April 27, 1943. G. F. WALES 2,317,424

APPARATUS FOR PERFORATING SHEET MATERIAL

Filed March 12, 1942 4 Sheets-Sheet 1

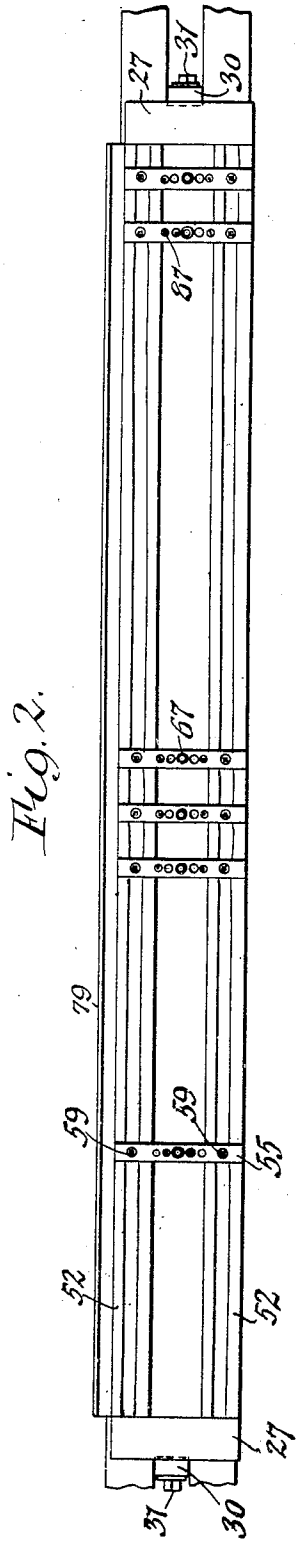


Fig. 2.

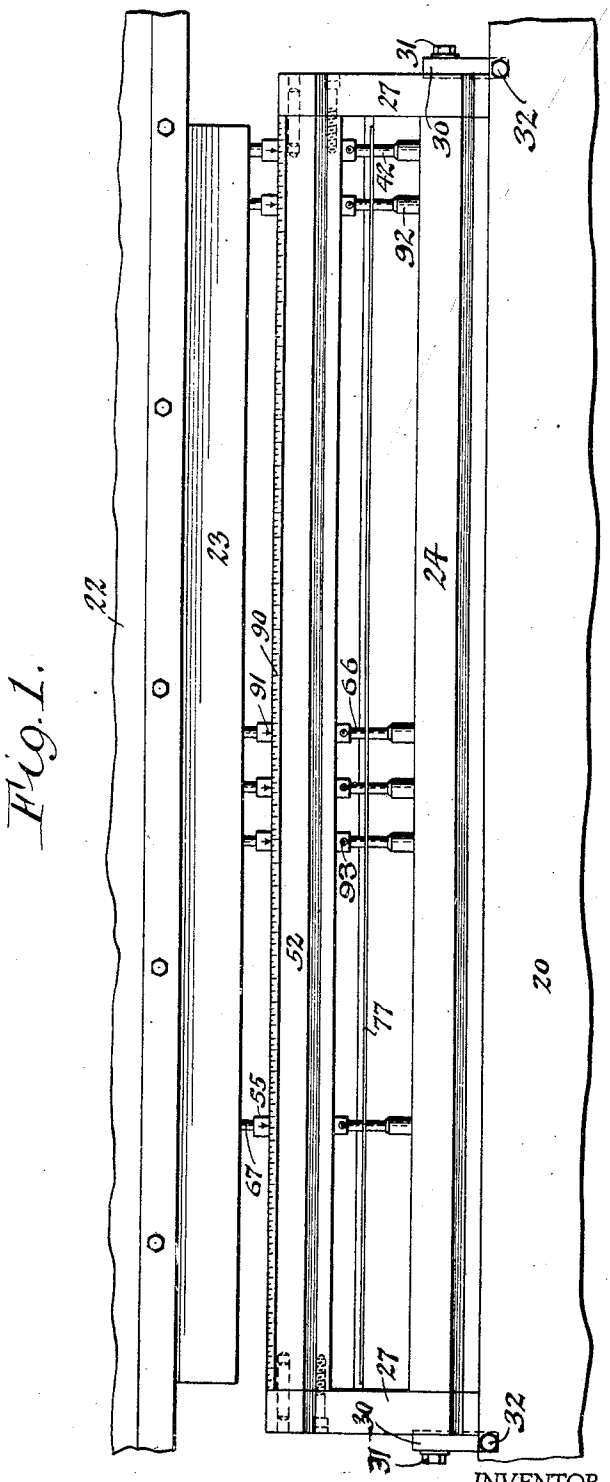


Fig. 1.

