H. K. FOOTE.

PUNCH PRESS.

APPLICATION FILED OCT. 13, 1915.

1,202,175.

Patented Oct. 24, 1916.

2 SHEETS—SHEET 1.

Fig. 1.

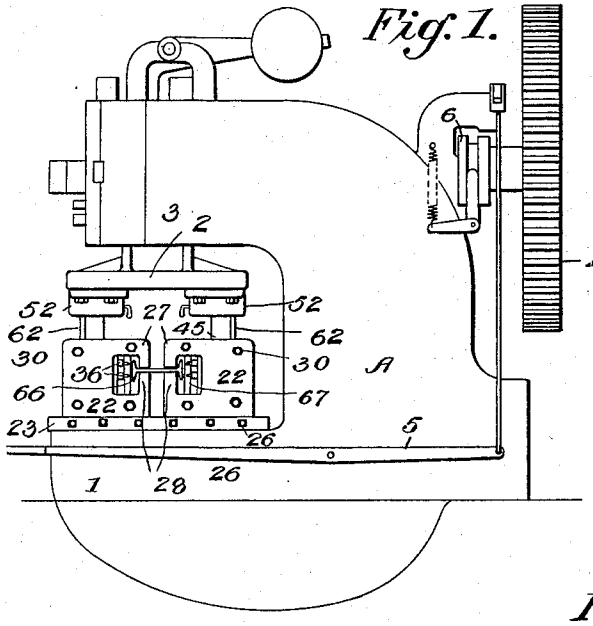


Fig. 4.

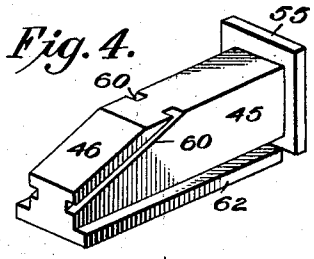


Fig. 5.

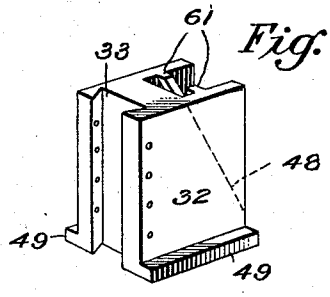


Fig. 2.

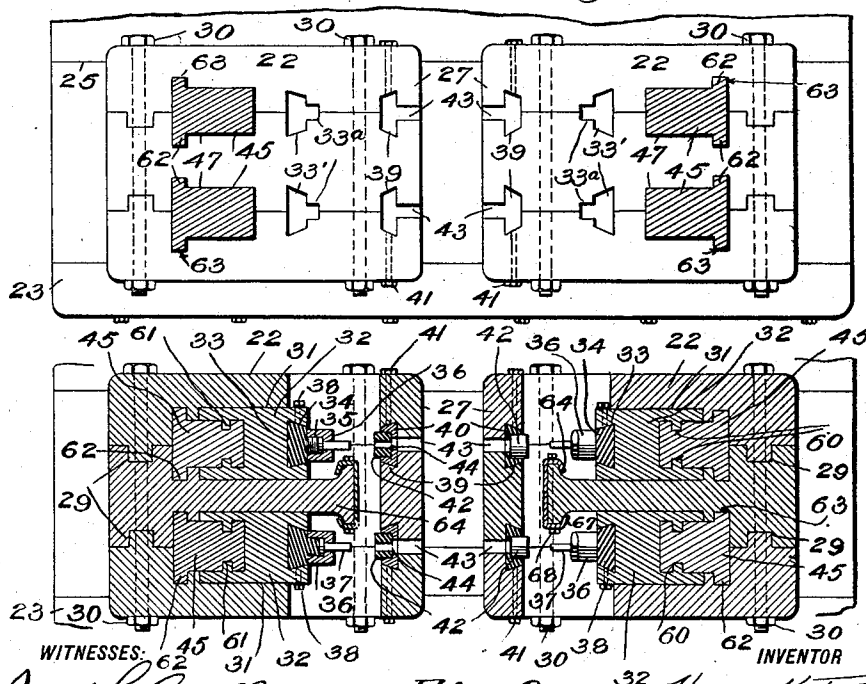


Fig. 3.

WITNESSES:

Jos. T. Collins.

Lillie Cooper

INVENTOR

Haynes K. Foote.

BY

Ralph S. Warfield.

ATTORNEY

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

H. K. FOOTE.

PUNCH PRESS.

APPLICATION FILED OCT. 13, 1915.

