing operations whereby a blank is drawn into a de-

sired shape, the combination of: a stationary bed, a plurality of punches fixedly mounted in a row on said bed, a ram slidably mounted above said bed for vertical movement, a carriage slidably mounted on said ram for horizontal movement, a plurality of dies fixedly mounted on said carriage corresponding in number and complementary in character to said respective punches and having the same center to center spacing and alignment as the punches and adapted to retain the drawn work therein, said carriage having one limit of horizontal movement at which said dies are vertically aligned with their complementary punches, and another limit at which all but the last of said dies are vertically aligned with the next adjacent punches progressively in the series, means to vertically reciprocate said ram when said dies are aligned with their complementary punches for simultaneously performing a plurality of drawing operations, yieldably mounted pressure rings on said punches to receive the work when stripped from the dies, to yield upon advance of said dies, and to strip the drawn work as said dies are withdrawn whereby said work is retained in the dies, and means in association with said dies to strip the drawn work from said dies to deposit it on the progressively adjacent punches when said dies are aligned with such punches.

3. In a press for performing a series of drawing operations whereby a blank is drawn into a tubular shape, the combination of: a stationary bed, a plurality of punches fixedly mounted in a row on said bed, a ram slidably mounted above said bed for vertical movement, a carriage slidably mounted on said ram for horizontal movement, a plurality of dies fixedly mounted on said carriage corresponding in number and complementary in character to said respective punches and having the same center to center spacing and alignment as the punches and adapted to retain the drawn work therein, said carriage having one limit of horizontal movement at which said dies are vertically aligned with their complementary punches, and another limit at which all but the last of said dies are vertically aligned with the next adjacent punches progressively in the series, means to vertically reciprocate said ram when said dies are aligned with their complementary punches for simultaneously performing a plurality of drawing operations, means on said punches to strip the drawn work as said dies are withdrawn whereby said work is retained in the dies, and strippers extendable through said dies to strip the drawn work from said dies to deposit it on the progressively adjacent punches when said dies are aligned with such punches.

4. In a press for performing a series of drawing operations whereby a blank is drawn into a tubular shape, the combination of: a stationary bed, a plurality of punches fixedly mounted in a row on said bed, a ram slidably mounted above said bed for vertical movement, a carriage slidably mounted on said ram for horizontal movement, a plurality of dies fixedly mounted on said carriage corresponding in number and complementary in character to said respective punches and having the same center to center spacing and alignment as the punches and adapted to retain the drawn work therein, said carriage having one limit of horizontal movement at which said dies are vertically aligned with their complementary punches, and another limit at which all but the last of said dies are vertically aligned with the next adjacent punches progressively in the series,

means to vertically reciprocate said ram when said dies are aligned with their complementary punches for simultaneously performing a plurality of drawing operations, yieldably mounted pressure rings on said punches to receive the work when stripped from the dies, to yield upon advance of said dies, and to strip the drawn work as said dies are withdrawn whereby said work is retained in the dies, and strippers extendable through said dies to strip the drawn work from said dies to deposit it on the progressively adjacent punches when said dies are aligned with such punches.

5. In a press for performing a series of drawing operations whereby a blank is drawn into a tubular shape by drawing operations which progressively reduce the diameter of said blank or work, the combination of: a stationary bed, a plurality of punches of progressively reduced diameters fixedly mounted in alignment on said bed, a ram slidably mounted above said bed for vertical movement, a carriage slidably mounted on said ram for horizontal movement, a plurality of dies fixedly mounted on said carriage corresponding in number and complementary in character to said respective punches and having the same center to center spacing and alignment as the punches and adapted to retain the drawn work therein, said carriage having one limit of horizontal movement at which said dies are vertically aligned with their complementary punches, and another limit at which all but the last of said dies are vertically aligned with the next adjacent punches progressively in the series, means to vertically reciprocate said ram when said dies are aligned with their complementary punches for simultaneously performing a plurality of drawing operations, means on said punches to strip the drawn work as said dies are withdrawn whereby said work is retained in the dies, and means in association with said dies to strip the drawn work from said dies to deposit it on the progressively adjacent punches when said dies are aligned with such punches.