INVENTOR.
George F. Wales
BY
ATTORNEYS

April 27, 1943. G. F. WALES 2,317,424

APPARATUS FOR PERFORATING SHEET MATERIAL

Filed March 12, 1942 4 Sheets-Sheet 2

Fig. 3

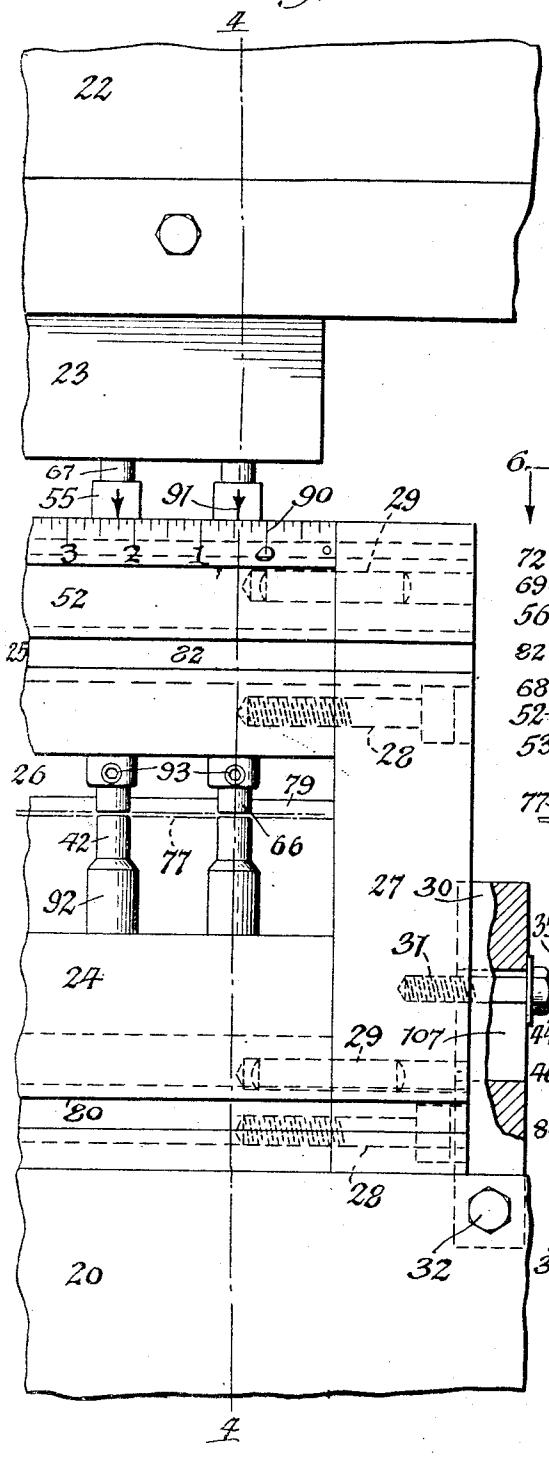
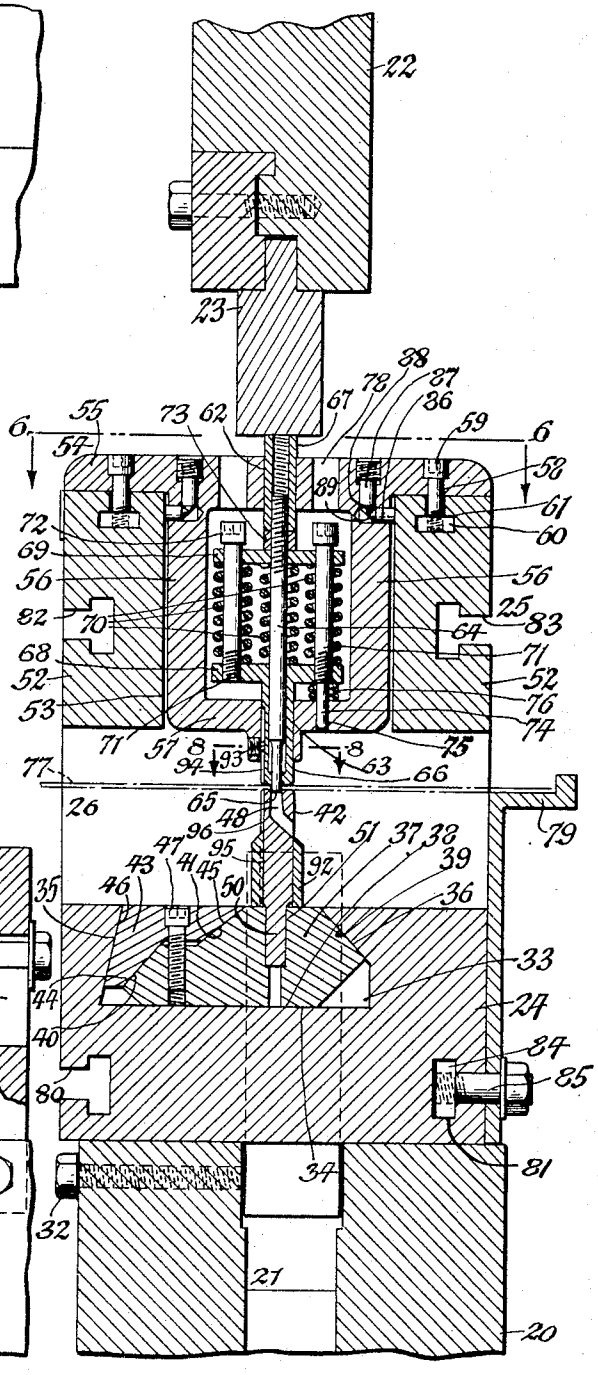


Fig. 4.



INVENTOR.

George F. Wales

BY Pollock & Pollock

ATTORNEYS

April 27, 1943. G. F. WALES 2,317,424

APPARATUS FOR PERFORATING SHEET MATERIAL

Filed March 12, 1942 4 Sheets-Sheet 3

Fig. 5.

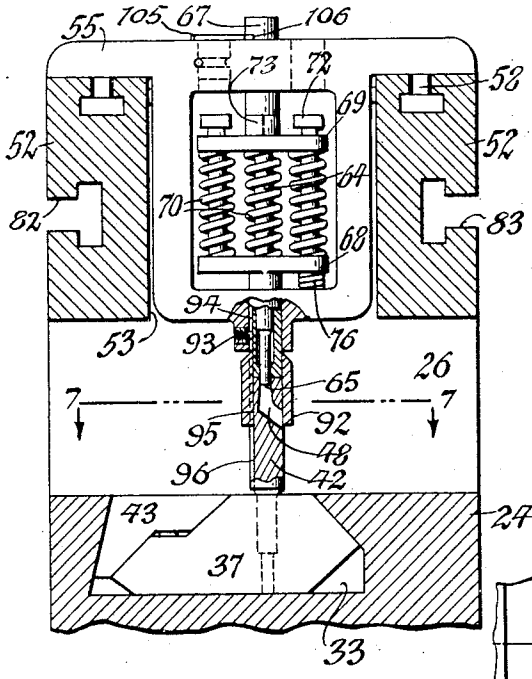


Fig. 6

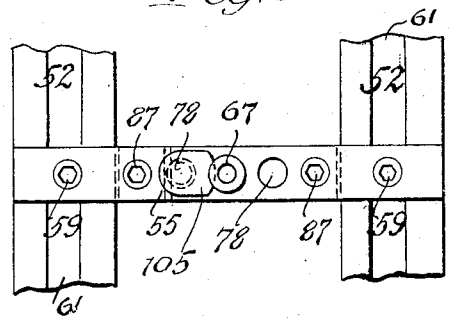


Fig. 7.

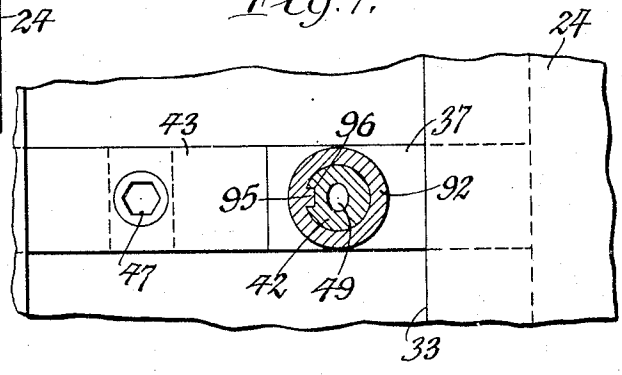


Fig. 9.

