F. TODD.

MACHINE FOR BENDING OR CORRUGATING AND CRIMPING SHEET METAL.

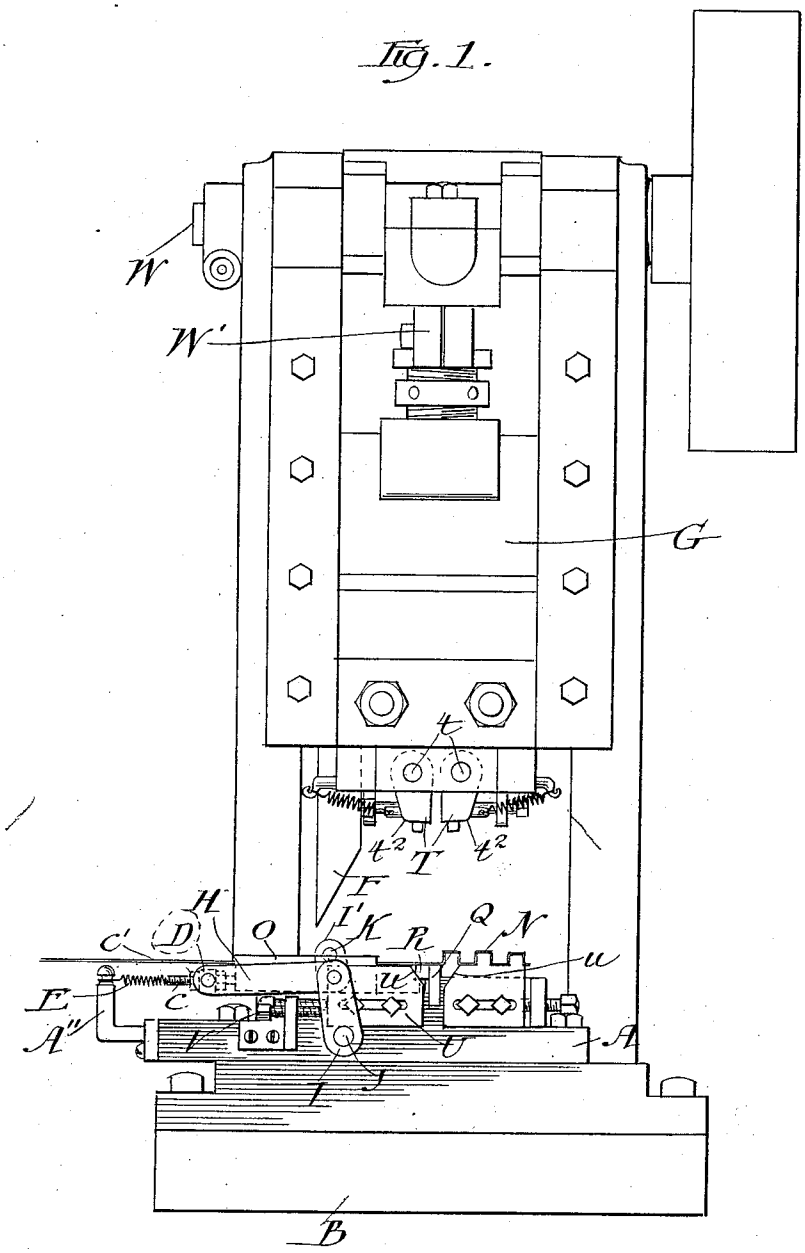
APPLICATION FILED DEC. 11, 1909.

1,031,599.

Patented July 2, 1912.

3 SHEETS—SHEET 1.

Fig. 1.



