Aug. 26, 1947. R. FUNK 2,426,446

PRESS BRAKE

Filed Nov. 22, 1943 5 Sheets-Sheet 1

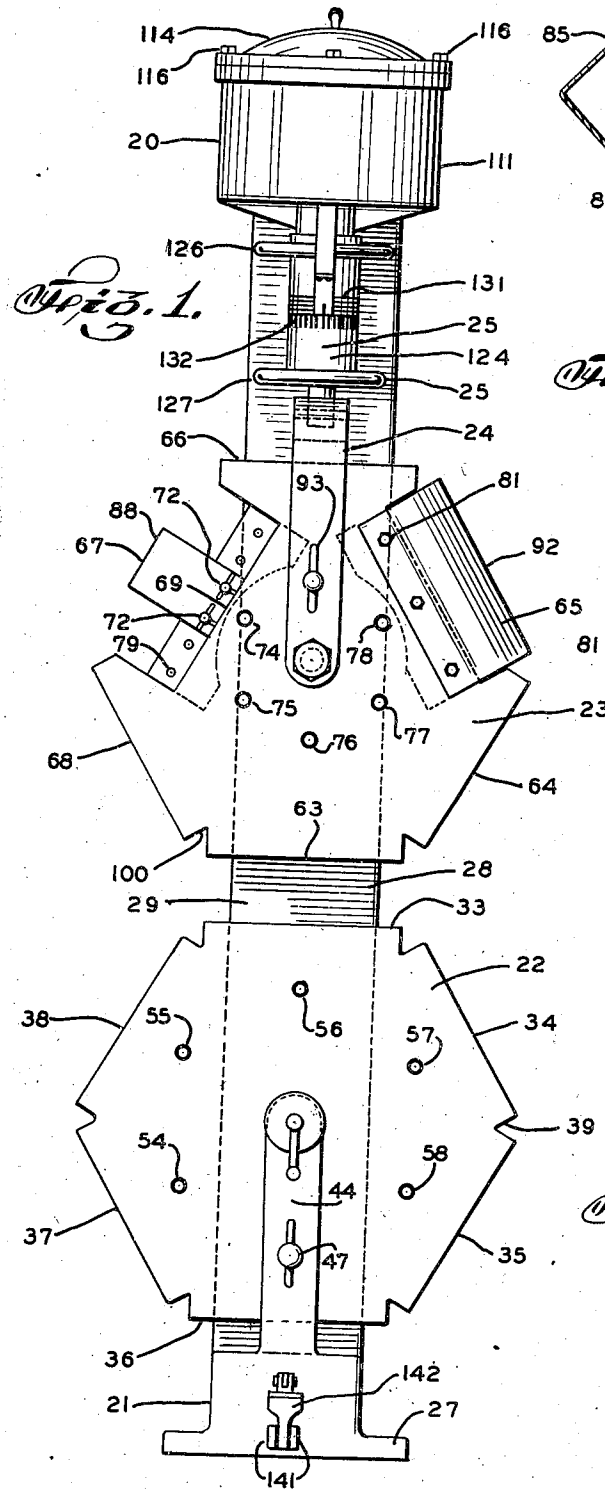


Fig. 1.

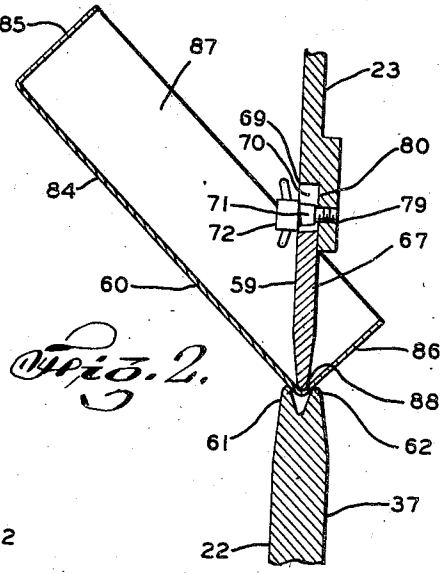


Fig. 2.

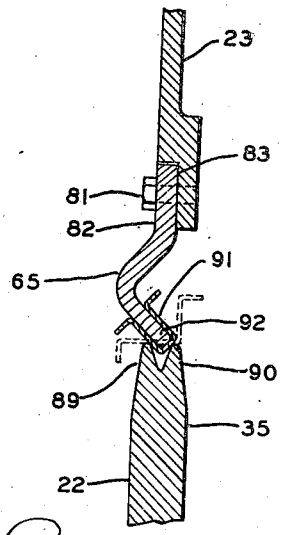


Fig. 3.