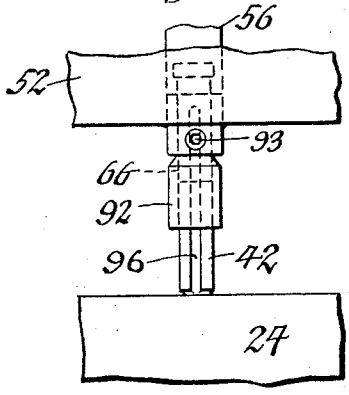
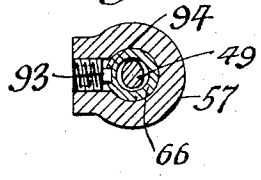


Fig. 8.



George F. Wales INVENTOR.

BY Toulmin & Toulmin

ATTORNEYS

April 27, 1943. G. F. WALES 2,317,424

APPARATUS FOR PERFORATING SHEET MATERIAL

Filed March 12, 1942 4 Sheets-Sheet 4

Fig. 10.

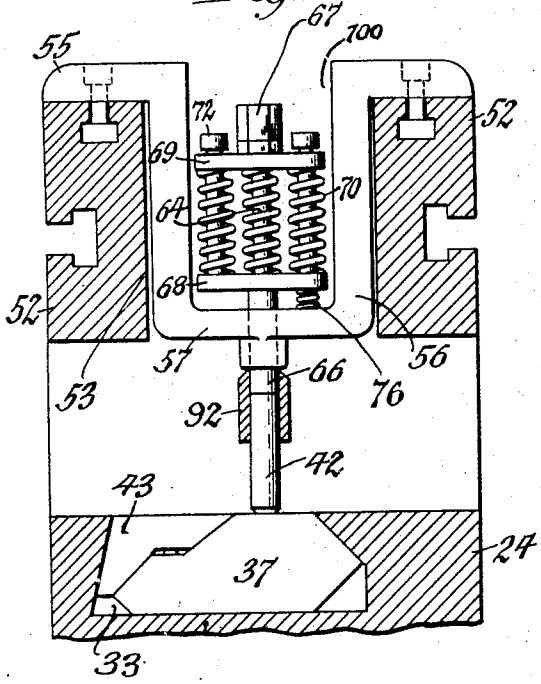


Fig. 12.

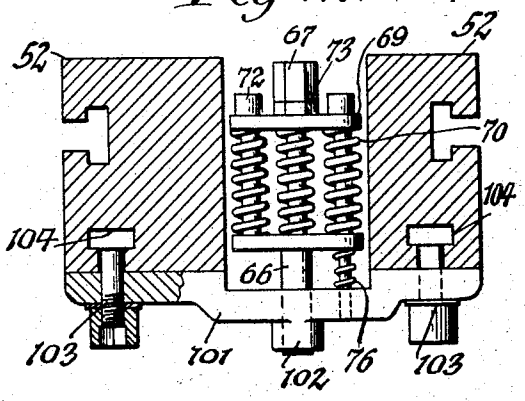


Fig. 13.

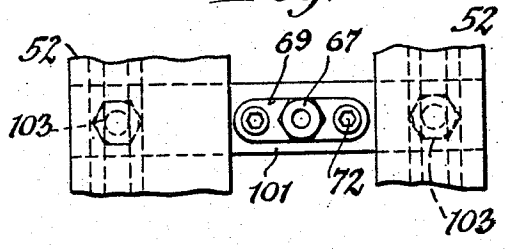


Fig. 11.

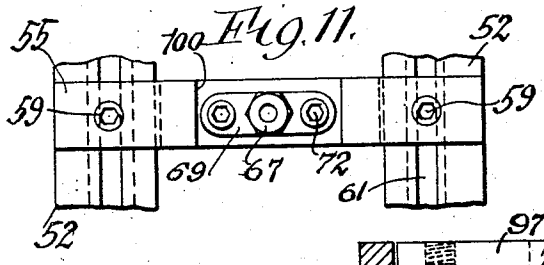


Fig. 14.

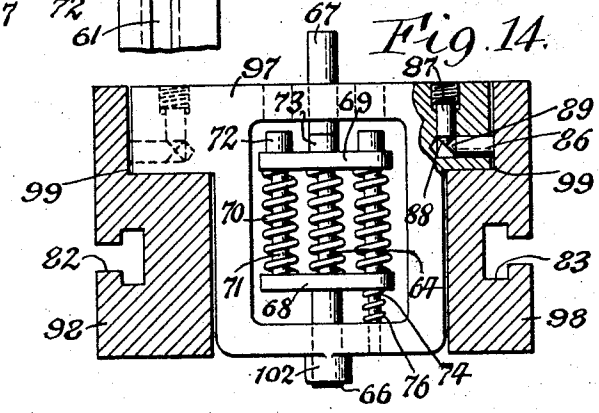
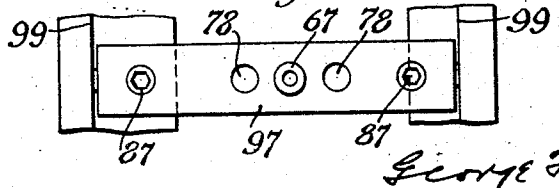


Fig. 15.



INVENTOR.
George F. Wales
BY Pope & Pope
ATTORNEYS

Patented Apr. 27, 1943

2,317,424

UNITED STATES PATENT OFFICE

2,317,424

APPARATUS FOR PERFORATING SHEET MATERIAL

George F. Wales, Kenmore, N. Y.

Application March 12, 1942, Serial No. 434,376

19 Claims. (Cl. 164—94)

This invention relates to a punching apparatus for perforating sheet material and more particularly to an apparatus of this character which is designed for perforating large sheets of metal which must pass through the apparatus from the front to the rear side of the same, although the same may also be used for perforating small sheets of like material.

The principal object of this invention is to provide a self-contained punching assemblage which includes a frame having an opening or gap extending from its front side to its rear side for the passage of a sheet or workpiece, a plurality of die sections adjustable lengthwise on the lower part of the frame, and a plurality of punch sections adjustable lengthwise on the upper part of the frame and having stripping means, said assemblage being movable into and out of an operative position between the bed and ram of any press and capable of being operated for perforating sheets or workpieces without requiring any connection between this punching assemblage and the ram and bed of the press.

A further object is to provide a punching apparatus having a plurality of perforating units, each of which has a punching section which practically floats on the upper part of the punching frame relative to the companion die section fixed on the lower part of this frame and in which any of the punch sections can be lifted from the top of the punching frame as a complete setup for the purpose of servicing the same or effecting adjustments.

Another object of this invention is to so construct each punching or perforating unit that the die section and the punch section are mounted on the lower and upper supporting rails or parts of the press in such manner that the sheets to be perforated can be freely passed between them from the front to the rear side of the press and yet permit the die and punch of each unit to cooperate properly for producing a perforation in the desired part of the work sheet.