1,202,175.

Patented Oct. 24, 1916.

2 SHEETS—SHEET 2.

Fig. 6.

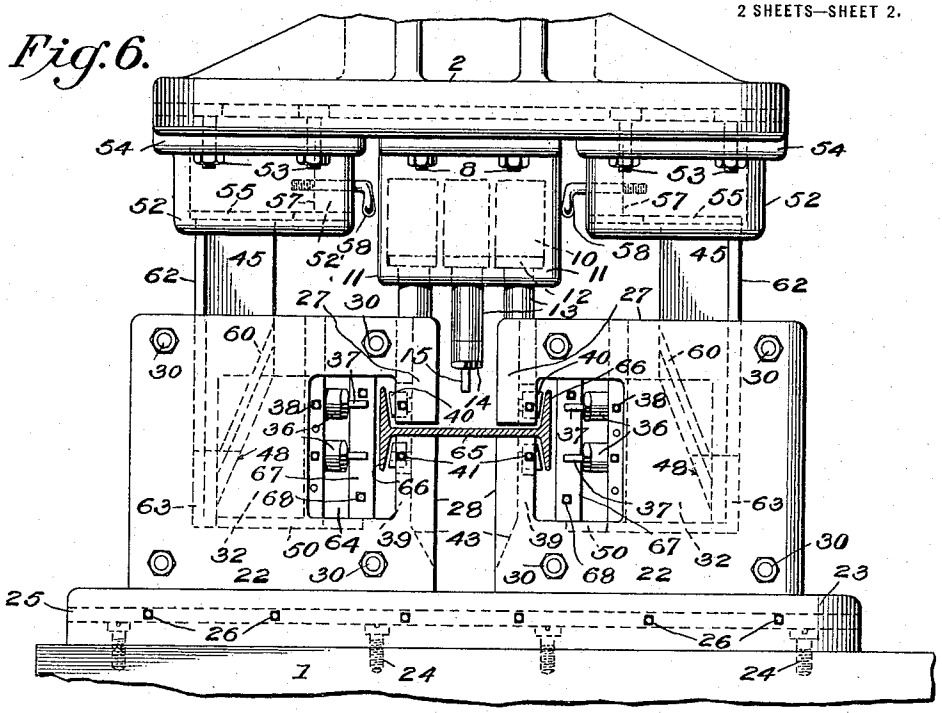
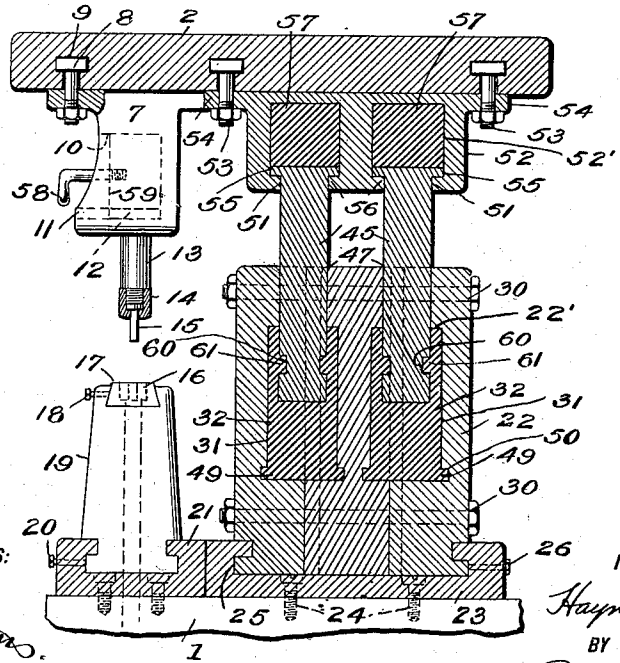


Fig. 7.



WITNESSES:

Jos. H. Collins.

Lillie Cooper

INVENTOR

Haynes K. Foote.

BY

Ralph S. Warfield.

ATTORNEY

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

HAYNES K. FOOTE, OF CHICAGO HEIGHTS, ILLINOIS.

PUNCH-PRESS.

1,202,175. Specification of Letters Patent. Patented Oct. 24, 1916.

Application filed October 13, 1915. Serial No. 55,737.

To all whom it may concern:

Be it known that I, HAYNES K. FOOTE, a citizen of the United States, residing at Chicago Heights, Cook county, Illinois, have invented new and useful Improvements in Punch-Presses, of which the following is a specification.