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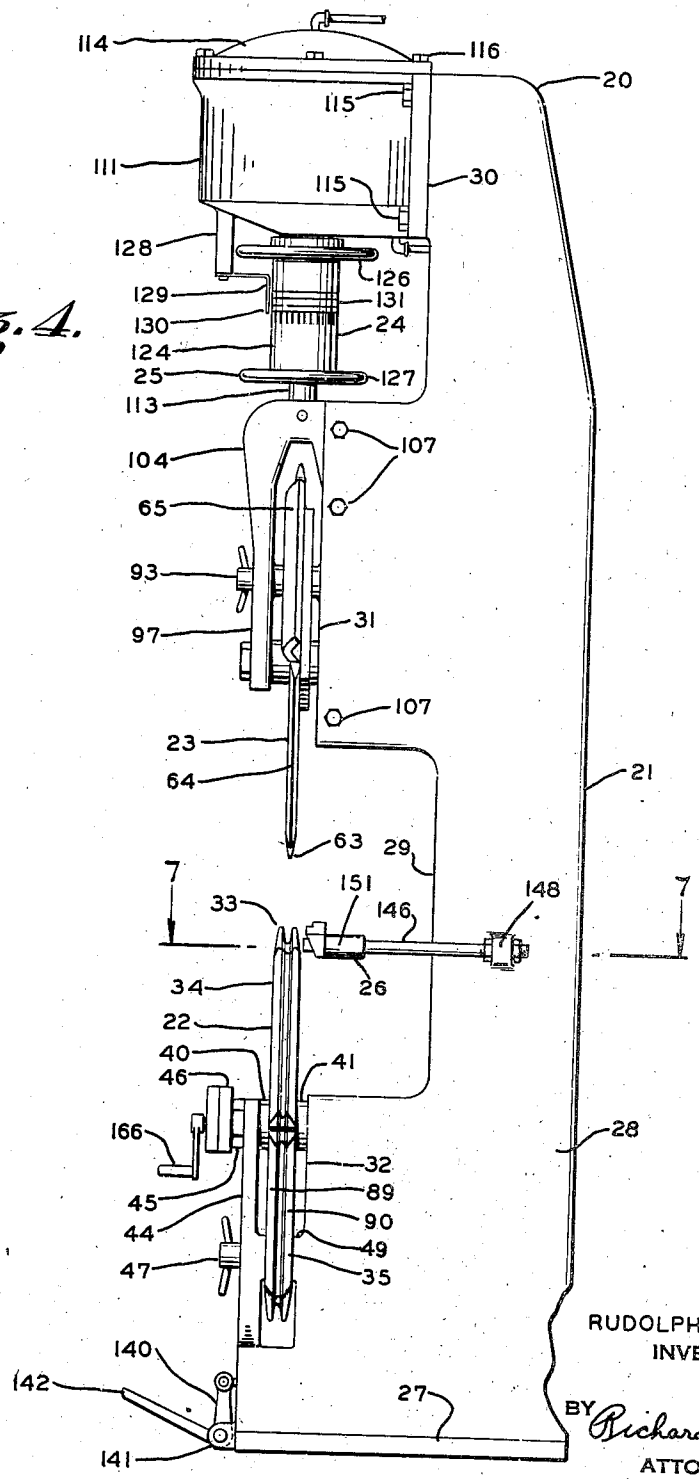
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PRESS BRAKE

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Fig. 4.



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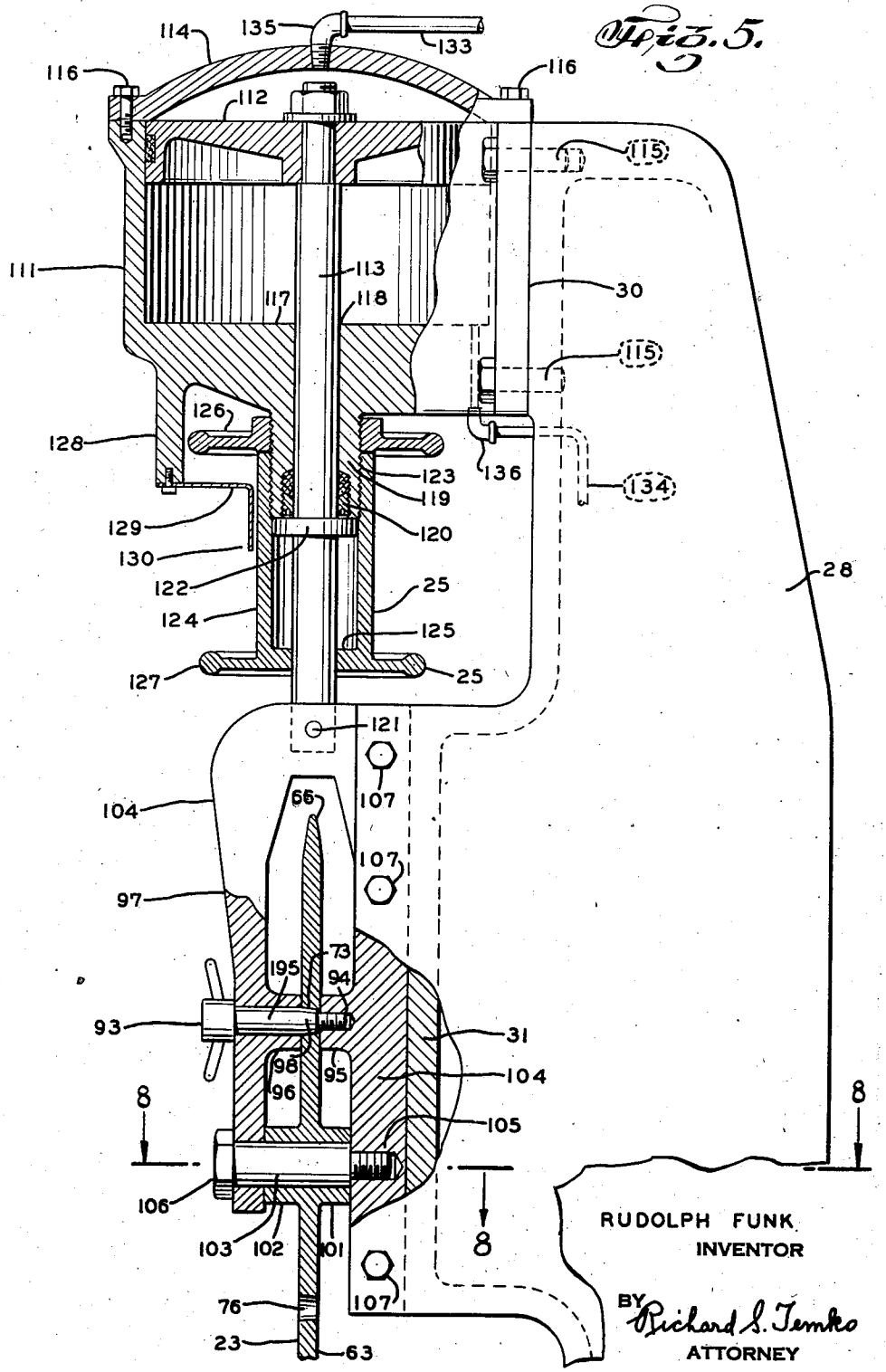
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Fig. 5.