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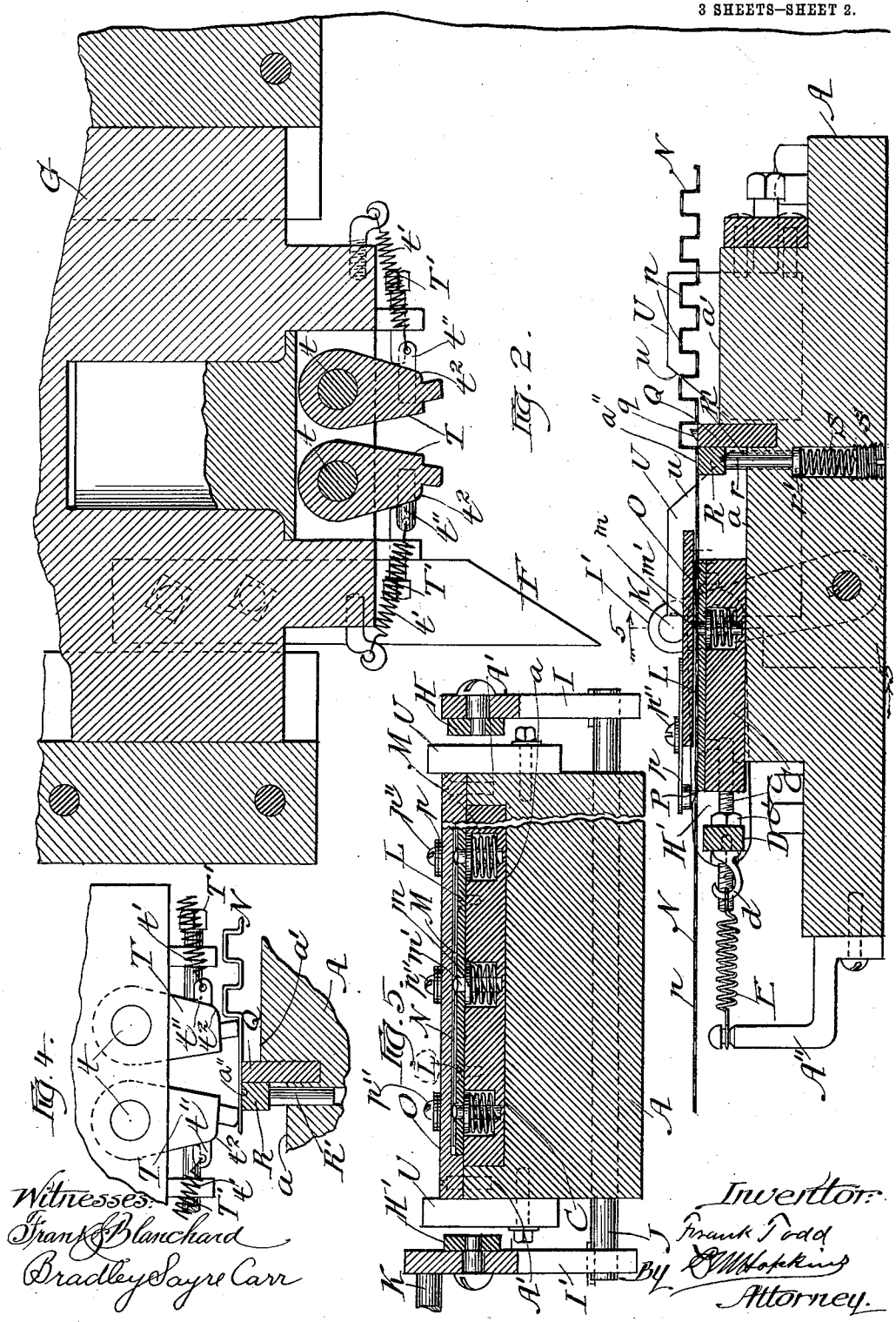