Another object of the invention is to provide means for mounting the die and punch sections of each unit quickly and conveniently on any part of the lower and upper rails to suit the respective location where the work sheet is to be perforated.

A still further object of this invention is to provide simple and efficient means whereby the die and punch sections of each perforating unit may be adjusted lengthwise of the upper and lower rails of the press frame and the centers of the die and punch maintained in accurate alinement during such adjustment and thereby facilitate the change from one location of the perforation in the work sheet to another location to suit different requirements.

Other objects of this invention relate to certain details of construction as will presently appear.

In the accompanying drawings:

Fig. 1 is a front elevation of a perforating apparatus embodying one form of this invention and the adjacent parts of a press in which the same is mounted.

Fig. 2 is a top plan view of a plurality of punching devices, the top rail carrying the same, and parts associated therewith.

Fig. 3 is a fragmentary front elevation, on an enlarged scale, of two punching units, similar to those shown at the right end of the apparatus shown in Fig. 1.

Fig. 4 is a vertical section taken on line 4—4, Fig. 3, and showing the parts in the position which they occupy while perforating a work sheet, the catch element for holding the punch in its elevated position being omitted.

Fig. 5 is a similar view showing the means whereby the die and punch of a unit are coupled so as to permit of adjusting the same into different positions lengthwise of the respective supporting rails of the press frame without disturbing the alinement of the die and punch of this unit.

Fig. 6 is a top plan view of the punch section of one of the perforating units and the upper part of the upper rail of the press frame, said view being taken on line 6—6, Fig. 4.

Fig. 7 is a horizontal section, on an enlarged scale, taken on line 7—7, Fig. 5.

Fig. 8 is a horizontal section, on an enlarged scale, taken on line 8—8, Fig. 4.

Fig. 9 is a fragmentary front elevation of the parts shown in Fig. 5.

Fig. 10 is a section similar to Fig. 5 but showing a modified form of this invention.

Fig. 11 is a top plan view of the construction shown in Fig. 10.

Fig. 12 is another section similar to Figs. 5 and 10 showing another modification of this invention.

Fig. 13 is a top plan view of the construction shown in Fig. 12.

Fig. 14 is a section similar to Figs. 5, 10 and 12 showing still another form of this invention.

Fig. 15 is a top plan view of the construction shown in Fig. 14.

In the following description similar reference characters indicate like parts in the several figures of the drawings.

Inasmuch as this invention may be employed in connection with power presses of various constructions it is sufficient to illustrate only those elements of a press with which the present improvements are directly associated which elements consist of a bed or base 20 which forms a lower part of the stationary main frame of the press and is provided with a longitudinal slot 21, a vertically movable ram 22 which is guided on the upper part of the frame and may be reciprocated by any suitable means, and a pressing bar 23 secured to the underside of the ram.

In general the improvements forming the subject of this invention include a holder detachably mounted on the bed or base of the frame, and one or more punching units each having a die section mounted on the lower part of the holder and a punch section mounted on the upper part of the holder and adapted to be actuated by the pressing bar of the ram.

In its preferred construction the holder comprises a lower horizontal rail 24 which rests on the upper side of the bed 20, an upper horizontal rail 25 arranged above the lower rail and spaced therefrom by a horizontal gap 26, and upright posts or bars 27 connected at their respective upper and lower ends with the corresponding ends of the upper and lower rails.

Each of the posts of the holder may be detachably connected at its lower and upper ends with the corresponding ends of the lower and upper rails by any suitable means but preferably by screws 28 and dowels 29, as shown in Fig. 3. The holder may also be detachably connected with the bed of the frame by various means, those shown in Figs. 1, 2, 3 and 4 being preferred and consisting of upright retaining bars 30 having their upper ends secured by screws 31 to the outer sides of the posts 27 while the lower ends of the same are arranged in the slot 21 of the bed and secured therein by clamping screws 32. The form of holder and the means for mounting the same on the frame permits readily attaching the holder and the parts carried thereby on the press frame and also detached therefrom for convenience in arranging the punching units thereon.

The construction of the die section of each punching unit and the means for mounting the same on the lower rail of the holder in accordance with this invention as shown in Figs. 1–11 is as follows:

The numeral 33 represents a horizontal adjusting groove formed lengthwise in the upper side of the lower rail 24 and having a flat bottom 34 and opposite front and rear longitudinal sides 35, 36 which are inclined and converge upwardly so that this groove is of substantially fan tail or undercut form, as best shown in Fig. 4. Within this groove is arranged a shoe 37 which is part of the respective die section and which is provided with a flat underside 38 resting on the bottom 34 of the adjusting groove 33, a tapering rear end forming a rearwardly inclined face 39 engaging with the inclined rear side 36 of the adjusting groove, a forwardly tapering lower part forming a lower inclined front face 40, and an upper front recess forming a forwardly inclined front face 41 on the shoe. This shoe may be readily introduced into the adjusting groove 33 and also removed from the top of the groove by tilting the same the required extent and it may also be moved lengthwise in this groove for bringing the die mounted thereon into the desired position relative to the companion section of the respective punching unit. After the shoe has been moved into the desired position on the lower rail of the holder this shoe may be held rigidly against displacement by a clamping block 43 provided with a lower front incline 44 engaging with the lower front incline 40 of the respective shoe, an upper rear incline 45 engaging with the upper front incline 41 of the shoe and a front incline 46 engaging with the front incline 35 of this adjusting groove. The clamping block 43 and the shoe are connected by a clamping screw 47 which upon being tightened will produce a wedge action between the cooperating inclines of the shoe and the lower rail and between the clamping block, shoe and lower rail, whereby the shoe will be reliably held against movement on the lower rail of the holder. In the form of the die shown in Figs. 1, 3 and 4, the same comprises an upper vertical cylindrical body 42 which contains a die opening 48 extending from the upper cutting edge of the die downwardly and laterally to a side part thereof and a stem 50 arranged at the lower end of the body 42 and seated in an opening or recess 51 in the top of the shoe 37. The lower part of the die opening 48 forms a chute for the discharge of slugs which are formed by the material removed from the workpiece when punching a hole in the same.