My invention relates to an attachment for punch presses, adapted to a variety of uses, and the one which I have selected to illustrate my invention, discloses the attachment arranged to punch I-beams, T-beams, channel and angle irons.

The primary object attained is economy in labor and time consumed in operating on the work, and in the space occupied by the work, whereby an operator is enabled to perform a greater amount of work than heretofore, with less expenditure of time and strength, and without necessitating a large amount of storage space for the partially completed work.

My invention enables the operator to complete the work of punching structural iron of the above-named forms, at one pass through the machine.

Heretofore, in punching I-beams, for example, the machine was first set up, that is, the punches and dies were properly adjusted to punch holes in one flange of the beam, after which the beams were lifted to position one by one, and passed through the machine, one flange punched, and the beams taken off the machine and piled. After all the beams had had one of their flanges punched, they were again placed one by one on the machine, run through a second time to punch the remaining flange, and again piled. The operator then reset the machine to punch the webs, after which the beams were again placed on the machine one by one, passed through, punched, and lifted off for the last time when they were ready for use. Thus there were three lifting on operations, and three lifting off operations, besides the necessity for providing space in which to pile the partially completed beams, twice. Also, it will be noted that it required three passes through the machine to punch holes in both flanges and the web.

By the use of my invention, the machine is set up but once to punch holes in both flanges and in the web simultaneously, all holes being punched during one pass through the machine, so that the beam, after passing through the machine a single time, is ready for use and may be at once removed.

The points at which the holes are to be punched in the beam are gaged or located from the end of the beam, and heretofore, under the old method, when holes were punched in one flange at a time, if the end was not square, the holes in one flange would not be located in proper relation to those in the other flange, unless the operator took particular pains and consumed considerable time in adjusting the beam in the machine for each pass.

In my invention where the holes are punched simultaneously in both flanges, they must necessarily be in proper relation to each other regardless of whether the ends of the beam are square or not.

In my invention the beam as it is delivered from the machine after the first pass through, is ready to use, thus avoiding two handlings on the machine and two off, which were heretofore necessary, as well as saving the time then necessary to pass the work through the machine for the second and third operations.

T-irons can be run through the machine in pairs at one pass, in the same manner as an I-beam, whereas, by the old method, each T-iron had to be run through the machine twice with a resetting of the machine between the two passes. Thus my invention saves three handlings of material and one setting of the machine. Likewise, a similar economy is effected in punching angle irons, two of which can be completed at one pass through the machine, and with greater accuracy and less trouble than by the old method of punching one leg at a time.

Under the former method, when it was necessary to punch a number of holes close together, the material stretched when first passed through the machine, thus necessitating a re-adjustment of the work before being passed through a second time, and on such second run through the machine, the part already punched, stretched with the part punched on the second operation, which displaced the holes punched on the first operation. My invention avoids these disadvantages by punching all the holes at one time and with one adjustment.

I attain these and other objects by a novel

arrangement, and operation of punches and dies, and further advantages pertaining thereto, will be more fully disclosed hereinafter and particularly pointed out in the claims.

In the accompanying drawings, Figure 1 is a side view of an ordinary punch press equipped with one embodiment of my invention. Fig. 2 is an enlarged plan view, partly in section, showing the horizontal punch and die arrangement, and the means to operate the punches. Fig. 3 is a sectional plan view of the same structure. Fig. 4 is a detail perspective of one of the plungers or actuating members for the horizontal punches; Fig. 5 is a similar view of one of the cross heads, or punch carriers operated by said plunger. Fig. 6 is an enlarged side view of my invention, and Fig. 7 is an enlarged front view, partly in section, showing my invention combined with the ordinary vertical punch, and also illustrating the connection between the punch carriers and their plungers or drive members.

Referring to Fig. 1, A is a punch press of well-known type, the lower jaw 1 of which forms the usual die support, a vertically reciprocating working head 2 being fitted in the upper overhanging jaw 3, and operated in the usual manner (not shown) from the drive gear 4. A foot lever 5, clutch 6, and connections control the operation of the working head 2.

A chambered holder 7 (Figs. 6 and 7) is adjustably secured to the working head 2 by headed bolts 8 slidable in grooves 9 in the head. The lower end of the chamber in the holder 7, indicated by dotted lines 10 in Figs. 6 and 7, is partially closed or restricted by the lips 11, which support the heads 12 of vertical punch stems or posts 13 depending from the holders. Nuts 14 removably secure punches 15 to the lower reduced and threaded ends of the punch stems, in line with dies 16 (Fig. 7) mounted in die holders 17 adjustably secured by set screws 18 in die blocks 19, which in turn may be adjustably secured by set screws 20 in a grooved bed plate 21 mounted on the lower jaw or die support 1, of the punch press. Holes may be punched in the webs of I-beams, channel irons and other beams, by means of this vertical punch and die.