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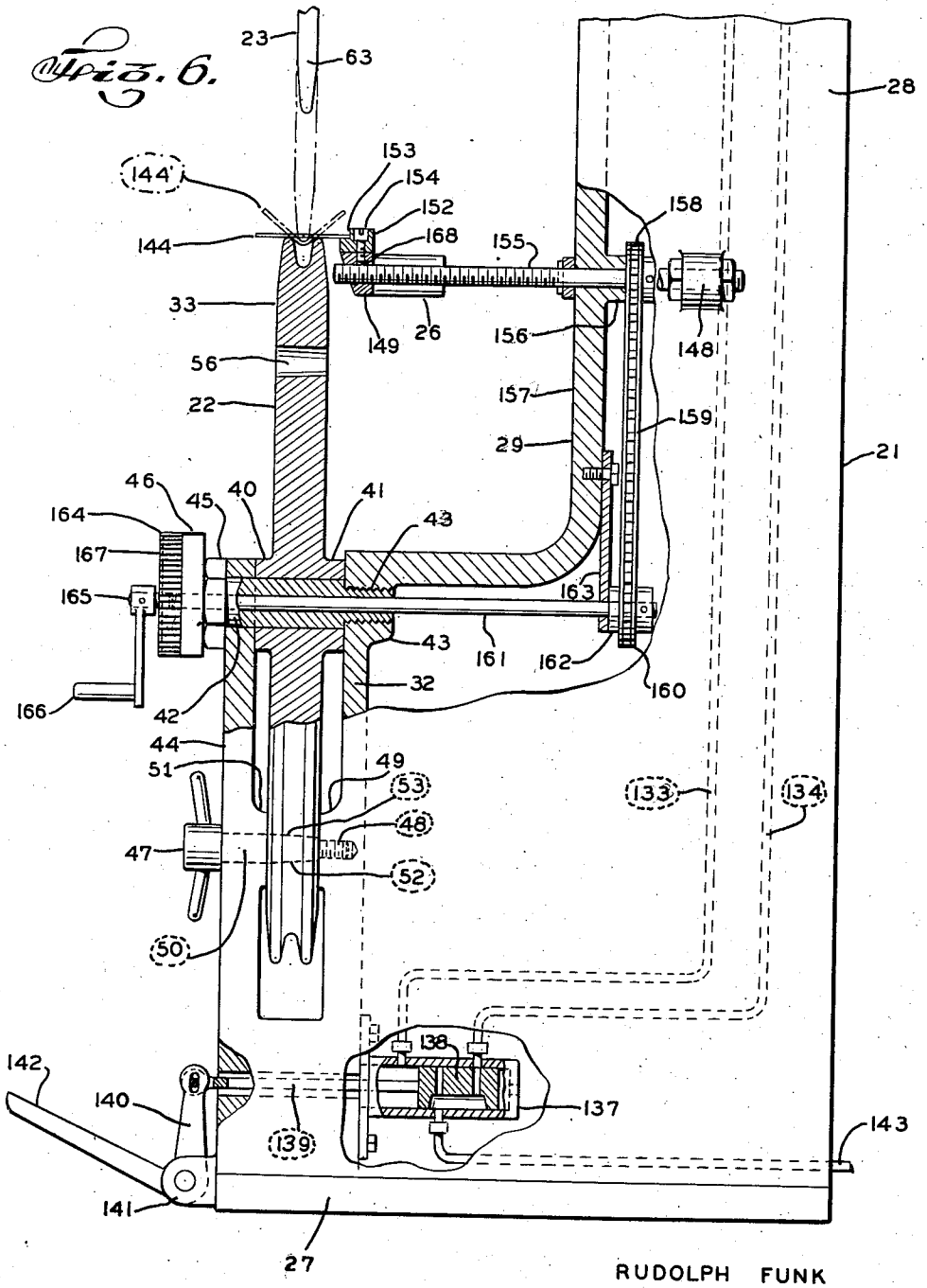
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Fig. 6.



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PRESS BRAKE

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Fig. 7.