The construction of the punch section of each perforating unit and the manner of mounting the same in accordance with that form of the invention shown in Figs. 1, 2, 3 and 4 is as follows:

The upper rail 25 preferably comprises two horizontal bars 52 which are spaced apart laterally to form a longitudinal slot 53 between them. The numeral 54 represents a carrier which supports the punch cooperating with the die 42 and the parts associated with the punch. This carrier comprises an upper cross bar 55 which rests with its opposite ends on the bars 52 of the upper rail and extends across the slot between the same, two vertical side bars 56 extending downwardly from the upper cross bar along the inner side of the longitudinal bars 52 and a lower cross bar 57 connecting the lower ends of the side bars 56. This punch carrier is capable of being adjusted lengthwise of the upper rail 25 and secured in its adjusted position by means consisting preferably of two clamping bolts 58 passing through the front and rear ends of the upper cross bar 55 and having the heads 59 at their upper ends bearing against the upper side of this bar while the screw nuts 60 at their lower ends are arranged in T-shaped grooves 61 arranged lengthwise in the upper side of the bars 52 forming the upper rail of the holder. In their central parts the upper and lower cross bars of the punch carrier are provided with guide openings 62, 63 which are vertically in line. Centrally within the punch carrier is arranged a punch 64 which is provided at its lower end with a bit 65 which cooperates with the opening in the die and has its upper end screw threaded externally. The lower part of the punch slides vertically in a lower stripper and guide sleeve 66 and the latter slides vertically in the lower guide opening 63 of the punch carrier. At its upper end the punch is provided with an upper guide sleeve 67 which is threaded internally and adjustable vertically on the punch by engagement with the thread on the upper end of the

latter. The upper guide sleeve slides vertically in the upper guide opening 62 of the punch carrier and is adapted to be engaged at its upper end by the pressing bar 23 of the ram.

Work stripping means are associated with the punch and its carrier, which means preferably have a lower lifting bar 68 connected with the upper end of the lower punch guide sleeve 66, an upper lifting bar 69 which slides on the upper part of the punch, stripper springs 70 interposed under an initial compression between said lower and upper lifting bars, and tying means which limit the separation of said lifting bars under the expansion action of said stripper springs and which preferably consist of tie rods or bolts 71 connected by screw joints at their lower end with the lower lifting bar 68 and are provided with upper stop heads 72 adapted to be engaged by the upper side of the upper lifting bar 69. The allover length of the punch may be adjusted by screwing the upper guide sleeve 67 up or down on the punch and after such adjustment this sleeve and the punch may be retained in this relative position by means of a clamping screw nut 73 arranged on the upper threaded part of the punch between the upper lifting bar 69 and the upper guide sleeve 67. The lifting bars, stripper springs and tie rods are maintained in a plane parallel with the bars of the punch carrier by means of a pilot or retaining pin 74 projecting downwardly from the lower lifting bar 68 and sliding in a guide opening 75 in the lower carrier bar 57, as shown in Fig. 4. The punch and the stripper mechanism are yieldingly held in their uppermost or retracted position by resilient lifting means consisting preferably of a helical lifting spring 76 interposed between the lower carrier bar 57 and the lower lifting bar 68 and surrounding the pilot pin 74.

Preparatory to operating the punching apparatus the upper and lower sections of the several punching units are moved lengthwise on the rails of the holder to the positions for forming holes in the predetermined locations on the workpiece and then the companion sections of each unit are secured in place so that the punch of each unit is axially in line with the die of the respective unit.

When the ram of the press is elevated the stripper springs are expanded until the upper lifting bar engages the upper heads of the tie rods whereby the punch is raised so that its bit is raised flush, or substantially so, with the lower end of the guide sleeve 66 and the punch together with the stripper mechanism is raised by the lifting spring 76 so as to form a gap between the die and punch of each perforating unit. The workpiece 77 is now placed upon the dies of the several units and the ram descends and by engagement with the adjusting sleeve 67 moves the punch and associated parts of each perforating unit downwardly. During the initial part of the downward movement of these parts the same move in unison until the stripper guide sleeve 66 engages with the top of the workpiece but the final part of the downward movement of the punch is effected independently of the stripper guide sleeve and while the latter is at rest, thereby causing the bit of the punch to form a hole in the workpiece and push the slug severed from the workpiece at this time downwardly into the opening of the die. During the final part of the downward movement of the punch the compression of the stripper springs and the lifting spring is increased. As the ram rises and relaxes its pressure on the punch, the latter rises with the ram but the stripper sleeve 66 remains at rest in its lowermost position during the initial part of this upward movement of the ram, thereby causing the workpiece to be stripped from the punch until the stripper springs have reached the limit of their expansion. Thereafter the stripper mechanism and the punch are raised by the lifting spring 76 to form a gap between the die and punch of the respective punching unit, thereby permitting shifting of the workpiece into another position or its replacement by another workpiece.

The compression of the stripper springs may be varied to suit the requirements of the work in hand and this may be effected by varying the number of stripper springs which are employed, or by selecting springs of different strength, or by varying the compression of the stripper springs already in use, which last mentioned result may be obtained by turning the tie rods or bolts 71 in one direction or another by a wrench engaging with the upper ends of the tie rods. The latter are accessible for this purpose by means of wrench passages or openings 78 formed in the upper lifting bar 69 in line with the tie rods or bolts 71.

For the purpose of readily locating the workpiece in the desired position relative to the die and punch of each unit preparatory to perforating the workpiece, locating means are provided such, for example, as the gage 79 arranged in rear of the holder in position to be engaged by the front edge of the workpiece. A gage of this character may be mounted on any part of the holder to suit the requirements of the particular workpiece in hand. The means for accomplishing this purpose, shown in Figs. 1, 3 and 4, consist in forming longitudinal grooves or slots 80, 81, 82, 83 on the front and rear sides respectively of the upper and lower rails of the holder any of which are adapted to receive the nut 84 of a clamping bolt 85 for holding the respective gage in the required position on the holder.

If desired the following wedge clamping means may be employed either alone or in addition to the clamping bolts 59 for securing the upper section of each punching unit in its lengthwise adjusted position on the upper rail of the holder.

Referring to Figs. 1 and 4, the numeral 86 represents clamping pins slidable horizontally and laterally in guideways formed in the upper part of the respective carrier and each provided at its outer end with a flat face which bears against the adjacent vertical inner side of the respective upper rail bar. Adjacent to each clamping pin 86 is arranged a vertical clamping screw 87 which engages with a threaded opening in the carrier and is accessible from the top of the latter so that the same may be turned by a suitable tool, such as a wrench or screw driver for raising and lowering this screw. At its lower end this clamping screw is provided with a conical taper 88 which engages with a corresponding taper 89 at the inner end of the respective clamping pin 86. Upon loosening the screws 87 the grip of the clamping pins 86 on the upper rail bars 52 is released and permits the respective carrier to be moved lengthwise of this rail to the desired position and upon tightening these screws the clamping pins 86 will be pressed outwardly against the upper rail bars 52 and hold the carrier securely in place thereon.