6. In a press for performing a series of drawing operations whereby a blank is drawn into a tubular shape, the combination of: a stationary bed, a plurality of punches fixedly mounted in a row on said bed, a ram slidably mounted above said bed for vertical movement, a carriage slidably mounted on said ram for horizontal movement, a plurality of dies fixedly mounted on said carriage corresponding in number and complementary in character to said respective punches and having the same center to center spacing and alignment as the punches and adapted to retain the drawn work therein, said carriage having one limit of horizontal movement at which said dies are vertically aligned with their complementary punches, and another limit at which all but the last of said dies are vertically aligned with the next adjacent punches progressively in the series and said last die is disposed at a delivery position progressively adjacent the final punch of the series, means to vertically reciprocate said ram when said dies are aligned with their complementary punches for simultaneously performing a plurality of drawing operations, means on said punches to strip the drawn work as said dies are withdrawn whereby said work is retained in the dies, and means in association with said dies to strip the drawn work from said dies to deposit it on the progressively adjacent punches when said dies are aligned with such punches.

7. In a press for performing a series of drawing operations whereby a blank is drawn into a tubular shape by drawing operations which progressively reduce the diameter of said blank or work, the combination of: a stationary bed, a plurality of punches of progressively reduced diameters fixedly mounted in alignment on said bed, a ram slidably mounted above said bed for vertical movement, a carriage slidably mounted on said ram for horizontal movement, a plurality of dies fixedly mounted on said carriage corresponding in number and complementary in character to said respective punches and having the same center to center spacing and alignment as the punches and adapted to retain the drawn work therein, said carriage having one limit of horizontal movement at which said dies are vertically aligned with their complementary punches, and another limit at which all but the last of said dies are vertically aligned with the next adjacent punches progressively in the series, means to vertically reciprocate said ram when said dies are aligned with their complementary punches for simultaneously performing a plurality of drawing operations, yieldably mounted pressure rings on said punches to receive the work when stripped from the dies, to yield upon advance of said dies, and to strip the drawn work as said dies are withdrawn whereby said work is retained in the dies, and strippers extendable through said dies to strip the drawn work from said dies to deposit it on the progressively adjacent punches when said dies are aligned with such punches.

8. A press of the character described comprising: a frame including a bed, a plurality of punch and die units mounted on said frame, a ram vertically slidable on the frame, a carriage horizontally slidable on the ram, the punches of said units being fixed to the bed of the frame and the dies being supported on said carriage, said units being uniformly spaced apart with the dies and punches thereof arranged in horizontal rows, means for moving the carriage and the dies carried thereby to an extent of the center to center distance between adjacent dies while the ram is at rest at its uppermost limit of movement for shifting all of the dies simultaneously between normal positions of registration with their complementary punches to positions of registration with the next succeeding punches and vice versa, whereby pieces of work are operated upon by an initial punch and die unit and are then transferred to succeeding punch and die units progressively for successive operations and following operation by a final unit are discharged from the press, and means for vertically reciprocating the ram and the carriage for extending and retracting the dies to and from operative engagement with the work and the associated punches.

9. A press of the character described in claim 8 including: tensioned work supporting rings associated with and yieldable relative to the punches, one of said rings initially receiving a blank and the remaining rings receiving partially formed work of progressively decreasing diameter and gradually increasing depth.

10. A press of the character described in claim 8 including: tensioned work supporting means associated with and yieldable relative to the punches, the tensioned work supporting means associated with the first punch in the row initially receiving a blank and the remaining tensioned work supporting means receiving partially formed work of progressively decreasing

diameter and gradually increasing depth, said dies having cavities and counter-cavities substantially corresponding in diameter to the external dimension of the work formed in given operations and the internal dimension of the work as formed in the immediately preceding operations, respectively.