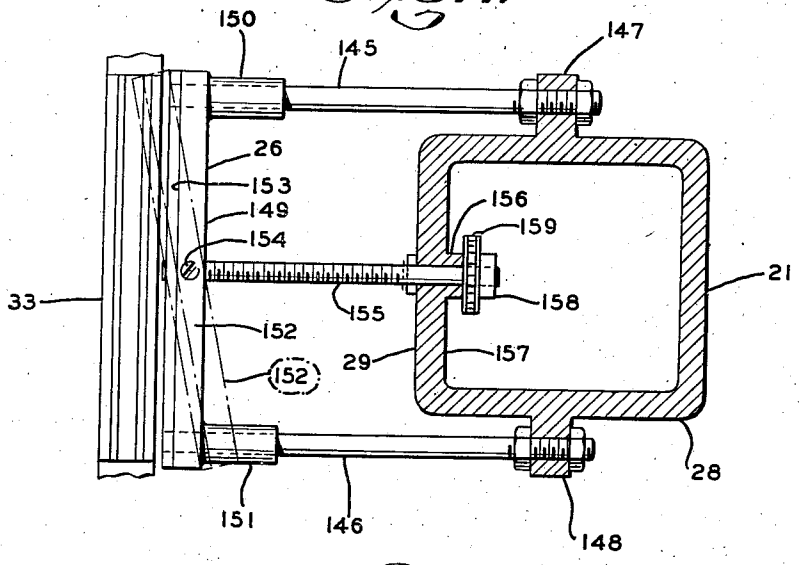
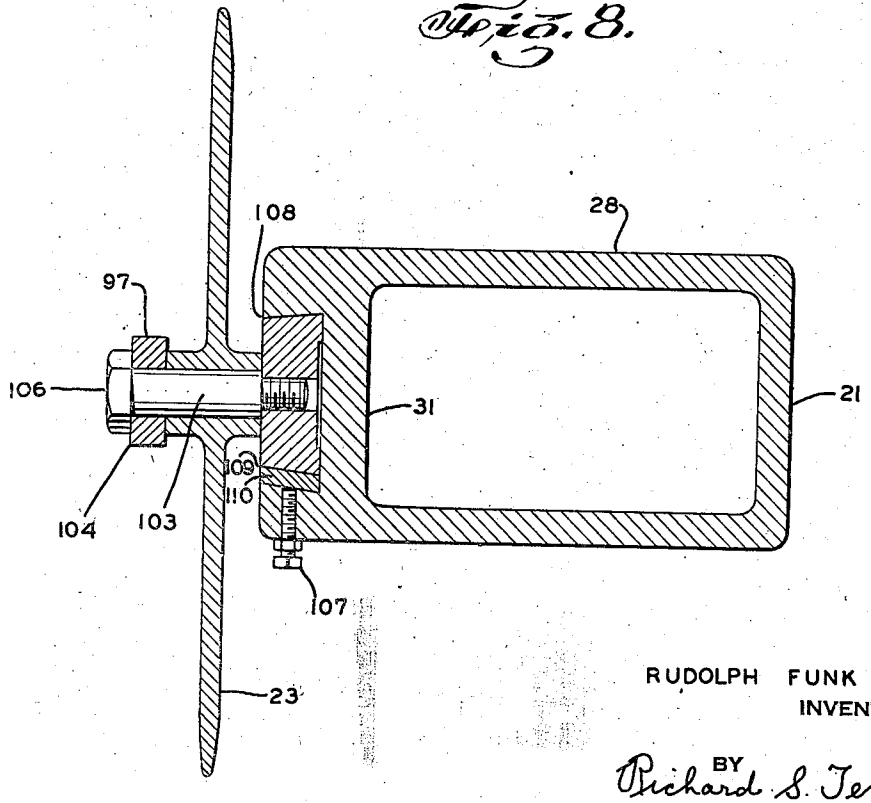


Fig. 8.



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2,426,446

UNITED STATES PATENT OFFICE

2,426,446

PRESS BRAKE

Rudolph Funk, Hagerstown, Md.

Application November 22, 1943, Serial No. 511,245

6 Claims. (Cl. 153—21)

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This invention relates generally to the field of pressing, bending and forming metals or similar sheet materials and more particularly to a novel press brake construction in which a single press may be utilized to produce a variety of forms.

In connection with the fabrication of small parts generally of sheet metal in various industries, frequently the need for a part is limited to a small number and it becomes uneconomic to make up dies for them. It is therefore one of the principal objects of the present invention to provide press brake structure adaptable to produce a plurality of shapes and configurations which ordinarily would be formed up from specially prepared dies.

Apart from the necessarily increased cost in the production of a small number of stamped or pressed parts by the use of special dies considerable time is consumed in changing the dies on the press and adjusting them so that they function properly.

It is another object herein to provide a novel press brake in which changes to accommodate the production of varying shapes may be rapidly made and adjustments for alignment and registration may be quickly accomplished.

In connection with the present structure it is to be noted that different shapes are produced through the use of the same male and female dies by adjusting the inter-engagement of the dies. An object of the present invention lies in the provision of control mechanism whereby the stroke of the press can be quickly and easily set and indicator means are used so that by proper calculation the operator is able to obtain a certain depth of bend each time without the effort of trial and error and the consequent waste of material thereby entailed.

A further feature of the present construction lies in the fact that the legs or tab lengths of bent-up parts can be controlled by the use of an adjustable gauge which can be set to a predetermined figure which will establish the length of a leg or tab of a bend.

In accordance with the invention, two separate groups of dies or punch and die combinations are utilized and means are provided whereby the die groups may be quickly shifted so as to position different sets of die elements for interengagement and whereby the die wheels themselves may be easily removed and reinstalled or have other die wheels substituted therefor.