For the purpose of facilitating the location of each upper punch section of the perforating unit

in the required position lengthwise of the upper holder rail and thus enable the holes to be formed accurately in the workpiece, locating means are provided which preferably include a horizontal scale or row of graduations 90 arranged on the front side of the upper rail and a mark or indicator 91 arranged on the front side of the respective carrier and adapted to traverse said scale, as shown in Figs. 1 and 3.

Alining means are provided for maintaining the die and punch sections of each punching unit in alinement while the same are shifted lengthwise from one part of the holder to another and thus facilitate such adjustment and enabling accuracy in the relation of the die and punch of each unit to be secured without exercising special care or repeated tryouts for this purpose.

In its preferred form these alining means include a plurality of alining sleeves 92 each of which has a bore of exactly the same diameter as the peripheries of the upper part of the die and the lower part of the companion punch guide sleeve 66 of the respective perforating unit. Normally this alining sleeve when not in use surrounds the lower part of the die body so that the lower end thereof rests on the die shoe and the upper end thereof uncovers the slug opening or discharge chute 48 of the die, as shown in Figs. 1, 3 and 4. In this position of the alining sleeve the same is out of the way but always connected with the apparatus ready to be used. If it is desired to shift the die and punch sections of a perforating unit lengthwise from one position on the holder to another the alining sleeve of the respective unit is first moved upwardly so that its upper end encloses the lower part of the lower guide and stripper sleeve 66 while the latter is in lowered position, as shown in Fig. 5. At this time the alining sleeve fits tightly around the die and stripper and guide sleeve 66 so that the die and punch sections of the punching or perforating unit after being loosened on the holder can be moved horizontally in unison thereon without disturbing the alinement of the die and punch. After the die and punch sections have been shifted to the desired position the die shoe and punch carrier are first tightened on the lower and upper rails of the holder and then the alining sleeve is lowered so as to disengage the same from the respective guide and stripper sleeve 66 and restore the same to its inoperative position on the shoe, thereby enabling the use of the respective die and punch to be resumed without requiring any further adjustment of the die and punch to secure correct cooperation for punching holes in a workpiece. It is to be noted in this connection that the axial alinement of the die and punch of the respective unit are maintained by these means notwithstanding that it is common practice to make the bit of the punch slightly smaller in diameter than the bore of the die opening in order to provide the clearance which is necessary between the punch and die to sever the slug from the workpiece during the perforating operation.

When the bit of the punch and the opening of the die are perfectly round the alining sleeve may be turned on the die into any position and still permit the same to be raised for coupling the die and punch guiding and stripping sleeve without disturbing the proper alinement between the die and punch. When the bit of the punch and the opening of the die are perfectly round no means need be provided for holding the punch and die against rotation relative to each other, as shown in Fig. 10. When, however, the opening of the die and the bit of the punch are of non-circular form, as shown for example at 48 in Figs. 7 and 8, for producing an oval perforation in the workpiece, then the die and the punch guiding and stripper sleeve must be coupled so that the same are not only alined but also held in the correct circumferential position relative to each other. This is preferably accomplished by a key 93 arranged on the inner end of a screw secured to the lower part of the punch carrier and engaging with a vertical keyway or groove 94 formed on the periphery of the punch guiding and stripping sleeve 66, as shown in Figs. 4, 5 and 8, and a spline 95 formed lengthwise on the bore of the alining sleeve and constantly sliding in a longitudinal spline groove 96 on the periphery of the die and movable into and out of engagement with a longitudinal groove 97 on the periphery of the punch guiding and stripping tube. When the perforating apparatus is in operation the alining sleeve 66 is lowered upon the die, as shown in Figs. 1, 3 and 4 in which position of the same the die and punch guiding and stripping sleeve are uncoupled. When, however, it is desired to move the die and punch sections of the respective unit for perforating holes in another part of the workpiece the alining sleeve is raised so that its spline 95 engages not only with the spline groove 96 on the die but also the key groove 94 of the punch guiding and stripping sleeve, as shown in Figs. 5 and 9, thereby coupling the die and punch sections of the respective unit so as to prevent axial disalinement of the die and punch while effecting horizontal adjustment of the same in the apparatus.

Instead of extending the top of the punch carrier above the top of the upper rail bars, as shown in Fig. 4, the top 97 of the carrier may be flush with the top of the upper holder rail bars 98, and upper parts of the front and rear ends of the carrier may be slidable in longitudinal rabbets 99 in the adjacent parts of the upper rail bars, as shown in Figs. 14 and 15. In this construction no clamping bolts on the carrier engaging with T-grooves in the upper rail bars are employed for securing the respective punch section on the upper rail of the holder and instead this fastening of the punch carrying section of the perforating unit is effected solely by clamping pins 86 and clamping screws 87 similar to the construction shown in Fig. 4, and the same description therefore applies to both.

If desired the central upper part of the punch carrier may be omitted so that the space between the vertical bars 56 of the punch carrier opens upwardly, as shown at 100 in Fig. 10. In this case the punch is not guided at its upper end and only the lower guiding and stripping sleeve 66 serves to guide the punch on the lower part of the punch carrier.

Instead of connecting the punch carrier with the upper parts of the upper rail bars, as shown in Figs. 1–11, 14 and 15, this carrier may be constructed in the form of a single bar 101 which extends across the underside of the slot 53 between the upper rail bars and is provided centrally with a vertical guide 102 in which the punch guiding and stripping sleeve 66 slides while the front and rear ends of this carrier bar are secured to the underside of the upper rail bars by bolts 103 passing through this bar and having their heads arranged in T-grooves 104 formed lengthwise on the undersides of the upper rail bars.

When the punch and punch guide sleeve 66 are in their lowered position and coupled in line with

each other by the alining sleeve **92** the space above the punch supporting carriage **55** should be free to permit of manipulating this carriage from the top for adjusting the same lengthwise of the assembly frame. In order to permit of doing this while the ram is raised to render the punch carriage accessible from the top the punch section may be first lifted as a unit from the punching frame and the lifting spring **76** removed so that upon restoring this punching section to the frame the punch together with its guide sleeve and stripping mechanism will rest by gravity in its lowered position on the carriage and thus permit the companion die and punch when coupled by the sleeve **92** to be adjusted lengthwise on the punching frame while the ram is elevated.

Instead of removing the spring **76** for this purpose the same result may be accomplished by locking means whereby the punch and its guide tube **66** and stripper mechanism may be held in a depressed position while the ram is raised and the alining tube **92** embraces the die and punch guide sleeve. Any suitable locking means may be employed for this purpose, for example, a horizontally swinging latch **105** pivoted on the upper side of the carriage **55** and movable into engagement with a notch **106** in the side of a part of the punch as shown in Figs. 5 and 6, for holding the punch and the parts associated therewith in a lowered position and also movable out of engagement from said notch to restore the punch and its associated parts to their normal working condition.