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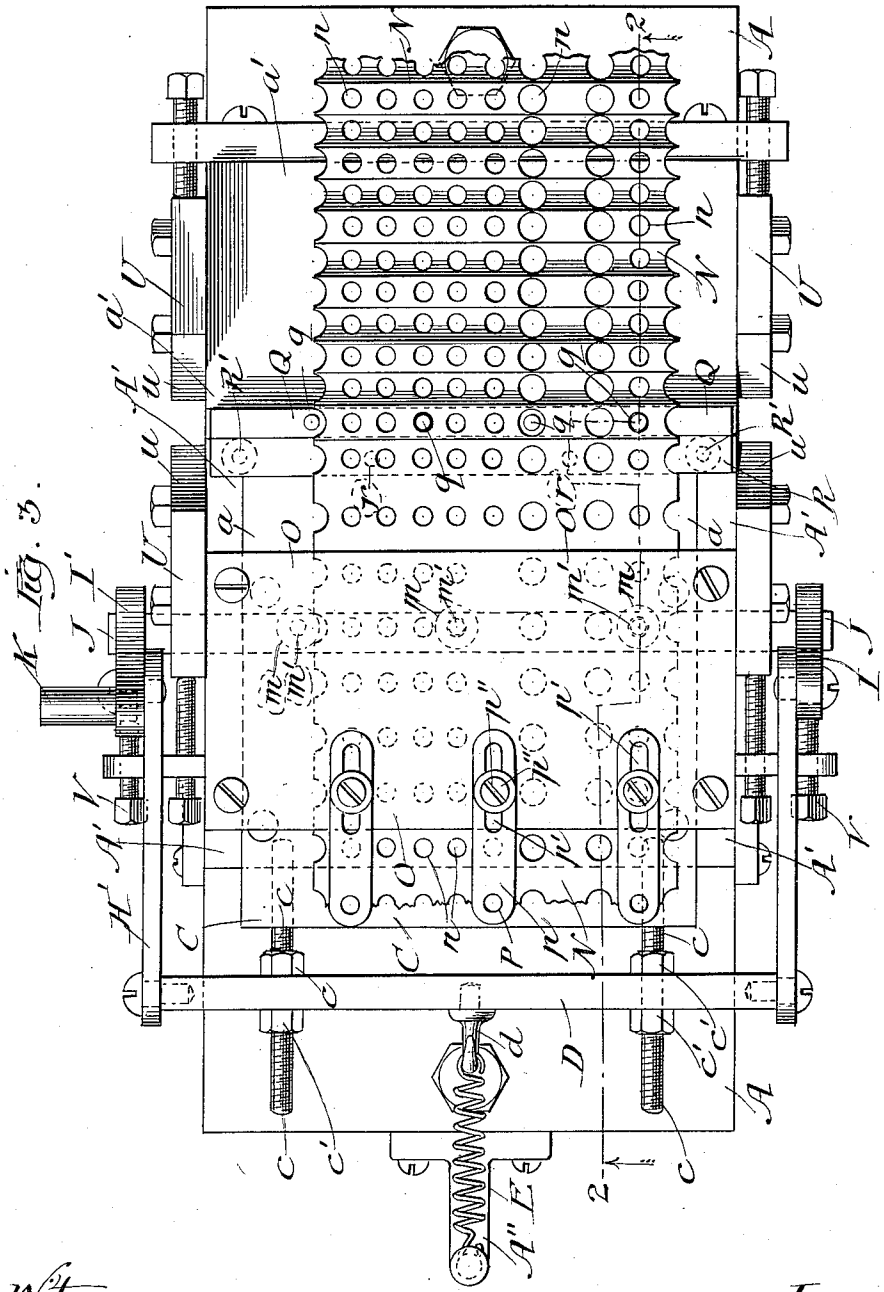

Fig. 3.

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UNITED STATES PATENT OFFICE.

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MACHINE FOR BENDING OR CORRUGATING AND CRIMPING SHEET METAL.

1,031,599. Specification of Letters Patent. Patented July 2, 1912.

Application filed December 11, 1909. Serial No. 532,554.

To all whom it may concern:

Be it known that I, FRANK TODD, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Machines for Bending or Corrugating and Crimping Sheet Metal, of which the following is a specification.

The present invention relates to a machine for bending sheet metal upon parallel lines and in such directions that the sheet will be provided with a continuous series of corrugations, crimps or channels crossing it transversely, which corrugations, crimps or channels have their open sides presented alternately in opposite directions or at opposite faces of the sheet. I am, of course, aware that machines have heretofore been used for thus crimping or corrugating sheet metal and the object of the present invention is to provide a machine which will crimp or corrugate the sheet with absolute uniformity, and more particularly one which will form corrugations, crimps, or channels, the sides of which are flat and form true and accurate angles relatively to each other, uniformly throughout the sheet. By properly shaping and adjusting the relatively reciprocable, coöperating forming dies of the machine the sides of the crimps or channels may be brought to any desired angles relatively to each other and there permanently set or fixed, and this setting or fixing of the crimps or channels, together with the accurate spacing apart of the centers of the crimps or channels, is the principal object of the present invention.

Another object of the invention is to accurately form and space apart the centers of the crimps or channels with relation to certain other features, such as perforations, with which the sheet is provided before being subjected to the action of the forming dies and which are to be essential features of the completed article and in this use of the machine such features or perforations are made use of in connection with the feeding mechanism in bringing the sheet into accurate, proper position to be acted upon by the forming dies. In those instances in which the completed crimped or channeled sheet is not to have any such features or perforations accurately related to the crimps or channels, the sheet is nevertheless preferably provided with a sufficient number of such features or perforations for coöperating with the feed mechanism for bringing the sheet into proper position to be operated upon by the forming dies.