A feature of the invention lies in the fact that by virtue of the easy removal and replacement of the die elements not only can shifts in the die

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shapes be readily accomplished but also the dies may be sharpened or ground to new shapes in a quick and easy manner.

Another object herein lies in the provision of a machine of the class described which is compactly arranged so that the same requires a minimum of floor space and in which all of the parts are within easy reach and accessible to the operator with a minimum of effort.

These objects and other incidental ends and advantages will more fully appear in the progress of this disclosure and be pointed out in the appended claims.

In the drawings in which similar reference characters designate corresponding parts throughout the several views:

Figure 1 is a front elevational view of a preferred embodiment of the invention.

Figure 2 is an enlarged fragmentary vertical sectional view showing a pair of cooperating die elements in the operation of forming a bend in a sheet metal box.

Figure 3 is a view similar to Figure 2 but shows another pair of co-acting die elements forming up a flanged U-shaped channel.

Figure 4 is a right side elevational view of Figure 1.

Figure 5 is an enlarged fragmentary elevational view partly in section of the upper portion of Figure 4.

Figure 6 is an enlarged fragmentary elevational view partly in section of the lower portion of Figure 4.

Figure 7 is a fragmentary enlarged horizontal sectional view as seen from the plane 7—7 on Figure 4.

Figure 8 is a fragmentary enlarged horizontal sectional view as seen from the plane 8—8 on Figure 5.

In accordance with the invention the press brake is indicated generally by numeral 20 and comprises broadly a frame or chassis 21; a relatively stationary die element 22; a relatively movable die element 23; means 24 to move the relatively movable die element; means 25 to regulate the extent or depth of the stroke of the means 24 and gauge means 26.

The frame 21 is of irregular configuration and generally of box section, as best seen in Figures 7 and 8, and includes a base 27; a column 28; a recessed throat 29; a portion 30 adapted to support the means 24; a portion 31 adapted to support the first or upper die element and a portion 32 adapted to support the second or lower die element.

The second or lower die element 22 referred to above as the relatively stationary die element is preferably in the form of a plate having a polygonal periphery and by way of example is shown as having a generally hexagonal shape including the male die members 33, 34, 35, 36, 37 and 38. The ends of the members 33—38 are preferably separated by indentations generally indicated by reference character 39. The die element 22 is preferably wheel-like in character and is provided with centrally disposed hubs 40 and 41. Said hubs and the wheel are provided with a central orifice, by the penetration of which said die element is rotatably mounted upon the hollow axle 42. The rear end of the axle 42 threadedly engages the frame 21 at the portion 43 (see Figure 6) and is supported in an orifice in the upper end of the arm 44. The axle 42 may take the form of a hollow bolt having a head 45 to which is fixedly secured the stationary indicator wheel 46.

The relatively stationary die element 22 is rotationally adjustable and is retained in any rotated position thereof, in which one of the female die members is in operative position by the engagement of the positioning means control 47. The control 47 has the terminal 48 thereof threadedly engaged in a boss 49 while the body 50 slidably penetrates an orifice in the boss 51 extending rearwardly from the arm 44. Thus the control 47 is axially shiftable in position with relation to the arm 44 so that the frusto-conical portion 52 may seat within a correspondingly formed orifice 53 in the element 22. The orifice 53 is therefore positioned in the element 22 so that the female die member 33 is in proper position when the control 47 engages said orifice. The orifices 54—58, inclusive, are correspondingly positioned in correlation with the desired operating position of the die members 34—38, respectively. In order to rotate the die element 22 it is necessary to move the control 47 forwardly of the press brake 20 until the terminal 48 clears the element 22.

The first or upper die element 23, referred to above as the relatively movable die element, is preferably in the form of a plate having a polygonal periphery and by way of example, is shown as having a generally hexagonal shape including the male die members 63, 64, 65, 66, 67 and 68. Each of the said male die members are of a size and shape adapted to co-act with one or more of the female die members 33—38, inclusive. As best seen in Figure 1 some of the female die members are detachably engageable with the die element 23 as, for example, the male die members 67 and 65. The construction of the male die member 67 and its interengagement with the portion of the die element 23 adjacent thereto is seen in Figure 2. The die member 67 as illustrated is narrower in width, that is to say: the effective length of the working edge thereof is less than the total length of the working edge of the female die member 37. This reduced effective length of the working edge of the die member 67 permits the same to be inserted within the confines and between the relatively vertical walls of formed-up boxes. Thus in Figure 2, the box shown, by way of example, and indicated by reference character 84, has end walls 85 and 86 and a side wall 87. The side wall opposite the side wall 87 is not shown but the die member 67 has the working edge 88 resting upon the inner surface of the sheet forming the bottom 60 and the end wall 86 and is pressing these parts against the ribs 61 and 62 of the

female die member. The body 59 of the die member 67 has the rear edge 69 thereof provided with a plurality of slots 70 which are provided with indentations in the opposed walls thereof to form a proper seat for the frusto-conical shank 71 on the clamping screws 72. The screws 72 are adapted to engage spaced and aligned orifices 79 in the rabbet portion 80 of the die element 23. The indentations in the walls of the slots 70 are so positioned that when the edge 69 of the die member 67 abuts against the horizontal edge of the rabbet 80 as viewed in Figure 2 the orifices 79 are aligned in one direction with the clamping screws 72 as seated in said indentations. The orifices 79 are preferably uniformly spaced so that the substitution of male die elements corresponding to the die element 67 but of different working edge length may be readily accomplished in a minimum amount of time.