Heretofore, in punching the flanges of I-beams, for instance, the beam has been fed to the punches with its flanges in a horizontal plane and the web in a vertical plane. The upper horizontal flange was first passed beneath the vertically operating punches, and punched, after which the beam was turned over to bring the remaining flange uppermost and again passed through the machine and punched, and then, after the machine had been reset, the beam was passed through the machine for a third time, with its web in a horizontal position and its flanges vertical, so that holes could be punched in the web. By my method, the I-beam is passed through the machine but once, and at that time occupies a horizontal position, that is, the web lies in a horizontal plane and the flanges lie vertically. (Fig. 6)

To punch both right and left flanges at a single operation or simultaneously, I provide the punch press with a pair of oppositely located punch and die members, or blocks 22 adjustable horizontally toward and from each other on a bed plate 23 fastened in any convenient manner, to the die support 1 of the punch press. In the present instance, I have shown the bed plate fastened by screws 24 (Figs. 6 and 7), the blocks 22 being slidably mounted in a groove 25 on the bed plate 23 and held in adjusted position, when desired, by set screws 26. Each of these die blocks 22 are approximately C-shaped in side elevation, (Figs. 1 and 6) and have an upper jaw 27 and a lower jaw 28. As the die blocks are similar in construction, a description of one will suffice for both. The jaws approach each other quite closely, but are spaced far enough apart to accommodate webs of various thicknesses, and to permit the work to be shifted through the jaws. Each die block is preferably of sectional construction, as shown more particularly in Fig. 3, for convenience in manufacture and assembling, the sections being mortised as at 29, and firmly secured together by through bolts 30.

The respective inner faces of the sections are correspondingly laterally chambered as at 31 (Fig. 3) to form two chambers opening at their forward ends into the throat of the die block. Horizontally shiftable cross-heads or punch carriers 32 (Figs. 3 and 5) fit in the chambers, the outer faces of which cross heads project into the throats and are provided with vertically extending mortises 33 (Fig. 5). Punch holders 34 adjustable in the mortises, have threaded studs 35 on which the apertured punch nuts 36 are screwed to retain the headed punches 37 firmly against the studs. Each punch holder 34 preferably comprises a square base having two opposite sides beveled to fit the mortise 33. Set screws 38 secure the punch holders in adjusted position.

The punches 37 project horizontally from the back of the throat toward the inner faces of the upper and lower jaws 27 and 28, said jaws being provided with vertically extending mortises 39 parallel with and opposite to the mortises 33 in the cross heads or punch carriers. Die holders 40 whose bases are similar in shape to the punch holders 34, are adjustably secured in the mortises 39 by set screws 41, and are bored out to form seats for the dies 42, the jaws having open slots 43, parallel and communicating with the

mortises 39 to allow the punchings to drop out, the die holders being apertured, as at 44 (Fig. 3) in registry with the dies.

The mortises 33 extend through the top faces of the die blocks 22 as at 33′ (Fig. 2) to facilitate the insertion and removal of the punch holders 34, such mortise openings being extended as at 33ª, to accommodate the threaded studs 35. Similarly, the mortises 39 extend through the upper faces of the die blocks to facilitate the insertion and removal of the die holders 40.

Plungers or actuators 45 (Fig. 4) having inclined faces 46 at their lower ends, enter vertical apertures 47 formed in the upper faces of the die blocks 22 directly behind the inner ends of cross-heads 32, and in communication with the rear ends of the chambers 31 containing the cross heads. The tapered faces 46 contact complementary inclines 48 on the rear ends of the cross heads and exert a wedging action thereagainst, to slide the cross heads 32 outwardly and force the punches 37 into the dies 42. Ways 49 projecting from opposite sides of the base of each cross head 32 travel in grooves 50 in the die blocks to guide the punches in a true horizontal reciprocation.