To these ends the invention consists in the features of novelty that are hereinafter described with reference to the accompanying drawings which are made a part of this specification, and in which:

Figure 1 is a front elevation of a machine embodying the invention. Fig. 2 is a vertical longitudinal section of portions thereof on a larger scale, the planes in which the section is taken being indicated by the line 2—2 Fig. 3. Fig. 3 is a plan view of those portions of the machine which are below the upper die. Fig. 4 is a view, partly in elevation and partly in section, of the coöperating dies in the positions which they occupy when about to commence the bending and crimping operation, the upper die being shown in front elevation and the bed die in vertical longitudinal section in the axial plane of the rear guide-pin of the stripping bar. Fig. 5 is a vertical transverse section on the line 5—5, Fig. 2, looking in the direction of the arrows.

A is a bedplate which may be mounted upon any suitable frame or support, as shown at B. The bedplate has a longitudinal channel *a* resulting in parallel shoulders A′ extending along its front and rear sides, respectively, and the bottom surface of this channel, taken in connection with the inner or adjacent surfaces of the shoulders A′, form a longitudinal guideway in which a slide C fits snugly but with sufficient freedom to permit the slide to be reciprocated therein. Projecting from the outer end of the slide are two stud bolts *c*, which pass through a crossbar D and receive upon opposite sides of said cross-bar lock-nuts *c*′, whereby the cross-bar is adjustably connected to the slide for imparting reciprocating movement to it. A coiled spring E is connected at one end to the bedplate A through the medium of a centrally located bracket A″ and at its other end to the crossbar D through the medium of a hook *d*, or other suitable device, located at the center of said bar. This spring serves to move the slide in one direction, for retracting it and its movement in the opposite direction, advancing it, is derived from a cam F, which, in turn, derives its movement from, and there-

fore, moves synchronously with, the reciprocating plunger G, by which one of the forming dies is carried. Movement is transmitted from the cam F to the slide C through the medium of a pair of substantially horizontal, longitudinal links H and H′, located, respectively, at the front and rear sides of the bedplate, corresponding ends of which links are jointed to the upper ends of a pair of arms I and I′, which, also, are located at the front and rear sides of the bedplate, respectively, a transverse rock-shaft I which is journaled in the bedplate, and to the front and rear ends of which the lower ends of said arms are rigidly secured, respectively, the cross bar D, the front and rear ends of which are jointed to the remaining ends of the links H and H′, respectively, and a pin K projecting laterally from the upper end of the arm I′ in position to be engaged by the cam F as it descends. It will be observed that this mechanism avoids all unequal lateral strains upon the slide C, and while this is preferable, it is manifest that the duplicated parts constituting the equalizing features of this mechanism for reciprocating the slide may be dispensed with, without materially detracting from the efficiency of the machine.

A wearplate L is secured to the top side of the slide C and this wearplate also serves to partially close the tops of sockets or cavities which are formed in the slide and in each of these sockets is arranged a coiled spring M, which exerts its pressure downward upon the slide at the bottom of the socket and upward against a shoulder *m* formed upon or secured to a feed dog *m′*. The upper portion of the dog extends through and projects slightly above the wearplate L, and its upper extremity is beveled or sloped downward and away from its advancing side as it feeds the stock (a strip of sheet metal) N to the machine, while its advancing side presents an abrupt shoulder adapted to engage the sheet N and feed it to the machine. As the sheet N is being fed forward through the machine it rests upon the wearplate L and is held down thereon, or prevented from moving upward therefrom for any considerable distance, by a bridge-plate O which spans the channel *a* and is secured to the bedplate along the tops of the shoulders A′. This bridge-plate carries one or more retractile stop dogs which are adapted to engage the sheet and prevent its retrograde movement. Each of these stop dogs consists of a stud or short pin P, the lower extremity of which is beveled or sloped downward and in the direction of the feed, while its side which is presented in the direction of the feed forms an abrupt shoulder. Each of these pins is carried by a spring *p* which, in turn, is secured to and carried by the bridge-plate C. For this purpose each of them is slotted, as shown at *p′* and through each of these slots passes a screw *p″* which is screwed into the bridge-plate, washers being interposed between the heads of the screws and the springs, if desired. The bedplate is provided also with a transverse groove in which is immovably secured a plate Q the upwardly projecting portion of which may be called the anvil of the bed die. Its top preferably terminates in the plane of the top surface of the wearplate, and the form or shape of its working faces is determined by the shape or angular relations which it is desired to give the sides of the crimps or channels. They are rectangular in the illustration given in the drawings but they may flare outward or be undercut, and of dovetail or other desired shape. The bedplate carries also a bar R which has a double purpose, namely, a stripper and a depressible die-part or section. As a stripper it lifts the sheet upward and clear of the fixed anvil Q after each closing operation of the dies, in order that the sheet may be advanced or fed forward another step. It is preferably located at the receiving side of the anvil—or in other words at the side toward which the sheet advances in being fed forward. It is carried by a pair of pins *r* which loosely occupy vertical bores in the bedplate and have enlarged heads *r′* which occupy enlarged bores in the bedplate and communicate with the bores aforesaid, the enlarged bores constituting sockets occupied by coiled springs S which exert their pressure against the enlarged heads *r′* and downward against the bedplate through the medium of screw-plugs *s* which close the lower ends of the bores. The springs S normally hold the bar R in its elevated position and restore it to this position when the upper die is lifted, and in moving to this upper position it serves the purpose of a stripper for stripping the channeled sheet from the anvil Q. As the upper die descends it will depress the bar R until the latter comes in contact with the bedplate, at the bottom of the channel *a*, whereby its further downward movement is arrested. In this position it forms a part of the bed die, its upper surface *a″* being at right angles to the forward side and parallel with the top side of the anvil Q. Also, the upper surface *a′* of the bedplate forms a part of the said bed die and has a similar angular relation to the anvil. For assisting in guiding the bar R in its movements both upward and downward it is provided with downwardly projecting pins R′ which work freely in sockets in the bedplate near its front and rear sides.