To permit the punching frame and the parts mounted thereon to be conveniently moved into and out of its operative position in a press without requiring the retaining bars **30** to be completely detached from the punching frame, each of these bars is provided with a vertical slot **107** for the reception of the respective fastening screw **31**, as shown in Fig. 3. Upon loosening the screws **31** and **32** the bars **30** can be raised out of the slot **21** in the press bed and above the bottom of the punching frame and thus permit the latter to be slid over a press bed without interference when setting up the apparatus for a job or changing from one press to another.

It will be noted that in all of the several forms of this invention each punching section is a complete organization by itself and that the same practically floats on the frame which supports it relative to the companion die section and on which the respective punch section is capable of being adjusted bodily lengthwise of the perforating apparatus to suit different requirements.

Moreover, no parts of the punch guiding means and stripping mechanism are subjected to any pressure while perforating a working piece inasmuch as only the punch is pressed downwardly on the workpiece by the ram, thereby permitting the use of lighter stripper springs and effecting a saving in power.

I claim as my invention:

1. An apparatus for perforating sheet material comprising a holder adapted to be placed between the bed and ram of a press and having lower and upper rails and posts connecting opposite ends of said rails, a perforating unit including a die section adjustable lengthwise on said lower rail and having a die and a punching section adjustable lengthwise on said upper rail and having a punch adapted to cooperate with said die, a gage, and means for adjustably mounting said gage lengthwise on the front and rear sides of said lower and upper rails, including T-grooves arranged lengthwise on said front and rear sides of the rails, and a clamping bolt passing through said gage and having a head arranged in one or another of said T-grooves.

2. An apparatus for perforating sheet material comprising a holder adapted to be placed between the bed and ram of a press and provided with an upper rail and a lower rail having a longitudinal undercut groove the sides of which incline and converge upwardly, and a punch unit comprising a punch section which is adjustable lengthwise on said upper rail and a lower die section which has a shoe adjustable lengthwise in said undercut groove, and means for securing said shoe in different parts of said groove including an incline arranged on one end of said shoe and engaging with one of the inclined sides of said groove, a clamping block having an incline engaging with an incline arranged on the opposite end of said shoe and also provided with an incline engaging the opposite inclined side of said groove, and a clamping screw connecting said shoe and clamping block.

3. An apparatus for perforating sheet material comprising a holder adapted to be placed between the bed and ram of a press and provided with an upper rail and a lower rail having a longitudinal undercut groove the sides of which incline and converge upwardly, and a punch unit comprising a punch section which is adjustable lengthwise on said upper rail and a lower die section which has a shoe adjustable lengthwise in said undercut groove, and means for securing said shoe in different parts of said groove including an incline arranged on one end of said shoe and engaging with one of the inclined sides of said groove, a clamping block having an incline engaging with an incline arranged on the opposite end of said shoe and also provided with an incline engaging the opposite inclined side of said groove, and a clamping screw connecting said shoe and clamping block, said shoe and clamping block being constructed to be insertable into and removable from said undercut groove through the top thereof.

4. An apparatus for perforating sheet material comprising a holder adapted to be placed between the bed and ram of a press and having a lower rail and an upper rail provided with a longitudinal slot, and a perforating unit comprising a die section which is provided with a die and is adjustable lengthwise of said lower rail, a punch section having a carrier arranged in the slot of said upper rail, a punch mounted on said carrier and cooperating with said die, and means for adjusting said carrier lengthwise on said upper rail including T-shaped grooves formed lengthwise in said upper rail, and clamping bolts passing through said carrier and having nuts arranged in said grooves.

5. An apparatus for perforating sheet material comprising a holder adapted to be placed between the bed and ram of a press and having a lower rail and an upper rail provided with a longitudinal slot, and a perforating unit comprising a die section which is provided with a die and is adjustable lengthwise of said lower rail, a punch section having a carrier arranged in the slot of said upper rail, a punch mounted on said carrier and cooperating with said die, and means for securing said carrier in various positions lengthwise of said upper rail including clamping pins guided on said carrier and engaging adjacent sides of said upper rail, and clamping screws mounted on said carrier and having tapering ends which engage

correspondingly tapered ends on said clamping pins.

6. An apparatus for perforating sheet material comprising a holder adapted to be placed between the bed and ram of a press and having a lower rail and an upper rail provided with a longitudinal slot, and a perforating unit including a lower die section mounted on said lower rail and provided with a die, and an upper punch section having a punch which cooperates with said die and a carrier upon which said punch is mounted and which includes vertical side bars arranged along the opposite sides of said slot, a cross bar which connects the lower ends of said bars and on which said punch is mounted, and laterally projecting ends arranged on said side bars and secured to said upper rail.

7. An apparatus for perforating sheet material comprising a holder adapted to be placed between the bed and ram of a press and having a lower rail and an upper rail provided with a longitudinal slot, and a perforating unit including a lower die section mounted on said lower rail and provided with a die, and an upper punch section having a punch which cooperates with said die and a carrier upon which said punch is mounted and which includes vertical side bars arranged along the opposite sides of said slot, a cross bar which connects the lower ends of said bars and on which said punch is mounted, and an upper cross bar which is connected with the upper ends of said side bars and upon the central part of which said punch is mounted and the ends of which project laterally and are secured to said upper rail.

8. An apparatus for perforating sheet material comprising a holder adapted to be placed between the bed and ram of a press and having a lower rail and an upper rail provided with a longitudinal slot, and a perforating unit including a lower die section mounted on said lower rail and provided with a die, and an upper punch section having a punch which cooperates with said die and which is arranged within the slot of said upper rail, a carrier upon which said punch is mounted and which is secured to the adjacent parts of said upper rail, and resilient means for raising said punch and stripping the workpiece therefrom.

9. An apparatus for perforating sheet material comprising a holder adapted to be placed between the bed and ram of a press and having a lower rail and an upper rail provided with a longitudinal slot, and a perforating unit including a lower die section mounted on said lower rail and provided with a die, and an upper punch section having a punch which cooperates with said die, a carrier bar extending across the underside of said slot and connected at its opposite ends with the underside of said upper rail, and means for guiding said punch on the central part of said carrier bar.

10. An apparatus for perforating sheet material comprising a holder adapted to be placed between the bed and ram of a press and having a lower rail and an upper rail which includes two bars spaced apart to form a longitudinal slot between and provided with rabbets on their opposite upper parts, a punch arranged in said slot and cooperating with said die, and a carrier which is arranged within said slot and supports said punch and which has laterally projecting ends secured in said rabbets to said upper rail.