The male die member 65 is of irregular configuration, best seen in sectional view shown in Figure 3, and includes a working edge 92 while the shank or rear edge 82 thereof is provided with a row of aligned orifices adapted to receive the clamping screws 81 which detachably secure the same in place. The portion of the die element 23 to which the shank 82 is connected is provided with a rabbet 83 so that the working edge 92 may be in proper alignment with the ribs 89 and 90 of the female die member 35. As seen in Figure 3 the male die member may be utilized to form a U-shaped channel with flanged edges. The said channel in said figure is indicated by reference character 91. The rabbet portions 80 and 83 have the edges thereof which are nearest the axis of rotation of the die element 23 arcuately indented (see Figure 1) so that they may properly clear the positioning means control 93.

The die element 23 is rotatably adjustable and is retained in any rotated position thereof in which one of the male die members is in operative position by the engagement of the positioning means control 93. The control 93 has the terminal 94 thereof threadedly engaged in a boss 95 while the body 195 slidably penetrates an orifice in the boss 96 extending rearwardly from the arm 97. Thus the control 93 is axially shiftable in position with relation to the arm 97 so that the frusto-conical portion 98 may seat within a correspondingly formed orifice 73 in the element 23. The orifice 73 is therefore positioned in the element 23 so that the male die member 63 is in proper position when the control 93 engages said orifices. The orifices 74—78, inclusive, are correspondingly positioned in correlation with the desired operating position of the die members 64–68, respectively. In order to rotate the die element 23 it is necessary to move the control 93 forwardly of the press brake 20 until the terminal 94 clears the element 23.

The first or upper die element 23 is preferably so constructed that the ends of the male members 63–68 are separated by indentations generally indicated by the reference character 100. The die element 23 is preferably disc-like in character and is provided with centrally disposed hubs 101 and 102. Said hubs and the wheel are provided with a central orifice, by the penetration of which said die element is rotatably mounted upon the axle 103. The rear end of the axle 103 threadedly engages the carriage 104 at the portion 105 (see Figure 5) and is supported in an orifice in the lower end of the arm 97. The axle

103 may take the form of a bolt having a head 106.

The carriage 104 is slidably mounted for vertical reciprocation on the portion 31 of the frame 21 between a pair of ways 108 and 109 thereat (see Figure 8). The carriage 104 may be adjusted to prevent lateral shifting by rotation of the gib screws 107 which shift the gib 110.

The carriage 104 together with the attached structure as described, is vertically reciprocated by a pneumatically or hydraulically operated ram generally indicated by reference character 24. The means 24 includes a cylinder 111, a piston 112, a piston rod 113, and a cylinder head 114. The cylinder 111 is secured to the portion 30 of the frame 21 in any suitable manner as, for example, by the use of the bolts 115; while the cylinder head 114 is secured to the upper free edge of the cylinder 111 in any suitable manner as, for example, by the bolts 116. The lower wall 117 of the cylinder 111 is provided with a centrally disposed orifice 118 and a downwardly extending neck 119 within which the piston rod 113 is slidably mounted. The lower inside portion of the neck 119 is provided with a stuffing box structure 120 adapted to prevent the escape of gas or liquid from the inside of the cylinder 111 outwardly along the piston rod 113. The upper end of the piston rod 113 is secured to the piston 112 while the lower end thereof is articulately connected to the uppermost portion of the carriage 104. This connection may be accomplished by inserting the lower end of the piston rod 113 into a suitably formed orifice in the carriage 104 and linking these parts together by a pin 121. Upwardly of the pin 121 and below the stuffing box structure 120 the piston rod 113 is provided with an enlargement 122 which may take the form of an annular flange. The upper surface of the flange 122 is adapted to abut against the lowermost surface of the neck 119 of the lowermost portion of the cylinder 111 when the piston 112 is in its uppermost position adjacent the inner surface of the head 114.

The outer surface of the neck 119 is provided with a thread 123 and upon which is threadedly engaged the means to regulate the depth of stroke of the piston rod 113, said means being generally indicated by reference character 25. The means 25 may take the form of an internally threaded sleeve 124 having a detent flange 125 and a pair of hand wheels 126 and 127. The hand wheels 126 and 127 are preferably horizontally disposed and extend radially from the axis of rotation of the sleeve 124. Since the flange 125 projects into the downward path of travel of the enlargement 122 the vertical setting of the sleeve 124 with relation to the neck 119 will predetermine the lowermost point of travel of the piston rod 113 and hence the carriage 104, and the die element 23. The forward portion of the bottom wall 117 is provided with a downwardly extending projection 128 and has affixed thereto a pointer 129 the lower terminal 130 of which is adapted to lie forwardly of the graduation lines 131 disposed upon the outer surface of the sleeve 124. These graduation lines are generally horizontally arranged and for the purpose of finer adjustment vertical graduation lines 132 may also be employed, so that by the proper manipulation of either of the hand wheels 126 or 127 the limit of downward travel of the working face or edge of any of the male die members 63—68, may be accurately controlled to within relatively close tolerances.