The upper ends of the plungers 45 enter slots 51 in the chambered holders 52, which holders are adjustably secured to the working head 2 by bolts 53 passing through flanges 54 of the holders. The upper ends of the plungers are headed, as at 55 and are slidable in the chambers 52′ of the holders 52 from the open ends thereof, (shown in dotted lines, Fig. 6) the heads 55 resting upon the lips 56 (Fig. 7) forming the walls of the slots 51. Filler pieces 57 having handles 58 are insertible in the holders above the heads of the plungers to form a non-yielding backing therefor. Similar filler pieces 59 (Figs. 6 and 7) are insertible above the heads 12 of the vertical punch stems 13 for a similar purpose. When it is desired to render any punch 15 or plunger 45 inoperative, it is merely necessary to withdraw the filler piece 57 or 59, the height of the chambers in the holders being substantially equivalent to the operative stroke of the working head 2.

As the working head 2 drops, it drives the plungers 45 downwardly in the apertures 47 in the die blocks 22 and thrusts the inclined faces 46 of such plungers against the complementary inclined faces 48 of the punch carriers 32, to force the punches 37 horizontally against the work. The return stroke of the working head draws the plungers or actuators 45 upwardly with it. Inclined grooves 60 (Fig. 4) parallel with and behind the inclined face 46 of each actuator accommodate similarly inclined ways 61 (Fig. 5) formed on the inner side walls of the rear ends of the cross heads 32, which walls embrace the actuators, so that as the latter are withdrawn, the inclination of the ways 61 operates to retract the cross heads 32 and their punches 37 from the dies. The overhanging shoulders 22′ (Fig. 7) of the die blocks coöperate with the ways 49 and grooves 50 to restrain the punch carriers from rising with the plungers 45. Vertically extending lateral flanges 62 on the plungers or actuators travel in vertical grooves 63 formed in the die blocks 22, to guide the actuators and prevent them from binding. The central section of the die block 22 projects forwardly into the throat to form a vertical stripper 64 to strip the work from the punches. Shoes 67 may be removably secured to the strippers 64 by bolts 68 to provide more or less clearance between the work and the dies.

The operation and method of use of my invention is as follows: To punch both the flanges and the webs of I-beams at one operation, the horizontal punches 37 and the vertical punches 15, as well as the dies 42 and 16 are properly adjusted to punch the required holes in the proper locations, relatively to the work and to each other. The I-beam is then inserted endwise in the machine, the web 65 (Fig. 6) being horizontal and projecting between the upper and lower jaws 27 and 28 of the respective oppositely-located die blocks 22, which have been adjusted so that the vertically disposed flanges 66 at the opposite edges of the web enter the throats of the respective die blocks, sufficient clearance being left between the flanges and the inner faces of the jaws to permit the I-beam to be easily fed or passed through the machine. The die blocks 22 are not fastened to the bed plate when punching I-beams, but are free to slide horizontally.

When the beam has been brought to the point where the first punching is to be made, the plunger head 2 is lowered, which will force the vertical punches 15 through the web 65 and into their dies 16 in the usual manner. At the same time, the actuators 45 move downwardly in the vertical apertures 47 of the die blocks with their inclined faces 46 in contact with the complementary faces 48 of the cross heads or punch carriers 32, to thrust the cross heads out of the die blocks until the punches 37 contact the flanges 66 of the I-beam. Further pressure of the actuators against the cross-heads, operates to separate or shift the die blocks 22 apart from each other and relatively to the cross heads, until the inner faces of the upper and lower jaws 27 and 28 of the die blocks contact the inside faces of the flanges 66 of the I-beam, to thereby bring the dies flush against one face of the work and back it against bending, while the punches 37 press against the opposite side of the work. The opposed pressures or pull exerted by the

jaws of the opposite die blocks 22 on the flanges 66 hold the beam firmly against displacement. This method also effects an automatic adjustment of the punches and dies to accommodate any variation in the thickness of the work. The plungers or actuators shift with the die blocks in effecting this adjustment, such slight movement being permitted by allowing a clearance in the holders 52 relatively to which the heads 55 shift. Continued pressure of the actuators, forces the punches 37 through the flanges 66, and substantially simultaneously therewith, the punches 15 pierce the web 65. Raising the working head 2 withdraws the plungers or actuators 45, the first effect of which is to draw the die blocks 22 toward each other until the strippers 64 strike the flanges 66. Further return movement of the plungers 45 then effects the withdrawal of the punches 37 from the work.

By thus shifting the die blocks toward each other, sufficient clearance is afforded between the dies 42 and flanges 66 to enable the beam to be fed along until in position for the next punching operation. If no clearance was afforded, the burs struck up by the punches, would cause the beam to stick to the dies. The thickness of the shoes 67 on the strippers regulates the amount of clearance permitted between the work and the dies. The punches 37 are withdrawn behind the vertical plane of the strippers 64 so as to be out of the way.