The upper die, which is carried by the plunger G as aforesaid, has two parallel jaws T which are supported by pivot pins *t* having parallel axes, so that the lower por-

tions of the jaws may move toward and from each other in arcs co-incident with said axes. Normally, the lower portions of the jaws are held apart by coiled springs t', each of which is connected at one end to a centrally located arm t'' projecting laterally from one of the jaws and at the other end to the plunger itself by any suitable means. The movement of the jaws away from each other is limited by stop screws T' which have threaded engagement with lugs or other suitable parts carried by the plunger and at their inner ends engage the outer sides of the jaws. The working surfaces of the jaws are formed on their lower portions and are complementary to the working surfaces of the bed die, which includes the anvil Q and the horizontal surfaces a' and a''. In their normal positions the lowermost portions of the working surfaces of the jaws T are a distance apart equal to three times the width of the anvil Q and the opposite portions of these working surfaces diverge downward, slightly, but as the plunger descends the rounded portions t^2 of the jaws engage cams U, which are adjustably secured to the front and rear sides of the bedplate A and have working surfaces u which slope downward and toward each other, so that as the jaws descend they are forced toward each other in such manner as to bend the sheet N over the anvil and force it into close contact with the sides thereof and with the surfaces a' and a'' thus making four complete right-angle bends by one and the same operation of the coöperating dies. It will be understood that the several channels formed in the sheet N are of equal width and also of equal depth and that three units of length of the flat strip, equal to the bottom and two sides of each channel, must be fed forward through the machine for forming each channel. In other words each forward step-by-step operation of the feeding mechanism, supplemented by a certain pulling action which the dies exert as they are closing, must advance the flat sheet a distance equal to the width plus twice the depth of a channel.

The completed article is intended to have perforations n through the bottom of each and every channel while the sides of the channels are without perforations. This being so it is necessary that the sheet, before being fed to the machine, be provided with transverse rows of perforations n, the central lines of adjacent rows of which are located at a distance apart just equal to the width and depth of a channel *i. e.*, two units of length of the strip. When the sheet is in position to be acted upon by the dies the central line of one of these rows of perforations will be exactly in the central line of the anvil and will be occupied by the studs q. At the same time the feed dogs m' occupy perforations of another row and the stop dogs P occupy perforations of still another row. These positions of the parts just mentioned are best illustrated in Figs. 2 and 4, the former of which shows the parts in the positions which they occupy after the dies have operated, forming a new channel, and before the sheet has been advanced and positioned for the next operation, while the latter shows them in the positions which they occupy when the sheet has been advanced and positioned for the next operation, the dies being about to operate. It will be observed that the adjacent working faces of the jaws are separated by the distance equal to the width plus double the depth of a channel,—*i. e.*, three units of length. Or in other words, in the example given, where all of the channels are of equal width and depth (which might be varied) a distance equal to three times the width (or depth) of a channel. As the jaws descend from the positions shown in Fig. 4 they will bend the sheet over the anvil, forcing those portions of the sheet which are upon opposite sides of the anvil downward and toward each other, and in doing so they will draw the uncrimped portion of the sheet which is on the receiving side of the anvil forward a distance equal to the depth of the channel being formed (one unit of length) to form one side of it. This forward movement of the sheet is permitted by the beveled ends of the feed dogs and stop dogs, bodily movement of the sheet in either direction relatively to the anvil being prevented by the studs, q. This drawing forward of the sheet will bring perforations of succeeding rows in positions to be entered by said dogs, respectively. After the jaws have completed this action they will be lifted by the plunger, and as they are being lifted the newly formed crimp or channel will be stripped from the anvil by the stripping bar R and held in position to be advanced past the anvil, as shown in Fig. 2. It will be understood that while the jaws are moving from the positions shown in Fig. 4 to their lowermost positions the slide C, which is a part of the feeding mechanism will be at the limit of its forward movement, having been moved to this position by the cam, F, during its descent, acting through the mechanism already described. As the jaws move upward from their lowermost positions to the positions shown in Figs. 1 and 2 the slide will be retracted by the spring S, its rearward movement being limited by an adjustable stop-screw V carried by a bracket on the bedplate A and adapted to engage the link I. Any retrograde movement of the sheet as the slide is being retracted is positively prevented by the stop-dogs P and studs q. As the plunger descends from the position shown in Figs. 1 and 2 to bring