The cylinder 111 is provided with two conduits

133 and 134, best seen in Figure 5, where they are connected to said cylinder by means of the unions 135 and 136, respectively. The conduits 133 and 134 continue downwardly, as best seen in Figure 6, to the control valve 137. The valve 137 may be of any well known construction and is secured to the frame 21 at the lower portion thereof adjacent the base 27. The piston 138 of the valve 137 has the piston rod 139 thereof extending horizontally forward and connects to the bell crank 140 which is journaled between the lugs 141 projecting from the forward portion of the frame thereat. The forwardly extending portion of the bell crank 140 forms the operating pedal 142. It may thus be seen that downward pressure upon the pedal 142 pulls the piston 138 forward so that pneumatic or hydraulic pressure travelling through the conduit 143 from any suitable source thereof (not shown) will travel through the conduit 133 through the union 135 into the chamber below the cylinder head 114 causing the piston 112 to move downwardly. After the pressing or braking operation is completed release of pressure upon the pedal 142 will permit the same to be returned to the position shown in Figure 5 by any suitable spring means (not shown) so that the pneumatic or hydraulic pressure in the conduit 143 may travel through the conduit 134 to the lower chamber in the cylinder 111 to elevate the piston 112 and with it the die element 23. Suitable pressure escape means well known in the hydraulic or pneumatic arts are associated with the upper and lower chambers of the cylinder 111, that is, above and below the piston 112 so that the undesired pressure at any given moment when the pedal 142 is operated may be relieved.

For the purpose of properly positioning the planar or previously bent stock such as, for example, the piece of stock indicated by reference character 144 in Figure 6, the guage means 26 is utilized. The means 26 is best seen in Figures 6 and 7 of the accompanying drawings and includes a pair of generally horizontally arranged, spaced and parallel guide rods 145 and 146. The guide rods 145 and 146 are supported in operative position upon a pair of outwardly extending ears 147 and 148 projecting from the vertical side walls of the frame 21 adjacent the throat portion 29. Slidably mounted for movement longitudinally of said rods and forwardly or rearwardly of the device 26 is a guage base 149 which is provided at the outer ends thereof with a pair of integral collars 150 and 151. The base at each of the ends thereof is provided with an orifice which extends through the collars and which is penetrated by one of the rods 145, 146. The central portion of the base 149 is provided with a horizontally disposed threaded orifice.

A guide piece 152 may be of any suitable configuration adapted to act as a rearward stop for the particular piece corresponding to the piece 144 upon which the machine may act. For example, the guide piece 152 may be provided with a rabbet 153. The guide piece 152 is provided with a central vertically disposed orifice which is penetrated by a set screw 154 which serves to pivotally mount the guide piece 152 upon the base 149 and to secure said guide piece in any rotated position thereof, that is to say: rotated about a vertical axis through the screw 154.

Penetrating the central threaded orifice in the base 149 is a spindle 155. The forward portion of the spindle 155 threadedly engages the threaded orifice in the base 149 and is journaled at the rear portion thereof in a boss 156 extending rear-

wardly off the inner surface of the front wall 157 of the throat portion 29 of the frame 21. The rear end of the spindle 155 is provided with a sprocket 158, in turn connected by a sprocket chain 159. The chain 159 engages a sprocket 160 which is secured to the inner or rear end of the spindle 161. The spindle 161 is journaled adjacent the rear end thereof in a bearing 162 supported by a hanger 163 depending from the inner surface of the front wall 157. The forward portion of the spindle 161 is journalled in the axle 42 within which it is free to rotate. The forward end of the spindle 161 terminates in attachment to the rotatable indicator wheel 164. The indicator wheel 164 contains well known planetary gearing or other speed reducing mechanism which is connected to a stub shaft 165 the forward terminal of which has fixedly secured thereto a gauge operating handle 166. Any suitable means for reducing the effective speed of rotation of the spindle 161 with relation to the effective speed or movement of the stub shaft 165 may be used and confined within the wheel 164 and is therefore not particularly illustrated in the drawings. The uppermost portion of the stationary indicator wheel 46 is preferably provided with an indicator mark by means of which the graduations 167 on the wheel 164 may be calibrated and read. Upon a perusal of Figure 6 it will be seen that rotation of the handle 166 will provide forward or rearward movements of the base 149 and by reason of the stepped-down action previously described the guide piece 152 may be controlled in position within relatively close limits.

It may thus be seen that the operation of the present device in an efficient manner is a relatively simple procedure. By loosening and moving forward the controls 47 and 93 the die elements 22 and 23 may be readily shifted to obtain any desired pair of co-acting male and female die elements. The manipulation of the guide by movement of the handle 166 is quickly accomplished and where angular pieces are being treated operation of the set screw 154 quickly sets the guide piece 152 to the correct angle. By the provision of a soft metal plug 168 below the lower terminal of the set screw 154 the tightening of the screw 154 will also bring pressure to bear upon the forward threaded portion of the spindle 155 so as to lock not only the guide piece 152 in position but also the base 149.

The accurate and ready adjustment of the depth of the stroke of the male die member is of great importance because by the regulation of said stroke, channel or angle bends of various degrees of angularity may be obtained with the same pair of male and female die members. Thus, as seen in Figure 6, for example, when the die member 63 is in the lowered position thereof, indicated by the dot-dash lines on said figure, a bend of some particular angularity as, for example, that indicated by the reference character 144' will be obtained. The degree of angularity of the bend will be determined by several factors among which is the hardness or softness of the metal. By the fine regulation of the depth of the stroke of the male die member 63 by the rotation of the sleeve 124 the overbending necessary to accommodate for the "spring" of the metal is readily compensated for. With the die structure shown in Figure 6, lower limit of travel of the male die element 63 will produce more acute angular bends while, conversely, higher limits of travel of the said male die element will result in more obtuse bends.