The removable filler blocks 57 and 59 enable me to control the operation of the several punches 15 and 37. By removing such filler blocks from above the heads of the plungers 13 and 45, no pressure is transmitted to the latter when the working head 2 descends. Thus I can operate the cross heads individually or in any combination.

It is obvious that channels, angle and T-irons can be punched on the same die blocks. The die blocks can be varied in construction and a smaller number of punches and dies mounted therein, thus permitting their use in smaller machines for punching this kind of material. Where only one angle iron is to be punched at a time, a single die block would be sufficient, which would be secured against shifting, during the punching operation.

Obviously, the invention is adapted for all sorts of punching where lateral or horizontal punches can operate, and I have merely selected one of the many embodiments in which my invention may be incorporated.

Changes other than those referred to, may be made in the form and arrangement of the several parts set forth without departing from the spirit and scope of the invention.

What I claim as new, is:—

1. In a punch press, the combination with a working head; of a die block and die shiftable relatively to the work during a punching operation, to contact the die with the work; a punch carrier and punch shiftably supported in the die block for movement relatively thereto during the punching operation; and means driven by the working head to shift the die block and punch carrier alternately and simultaneously.

2. The combination with a punch press having a vertically-operable working head; of a chambered gage holder connected to the head; a punch-operating means supported in the gage holder; and a filler piece removably entered in the gage holder in contact with the punch-operating means to prevent independent movement of the head relatively to said means.

3. The combination with a punch press having a vertically-operable working head; of a gage holder attached to the head; a punch operating means supported in the gage holder, and adapted for lateral movement relatively thereto; a die block; a cross head in the die block engaged by the punch-operating means and movable relatively to the die block in a direction at an angle to the direction of travel of the punch-operating means; dies in the die block; and punches carried by the cross head to coöperate with the dies.

4. The combination with a punch press having a reciprocatory working head; of a punch carrier shiftable in a direction at an angle to the direction of travel of the head; a punch mounted in the carrier; a shiftable die block in which the punch carrier is supported; a die mounted in the block; and means operated by the working head to effect the automatic adjustment of the punch and die relatively to the work; and to drive the punch through the work.

5. The combination with a punch press having a reciprocatory working head; of die blocks and dies shiftable by the working head, in a direction at an angle to the direction of travel thereof, and relatively to the work, to automatically adjust themselves to the work, during the punching operation; and punches operated by the working head, in a direction at an angle to the direction of travel of the working head, to coact with the dies.

6. The combination with a punch press having a reciprocatory working head; of die blocks shiftable relatively to the work; cross heads mounted in the die blocks and shiftable at an angle to the direction of travel of the head; and means operated by the working head to shift the cross heads, and die blocks successively.

7. The combination with a punch press

having a reciprocatory working head; of a cross head shiftable in a direction at an angle to the direction of travel of the working head; a die block chambered to accommodate the cross-head; and means operated by the working head and slidably connected with the cross-head to advance and withdraw the latter relatively to the die block.

8. The combination with a punch press having a reciprocatory working head; of a die block having a throat inclosed by upper and lower jaws; dies adjustably mounted on the inner faces of the jaws; a cross head supported in the die block and adapted to shift toward and from the jaws; punches adjustably mounted on the outer face of the cross-head, to coöperate with the dies; and means operated by the working head to advance the cross head toward and retract it from the dies.

9. The combination with a punch press having a reciprocatory working head; of a die block having a throat inclosed by upper and lower jaws; dies adjustably mounted on the inner faces of the jaws, said jaws being slotted to permit the escape of the punchings; a cross head supported in the die block and adapted to shift toward and from the jaws; punches adjustably mounted on the outer face of the cross-head, to coöperate with the dies; and means operated by the working head to advance the cross head toward and retract it from the dies.

10. The combination with a punch press having a reciprocatory working head; of a die block having a jaw; a die mounted in said jaw; a cross head shiftably mounted in the die block to move in a direction at an angle to the direction of travel of the working head; means to guide the cross head, a punch secured to the cross head; and means operated from the working head to drive the punch through and withdraw it from the work.

11. The combination with a punch press having a reciprocatory working head; of opposed die blocks having throats adapted to accommodate the work; dies on the die blocks; said die blocks being shiftable toward and from each other during a punching operation; cross heads shiftably supported in the die blocks; punches secured to the cross heads; and means operated by the working head to drive the punches against the work, and to shift the die blocks to cause the dies to contact the work.