11. An apparatus for perforating sheet material comprising a holder having lower and upper longitudinal rails, a perforating unit including a die section having a shoe which is adjustable lengthwise of said lower rail and a die mounted on said shoe, and an upper punch section having a punch which cooperates with said die, a guiding sleeve in which said punch is guided, a carrier which is adjustable lengthwise of said upper rail and in which said sleeve slides vertically, and alining means which connect said punch and sleeve and hold the punch and die in axial alinement while the same are adjusted in unison lengthwise of said rails.

12. An apparatus for perforating sheet material comprising a holder having lower and upper longitudinal rails, a perforating unit including a die section having a shoe which is adjustable lengthwise of said lower rail and a die mounted on said shoe, and an upper punch section having a punch which cooperates with said die, a guiding sleeve in which said punch is guided, a carrier which is adjustable lengthwise of said upper rail and in which said sleeve slides vertically, and an alining sleeve which is slidable in one direction so as to fit only around said die and also slidable in another direction so as to fit around both said die and guiding sleeve for holding the die and punch in axial alinement while being adjusted in unison lengthwise of said rails.

13. An apparatus for perforating sheet material comprising a holder having lower and upper longitudinal rails, a perforating unit including a die section having a shoe which is adjustable lengthwise of said lower rail and a die mounted on said shoe, and an upper punch section having a punch which cooperates with said die, a guiding sleeve in which said punch is guided, a carrier which is adjustable lengthwise of said upper rail and in which said sleeve slides vertically, an alining sleeve which is slidable in one direction so as to fit only around said die and also slidable in another direction so as to fit around both said die and guiding sleeve for holding the die and punch in axial alinement while being adjusted in unison lengthwise of said rails, means for permitting said punch to slide in said guiding sleeve but preventing turning of the same therein, and means for permitting said alining sleeve to slide on said die and guiding sleeve but preventing the same from turning relative thereto.

14. An apparatus for perforating sheet material comprising a holder having lower and upper longitudinal rails, a perforating unit including a die section having a shoe which is adjustable lengthwise of said lower rail and a die mounted on said shoe, and an upper punch section having a punch which cooperates with said die, a guiding sleeve in which said punch is guided, a carrier which is adjustable lengthwise of said upper rail and in which said sleeve slides vertically, an alining sleeve which is slidable in one direction so as to fit only around said die and also slidable in another direction so as to fit around both said die and guiding sleeve for holding the die and punch in axial alinement while being adjusted in unison lengthwise of said rails, means for permitting said punch to slide in said guiding sleeve but preventing turning of the same therein, and means for permitting said alining sleeve to slide on said die and guiding sleeve but preventing the same from turning relative thereto, including a longitudinal key groove formed on said guiding sleeve, a longitudinal spline groove formed on said die, a key arranged on said guiding sleeve and engaging with said key groove, and a spline arranged on said alining sleeve and engaging constantly with said spline groove on the die and movable into

and out of engagement with the key groove on the guiding sleeve.

15. A perforating apparatus adapted to be placed as a complete operative unit between the bed and ram of a press and capable of producing a plurality of perforations in differently spaced relation without connection of any of the elements of the perforating apparatus with any part of the press which apparatus comprises a frame independent of and removable into and out of the space between the bed and the ram of the press and having a lower rail and an upper rail separated by a gap extending from the front to the rear side of the frame, a plurality of die sections which are mounted on said lower rail and capable of individual adjustment lengthwise of the same and each die section including a shoe adjustable lengthwise of said lower rail and a die mounted on said shoe; and a plurality of punch sections capable of individual adjustment on said upper rail and each punch section including a carriage which is adjustable lengthwise on said upper rail, a punch mounted on each of said carriages and adapted to be shifted by said ram for cooperation with the die of one of said die sections, and stripper means mounted on each of said carriages and operatively associated with the punch thereon to remove the workpiece therefrom after punching the respective hole in the workpiece.

16. A perforating apparatus adapted to be placed as a complete operative unit between the bed and ram of a press and capable of producing a plurality of perforations in differently spaced relation without connection of any of the elements of the perforating apparatus with any part of the press which apparatus comprises a frame independent of and removable into and out of the space between the bed and the ram of the press and having a lower rail and an upper rail separated by a gap extending from the front to the rear side of the frame, a plurality of die sections which are mounted on said lower rail and capable of individual adjustment lengthwise of the same and each die section including a shoe adjustable lengthwise of said lower rail and a die mounted on said shoe; a plurality of punch sections capable of individual adjustment on said upper rail and each punch section including a carriage which is adjustable lengthwise on said upper rail, a punch mounted on each of said carriages and adapted to be shifted by said ram for cooperation with the die of one of said die sections, and stripper means mounted on each of said carriages and operatively associated with the punch thereon to remove the workpiece therefrom after punching the respective hole in the workpiece, and means for fastening each of the carriages to said upper rail which are accessible from the top of the upper rail and carriage.

17. A perforating apparatus adapted to be placed as a complete operative unit between the bed and ram of a press and capable of producing a plurality of perforations in differently spaced relation without connection of any of the elements of the perforating apparatus with any part of the press which apparatus comprises a frame independent of and removable into and out of the space between the bed and the ram of the press and having a lower rail and an upper rail separated by a gap extending from the front to the rear side of the frame, a plurality of die sections which are mounted on said lower rail and capable of individual adjustment lengthwise of the same and each die section including a shoe adjustable lengthwise of said lower rail and a die mounted on said shoe; a plurality of punch sections capable of individual adjustment on said upper rail and each punch section including a carriage which is adjustable lengthwise on said upper rail, a punch mounted on each of said carriages and adapted to be depressed by said ram for cooperation with the die of one of said die sections, and stripper means mounted on each of said carriages and operatively associated with the punch thereon to remove the workpiece therefrom after punching the respective hole in the workpiece, and means for attaching stop gages to said frame on its front and rear sides and also above and below the punching level between the die sections and the punch sections.

18. A perforating apparatus comprising a frame, a die section mounted on the lower part of said frame and including a die, and a punch section including a punch cooperating with said die, a carriage mounted on said frame and upon which said punch is guided, resilient stripper means operating to remove the workpiece from the punch, and locking means for holding the punch in its lowered position relative to the die.

19. A perforating apparatus comprising a frame, a die section mounted on the lower part of said frame and including a die, and a punch section including a punch cooperating with said die, a carriage mounted on said frame and upon which said punch is guided, resilient stripper means operating to remove the workpiece from the punch, and locking means for holding the punch in its lowered position relative to the die including a latch pivoted on said carriage and movable into and out of engagement with a notch in said punch.

GEORGE F. WALES.