11. A press of the character described in claim 8 including: tensioned rings associated with and yieldable relative to the punches for receiving and supporting the pieces of work as they are advanced progressively from unit to unit in the press and operative for stripping the pieces of work from the punches subsequent to forming operations, whereby said pieces of work are retained in the dies for advancement and deposit upon succeeding rings of the series.

12. A press of the character described in claim 8 including: tensioned rings associated with and yieldable relative to the punches for receiving and supporting the pieces of work as they progress from one unit to a succeeding unit and are operative for stripping the pieces of work from the punches subsequent to forming operations, whereby said pieces of work are retained in the dies for deposit upon succeeding rings of the series, and means associated with the dies engageable with and for ejecting the pieces of work therefrom for deposit upon the next succeeding punches.

13. A press of the character described in claim 8 including: means carried by said carriage and by said ram for limiting the movement of the carriage in opposite directions.

14. A press of the character described in claim 8 including: means associated with the punches for stripping the work therefrom at the completion of each operation whereby the pieces of work are retained in the associated dies, means including individual ejectors carried by the several dies, and common engaging means for effecting their operation in the discharge of the pieces of work therefrom.

15. A press for performing a series of drawing operations upon a blank to convert said blank into an article of desired shape, comprising: a stationary bed, a plurality of die members fixedly mounted in a straight row upon said bed, a ram above said bed, means slidably guiding said ram for vertical movement in a fixed path toward and away from said dies, a carriage slidably mounted upon said ram for horizontal reciprocating movement thereon, a plurality of dies fixedly mounted in a straight row upon said carriage and being complementary in character to said respective first-mentioned dies and having the same center to center spacing and alignment as said first-mentioned dies, said carriage having one limit of horizontal movement in which the dies carried thereby are vertically aligned with their complementary dies on said bed, and another limit of movement in which all dies except the last die on said carriage are vertically aligned with the next adjacent die on said bed, and stop means constraining the movement of said carriage to said aforementioned two limits.

16. A press for performing a series of drawing operations upon a blank to convert said blank into an article of desired shape, comprising: a stationary bed, a plurality of male die members of progressively decreasing size fixedly mounted in a straight row upon said bed, a ram slidably mounted above said bed for vertical movement toward and away from said male dies, a carriage

slidably mounted upon said ram for horizontal reciprocating movement thereon, a plurality of female dies fixedly mounted in a straight row upon said carriage and being complementary in character to said respective male dies and having the same center to center spacing, said carriage having one limit of horizontal movement in which said female dies are vertically aligned with their complementary male dies, and another limit of movement in which all but the last of said female dies are vertically aligned with the next adjacent male die progressively in the series, and stop means on said ram constraining the movement of said carriage to said aforementioned two limits.

17. A press for performing a series of drawing operations upon a blank to convert said flat blank into an elongated hollow article of desired shape, comprising: a stationary bed, a plurality of male die members of progressively decreasing size fixedly mounted in a straight row upon said bed, a ram slidably mounted above said bed for vertical movement toward and away from said male dies, a carriage slidably mounted upon said ram for horizontal reciprocating movement thereon, a plurality of female dies fixedly

mounted in a straight row upon said carriage and being complementary in character to said respective male dies and having the same center to center spacing, said carriage having one limit of horizontal movement in which said female dies are vertically aligned with their complementary male dies, and another limit of movement in which all female dies except the female die smallest in size are vertically aligned with the next adjacent male die progressively in the series, stop means constraining the movement of said carriage to said aforementioned two limits, said female dies being adapted to retain the drawn work therein and to transfer the same upon movement of said carriage from said one limit of movement to said other limit of movement, and knock-out means for stripping the drawn work from all of said female dies when said carriage is in a position corresponding to said other limit of movement, to deposit the incompletely drawn work upon the underlying male dies, the completely drawn work in said female die of smallest size being stripped for discharge from the press.

KENNETH T. NORRIS.