the jaws to the position shown in Fig. 4 the cam F will engage and move the pin K and, acting through the mechanism already described, advance the slide, to the limit of its forward movement, and, transmitted to the feed dogs m', will cause the sheet to be advanced a distance equal to double the width of a channel (two units of length), thereby moving the sheet from the position shown in Fig. 2 to the position shown in Fig. 4 during which movement the stop-dogs P will be retracted by the sheet and again moved into engagement with the sheet by their carrying springs.

The cams U are adjustable toward and from each other for the double purpose of compensating for wear and bringing them into accurate positions for producing the proper movement of the jaws toward each other. Any suitable means for reciprocating the plunger G may be used. In the drawing I have shown a driven shaft W having a crank and a pitman, W′, the upper end of which is jointed to the crank and the lower end of which is jointed to the upper end of the plunger. It will be understood, however, that the invention is not limited to any particular means for producing movement of the dies relatively to each other, nor is it material which of the two dies is, in fact, movable and which is fixed, the requirements of the invention being satisfied by their relative movability, by whatsoever means this may be produced.

The feed dogs and the stop dogs are herein mentioned in the plural, but it is manifest that in many instances one of each will amply serve the purpose for which these dogs are provided, and although it is preferred to use a plurality of such dogs, with a view to avoiding unequal lateral strains upon the sheet, nevertheless the invention is not limited to any particular number of these dogs.

It will be understood that the terms above and below, upper and lower, vertical and horizontal and similar terms are not to be taken as absolute, but only relative and are used in this specification only for the sake of brevity combined with clearness. They are literally correct as applied to the invention in the specific form in which it is illustrated, and hence if the position of the machine be changed relative to a fixed standard said terms may be read for any other terms that are appropriate to the changed condition.

My original aim was to provide a machine for working upon very thin sheet metal and in order to do this successfully and avoid stretching or rupturing the sheet it is necessary, or at least highly desirable, that as it passes through the machine the sheet should not be subjected to any considerable tensile strains from any cause. To accomplish this it is necessary to avoid, as much as possible, the scraping or rubbing of the sheet, such as would be occasioned by dragging it over angular portions and at the same time bending it. It is for this reason that the lowermost working die surfaces of the jaws T are normally at such a distance apart that they engage the sheet precisely on the lines upon which it is bent to form the bottoms of the alternate channels, the bottoms of the intervening channels being formed by the top of the anvil and it is for the same reason that while the dies are approaching each other and thereby bending the sheet over the anvil the jaws are simultaneously approaching each other so that the angles of the die surfaces of the jaws will complete their movement toward each other and toward the sides of the anvil simultaneously with the completion of their movement downward toward the working surfaces a' and a'' of the bed die. Thus there is no scraping or relative movement of the die surfaces of the jaws upon the sheet. It was also one of my aims to provide a machine which would form a continuous series of similar channels in the sheet and to this end it is necessary that the reduced portions of the jaws on which the working die surfaces are formed be of less width than the channels, otherwise the channels could not be formed around them. As a matter of fact the machine actually forms only alternate channels, the intervening channels being simply incidental thereto. For example the last-formed channel shown in Fig. 4 was the result of the preceding operation with the dies and the channel which will be formed by the next operation of the dies will correspond to this last formed channel, the intervening channel which will be occupied by the reduced die portion of the right hand jaw T when the dies are brought together will be simply an incident due to the proportions and relations of the parts and the extent of the feeding of the sheet forward. In order to accomplish these results the machine must be timed so that the various parts will operate in the manner and at the times already set forth. When so proportioned and timed the jaws will be moved toward each other and the dies will be moved toward each other simultaneously and at the same speed after the sheet is engaged by both dies, as shown in Fig. 4.