12. The combination with a punch press having a reciprocatory working head; of opposed die blocks having throats adapted to accommodate the work; dies on the die blocks; said die blocks being shiftable toward and from each other during a punching operation; cross heads shiftably supported in the die blocks; punches secured to the cross heads; and means operated by the working head to shift the dies and punches relatively to the work to clamp the work in place during the punching operation, and to release the work after such operation to enable it to be fed through the die blocks.

13. The combination with a punch press having a reciprocatory working head; of opposed die blocks having throats adapted to accommodate the work; dies on the die blocks; said die blocks being shiftable toward and from each other during a punching operation; cross heads shiftably supported in the die blocks; punches secured to the cross heads; means operated by the working head to drive the punches against the work, and to shift the die blocks to cause the dies to contact the work; and strippers carried by the die blocks to enable the disengagement of the punches and work.

14. The combination with a punch press having a reciprocatory working head; of a punch carrier shiftable at an angle to the direction of travel of the working head, the carrier having an inclined face; a plunger operated by the working head and having a similarly inclined face to advance the punch carrier in one direction; said plunger having inclined grooves; and similarly inclined ways on the carrier entered in the grooves to permit said plunger to retract the carrier as the working head returns to normal position.

15. The combination with a punch press having a reciprocatory working head; of a punch carrier shiftable at an angle to the direction of travel of the working head, the carrier having an inclined face; a plunger operated by the working head and having a similarly inclined face to advance the punch carrier in one direction; said plunger having inclined grooves; similarly inclined ways on the carrier entered in the grooves to permit said plunger to retract the carrier as the working head returns to normal position; and means to guide the punch carrier during its advance and retraction.

16. In a punch press, the combination with a reciprocatory working head; of opposed die blocks, upper and lower jaws on each block, spaced apart from each other and inclosing a throat; dies on the inner faces of the respective jaws; strippers in said throats; the die blocks shiftable toward and from each other during a punching operation; punch carriers shiftably mounted in the respective die blocks; punches secured to the carriers; and means operated by the working head to shift the punch carriers to contact the punches with the work; and then shift the die blocks apart relatively to the work to bring the dies against the work and

hold the work in place, between the dies and punches.

17. The method of simultaneously punching the web and flanges of structural iron work at one pass through the machine, comprising passing the work between vertical, and opposed horizontal punches, and first, in forcing the horizontal punches against the work; secondly, while the punches still engage the work, in separating the die blocks relatively to the work to bring the dies against those faces of the work opposite the punches; third, in forcing the punches through the work; fourth, in shifting the die blocks toward each other relatively to the work to free the work from the dies; and fifth, in disengaging the punches and work.

18. The combination in a punch press having a reciprocatory working head; of a die block, having a jaw; a cross head shiftably mounted in the die block, a punch carried by the cross head; a die carried by the inner face of the jaw; means operated by the working head to advance the cross head and punch toward and retract it from the die, and a stripper projecting toward the jaw and against which the work contacts on the withdrawal of the cross head.

19. The combination with a punch press having a reciprocatory working head; of opposed die blocks having throats adapted to accommodate the work; dies mounted in the die blocks; said die blocks being shiftable relatively to the work during a punching operation; and punches carried by the die blocks and operated by the working head on its drive stroke, to force the punches against the work and thereby shift the die-blocks apart relatively to the work, to clamp the work between the punches and dies before the punching takes place.

20. The combination with a punch press having a reciprocatory working head; of opposed die blocks having throats adapted to accommodate the work; dies mounted in the die blocks; said die blocks being shiftable relatively to the work during a punching operation; and punches carried by the die blocks and operated by the working head on its drive stroke to force the punches against the work and thereby shift the die blocks apart relatively to the work, to clamp the work between the punches and dies before the punching takes place; and strippers on the die blocks, adapted to contact the work on the return stroke of the working head, which shifts the die blocks toward each other, to enable the withdrawal of the punches, and to afford clearance between the work and the dies to enable the work to be adjusted for the next operation.

21. In a punch press, the combination of a die block having upper and lower jaws; a punch carrier shiftable across the throat of the block; dies on the inner faces of the jaws opposite the punch carrier, the dies located above and below the mouth of the block; and means to operate the punch carrier.

22. In a punch press, the combination with a working head; of a die block, having upper and lower jaws between which is a mouth communicating with the throat of the block; a punch carrier slidably mounted in the body of the block and shiftable across the throat; punches in the carrier; dies fixed in the inner faces of the jaws opposite the punches, and on opposite sides of the work-receiving mouth of the block; and a stripper projecting from the back wall of the throat toward the mouth.