The present machine is particularly adapted for flexible production where large runs are not required and where it is necessary frequently to shift back to a product previously made. By virtue of the calibration of the graduations 131 and 132 as well as the graduations 167, it becomes possible to return to a previous product construction and to duplicate the same. On straight angle bends it is possible to set the depth of stroke by rotation of one of the hand wheels 126 or 127 with reference to the graduations 131 and 132 to a predetermined position so that the operator by referring to a suitable table (not shown) including previously determined calibrations, may obtain desired different angles or bends without experimentation. Such a chart may include not only the various stop settings, but information correlating these settings with the various combinations of dies, material thicknesses, and types of material.

Manipulation of the handle 166 enables the operator to quickly determine the length of a leg or legs of a particular bend. This gauge construction therefore permits the ready formation of many different types of bend, tabs, legs, brackets, or box forms. For example, if a piece of metal is to be bent up and is to have one leg thereof one inch long, handle number 166 is rotated until the graduations on the wheel 164 indicate one inch. By virtue of the compact arrangement of the various parts, a device of high versatility is produced and yet which takes a minimum of floor space. All of the controls are within handy reach of the operator's hands or feet so that apart from the adjustment of the device to handle different shapes, when it is desired to use the device as a production machine, this may be satisfactorily done.

I wish it to be understood that I do not desire to be limited to the exact details of construction shown and described, for obvious modifications will occur to a person skilled in the art.

I claim:

1. A quick change press brake for use in forming material, comprising: a first die; a second die; first means to move said first die toward said second die, said means including a cylinder having a hollow neck and an externally flanged piston rod slidably disposed within said neck; and second adjustable means to limit movement of the first die toward the second die, said second means including an internally flanged sleeve threadedly engaged on said neck, the internal flange on said sleeve being adapted to act as a detent for the external flange on the piston rod.

2. A quick change press brake for use in forming material, comprising: a first die; a second die; first means to move said first die toward said second die, said means including a cylinder having a hollow neck and an externally flanged piston rod slidably disposed within said neck; and second adjustable means to limit movement of the first die toward the second die, said second means including an internally flanged sleeve having graduations thereon and threadedly engaged on said neck, the internal flange on said sleeve being adapted to act as a detent for the external flange on the piston rod; and a stationary pointer mounted on said cylinder and adapted to coact with the graduations on said sleeve.

3. A quick change press brake for use in forming material comprising: a first die; a second die; means to move said first die toward said second die; means to rotatably mount the second die on said press brake; and gauge means adjust-

ably positioned in the vicinity of a point at which said dies are juxtaposed, said gauge means including a control therefor penetrating said means for rotatably mounting the second die substantially at the axis of rotation of said last mentioned means, whereby rotation of said second die does not affect the said gauge means.

4. A quick change press brake for use in forming material, comprising: a first die; a second die; means to move said first die toward said second die; means to rotatably mount the second die on said press brake; gauge means adjustably positioned in the vicinity of a point at which said dies are juxtaposed, said gauge means including a control therefor penetrating said means for rotatably mounting the second die substantially at the axis of rotation of said last mentioned means, whereby rotation of said second die does not affect the said gauge means; adjustable stop means to limit movement of said first die toward said second die; and graduations associated with said stop means to indicate the limit of travel of the first die toward the second die; and graduations associated with said gauge means control and disposed in front of the second die to indicate the position of said gauge means with relation to said point of juxtaposition.

5. A quick change press brake for use in forming material, comprising: a first die; a second die; first means to move the first die toward the second die; second means to rotatably mount the second die on the press brake; a guide rod extending from the press brake in the vicinity of the point of juxtaposition of said dies; a base horizontally movable on said guide rod; a guide piece on said base; a spindle rotatably mounted on the press brake and in threaded engagement with said base; and third means to rotate said spindle so as to advance and retract said base and guide piece; said third means penetrating said second means at the axis of rotation of the second means; whereby the third means may be actuated independently of the rotation of the second die.

6. A quick change press brake for use in forming material, comprising: a first die; a second die; first means to move the first die toward the second die; second means to rotatably mount the second die on the press brake; a guide rod extending from the press brake in the vicinity of the point of juxtaposition of said dies; a base horizontally movable on said guide rod; a guide piece mounted on said base for movement about a vertical axis; a spindle in threaded engagement with said base; and third means to rotate said spindle so as to advance and retract said base and guide piece in a generally horizontal plane; said third means penetrating said second means at the axis of rotation thereof; whereby the third means may be actuated independently of rotation of the second die.

RUDOLPH FUNK.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,664,851	Glass	Apr. 3, 1928
848,822	Greenleaf	Apr. 2, 1907
1,474,438	Muller	Nov. 20, 1923
1,268,277	Ransdall	June 4, 1918
2,135,639	Gorham	Nov. 8, 1938
Re. 10,665	Towle	Nov. 24, 1885
621,097	Keim	Mar. 14, 1889
626,448	Tennant	June 6, 1899
1,863,448	Landenberger et al.	June 14, 1932
986,809	Derbyshire et al.	Mar. 14, 1911
284,910	Seymour	Sept. 11, 1883