Having thus described my invention, the following is what I claim as new and desire to secure by Letters Patent:

1. In a machine for bending sheet metal the combination with a bed die and an upper die which are relatively reciprocable, the bed die having working surfaces of different heights presented toward the upper die, and the upper die having a pair of relatively movable jaws provided with working

die surfaces which are complementary to and adapted to coöperate with the opposing working surfaces aforesaid of the bed die as the dies approach, of means for relatively reciprocating the dies and means for relatively moving the jaws toward each other.

2. In a machine for bending sheet metal the combination with a bed die and an upper die which are relatively reciprocable, the bed die having working surfaces of different heights presented toward the upper die, and the upper die having a pair of relatively movable jaws provided with working die surfaces which are complementary to and adapted to coöperate with the opposing working surfaces aforesaid of the bed die as the dies approach, of means for relatively reciprocating the dies and means for relatively moving the jaws toward each other, said means for relatively reciprocating the dies and relatively moving the jaws toward each other being of such construction and so timed that the dies and jaws are moved simultaneously.

3. In a machine for bending sheet metal the combination with a bed die and an upper die which are relatively reciprocable, the bed die having working surfaces of different heights presented toward the upper die, and the upper die having a pair of relatively movable jaws provided with working die surfaces which are complementary to and adapted to coöperate with the opposing working surfaces aforesaid of the bed die as the dies approach, of means for relatively reciprocating the dies and means for relatively moving the jaws toward each other, said means for relatively reciprocating the dies and relatively moving the jaws toward each other being of such construction and so timed that the dies and jaws are moved simultaneously and at the same speed.

4. In a machine for bending sheet metal the combination with a bed die having an anvil over which the sheet is to be bent, an upper die having working surfaces adapted to coöperate with the working surfaces of the bed dies, said dies being relatively reciprocable, said upper die having a pair of relatively movable jaws, of means for relatively reciprocating the dies and means for relatively moving the jaws, said means for relatively reciprocating the dies and relatively moving the jaws toward each other being of such construction and so timed that after both dies have engaged the sheet, the relative approaching of the dies and relative approaching of the jaws will take place simultaneously and at the same speed.

5. In a machine for bending and forming a continuous series of corrugations in sheet metal, the combination with a pair of relatively reciprocable dies having opposing coöperating working surfaces of different heights, and reciprocating mechanism therefor, one of said dies having a pair of jaws movable laterally relatively to each other, of means for relatively moving said jaws and mechanism for feeding a strip of sheet metal between the dies, step by step, alternately with the bending operations toward each other as the coöperating dies approach each other.

6. In a machine for bending and forming a continuous series of corrugations in sheet metal, the combination with a pair of relatively reciprocable dies having opposing coöperating working surfaces of different heights and reciprocating mechanism therefor, one of said dies having a pair of jaws movable laterally relatively to each other, of a cam for relatively moving said jaws toward each other, means for supporting said cam in operative position, and mechanism for feeding a strip of sheet metal between the dies, step by step, alternately with the bending operations.

7. In a machine for bending and forming a continuous series of corrugations in sheet metal, the combination with a pair of relatively reciprocable dies having opposing coöperating working surfaces of different heights and reciprocating mechanism therefor, one of said dies having a pair of jaws movable relatively to each other, of a pair of cams for moving said jaws toward each other, means for supporting said cams in fixed relation to one of said dies and in the paths of the jaws of the other of said dies whereby said jaws are moved toward each other as the dies approach each other and mechanism for feeding a strip of sheet metal between the dies, step by step, alternately with the bending operations.

8. In a machine for bending and forming a continuous series of corrugations in sheet metal, the combination with a pair of relatively reciprocable dies having opposing coöperating working surfaces of different heights and reciprocating mechanism therefor, one of said dies having a pair of relatively movable jaws, and adjustable means for limiting the said movement of the jaws away from each other, of means for moving the jaws a fixed and limited distance toward each other, and mechanism for feeding a strip of sheet metal between the dies, step by step, alternately with the bending operations.