23. The combination with a punch press; of a die block, having upper and lower jaws between which is a mouth communicating with the throat of the block; the upper and lower jaws having grooves formed therein; and die holders adjustably secured in the grooves; dies in the holders; the jaws also having slots connecting with the grooves and leading to the outer sides of the jaws to permit the punchings to escape.

24. The combination with a punch press; of a die block, having upper and lower jaws between which is a mouth communicating with the throat of the block; the upper and lower jaws having grooves formed therein to accommodate the dies, which grooves extend through the respective jaws to enable the dies to be placed and removed.

25. The combination with a punch press having a working head; of an actuator driven by the head; a die block entered by the actuator; a punch carrier slidable in the die block and advanced and retracted by the actuator; ways on the punch carrier traveling in grooves in the die block; and shoulders on the die block overlying the carrier to guide the carrier in a rectilinear direction.

26. The combination with a punch press having a bed plate; and a working head; of oppositely-located die blocks mounted on the bed plate to slide toward and from each other; the die blocks provided with jaws to accommodate flanged work; dies mounted in the jaws; punch carriers and punches shiftably mounted in the die blocks; and actuators driven by the working head to operate the die blocks and punches successively, during a punching operation.

27. The combination with a punch press, having a working head operable toward and from the work; of a die block and a die actuated by the working head in a straight line toward and from the work, during the punching operation, the directions of travel of the die block and working head being at an angle to each other to coöperate with different sides of the work, respectively; and punching means to coact with the die.

28. In a punch press, the combination

with a working head; and a punch driven thereby in a rectilinear path at an angle to the path of travel of the working head; of a die block with which the punch coacts, and which is adapted to be shifted relatively to the work, by the working head, during a punching operation, and in a direction coincident with the travel of the punch.

29. The combination with a punch press having a working head and a punch carried thereby to act upon one face of an angular work piece; of a die block and die shiftable in a rectilinear path during a punching operation, at an angle to the path of the working head to contact another face of the work piece; a punch coöperating with the die; and means to actuate the die block and punch from the working head.

30. In a punch press, the combination with a working head; of a die block and die shiftable relatively to the work during a punching operation, to contact the die with the work; a punch carrier and punch shiftably mounted in the die block for movement relative thereto, during the punching operation; and means driven by the working head on its outward stroke, to operate the punch carrier and die block successively, and on its return stroke to operate the punch carrier and die block simultaneously.

31. In a punch press, the combination with a working head; of a slidably mounted die block having a throat and a jaw to restrict the mouth of the throat; a die on the inner face of the jaw; and a punch carrier and punch shiftably supported in the die block and reciprocated by the working head across the throat of the die block to coact with the die.

32. In a punch press, the combination with a working head; of a slidably mounted die block having a throat; opposed jaws to restrict the mouth of the throat; dies on the inner faces of the jaws; and a punch carrier and punch shiftably supported in the die block and driven by the working head, back and forth across the throat to coact with the die.

33. The combination with a punch press, having a working head; of opposed die blocks; punch carriers mounted therein; the die blocks and punch carriers being assembled for mutual movement relatively to each other; and means driven by the working head to move the punches toward each other and the die blocks away from each other during a punching operation.

34. The combination with a punch press, having a working head; of opposed die blocks; punch carriers mounted therein; the die blocks and punch carriers being assembled for mutual movement relatively to each other; and means driven by the working head to move the punches toward each other and the die blocks away from each other during a punching operation, and to move the die blocks toward each other as the punches are retracted from the work.

35. The combination with a punch press having a working head; of opposed die blocks; punch carriers and punches mounted for independent movement in the die blocks; and means operated by the working head to operate the punch carriers against the work relatively to the die blocks, and to subsequently shift the die blocks relatively to the work to clamp the work in place.

36. The combination with a punch press having a working head; of opposed die blocks; punch carriers and punches mounted for independent movement in the die blocks; and means driven by the working head and associated with the punch carriers and blocks to operate the punches, and shift the die blocks toward each other to release the work, as the punches are withdrawn from the work.

37. The combination in a punch press; of a die block carrying a die and shiftable during a punching operation to bring the die into contact with the work and subsequently to disengage the die from the work; and punching means mounted in the die block, the punching means and die block being relatively and respectively shiftable.

HAYNES K. FOOTE.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."