9. In a machine for bending and forming a continuous series of corrugations in sheet metal, the combination of a bed die and an upper die which are relatively reciprocable and have opposing, coöperating working surfaces, the bed die having an anvil and a depressible bar adjacent thereto, portions of the working surfaces of the bed die being carried by both the anvil and the depressible bar, and the upper die having a

pair of relatively movable jaws carrying its working surfaces, means for relatively moving the jaws, means for relatively reciprocating the dies, means for lifting the depressible bar as the dies separate, and mechanism for feeding a strip of sheet metal between the dies, step by step, alternately with the bending operations.

10. In a machine for bending and forming a continuous series of corrugations in sheet metal, the combination with a bed die having an anvil and a depressible bar located adjacent thereto, both of which have working die surfaces, means for guiding said bar in its movements, and springs for moving it upward for lifting the bar and stripping the work from the anvil, of an upper die reciprocable relatively to the bed die, means for reciprocating it, said upper die having working surfaces opposed to and adapted to coöperate with the working surfaces of the bed die, and mechanism for feeding a strip of sheet metal between the dies, step by step, alternately with the bending operations.

11. In a machine of the class described, the combination with a bed die having angularly related working surfaces located at different heights, one of said working faces being formed on a movable bar, means for yieldingly holding said bar in normal position and permitting it to recede under pressure, and a stop for limiting its movement under such pressure, of a second die having a pair of pivoted jaws movable toward and from each other and have working faces complementary to the working faces of the die first aforesaid, means for yieldingly holding said jaws apart, cams located in the paths of said jaws for moving them toward each other as the dies approach each other, and means for relatively reciprocating said dies.

12. In a machine of the class described, the combination of a pair of relatively reciprocable coöperating dies, reciprocating mechanism therefor, and feeding mechanism, said feeding mechanism having a reciprocable slide, retractile feed dogs carried by the slide, retractile stop dogs, means independent of the slide for supporting said stop dogs in fixed positions, a cam, means connecting the cam and one of the dies whereby they are held in fixed relations to each other, a part located in the path of and adapted to be engaged and moved by said cam, and means for transmitting movement from said part to the slide.

13. In a machine of the class described, the combination of a pair of relatively reciprocable coöperating dies, reciprocating mechanism therefor, and feeding mechanism, said feeding mechanism having a reciprocable slide, feed dogs carried by said slide and adapted to engage the sheet, a pair of links located upon opposite sides of the slide, means for connecting said links and slide, a cam, means for connecting said cam with one of the dies in fixed relation thereto, a part located in the path of and adapted to be engaged and moved by said cam, and means for transmitting movement from said part to the links.

14. In a machine of the class described, the combination of a suitable frame having a bedplate, a pair of relatively reciprocable coöperating dies, reciprocating mechanism therefor, and feeding mechanism, said feeding mechanism having a reciprocable slide mounted upon the bedplate, feed dogs carried by the slide and adapted to engage the sheet, a bar at the rear end of the slide, adjustable means for connecting said bar and slide, a spring for retracting the slide, a cam, means for connecting it with one of the dies in fixed relation thereto, a part located in the path of said cam, and means for transmitting movement from said part to said bar for advancing the slide.

15. In a machine of the class described, the combination of a suitable frame having a bedplate, a pair of relatively reciprocable coöperating dies, reciprocating mechanism therefor, and feeding mechanism, said feeding mechanism having a reciprocable slide, a pair of links located upon opposite sides of the slide, means forming a jointed connection between the links and slide, a shaft journaled to the bedplate, a second pair of links non-rotatively connected at one end to said shaft and at the other end jointed to the links aforesaid, a movable part carried by one of said links, and a cam for engaging and moving said part for advancing the slide.

16. In a machine of the class described, the combination of a suitable frame having a bedplate, a pair of relatively reciprocable coöperating dies, reciprocating mechanism therefor, and feeding mechanism, said feeding mechanism having a slide, feed dogs carried by said slide, means for advancing the slide, means for retracting the slide, a bridge-plate secured to the bedplate and spanning the slide, and retractile stop dogs carried by the bridge-plate and adapted to engage the sheet for preventing its retrograde movement.

17. In a machine for bending sheet metal the combination of a bed die having an anvil over which the sheet is to be bent and working surfaces extending relatively outward from the sides of the anvil below the top thereof, an upper die having a pair of relatively movable jaws carrying working surfaces opposed to and adapted to coöperate with the working surfaces of the bed die, means for normally holding said jaws at a predetermined distance apart, mechanism for feeding a sheet of metal between the dies

step by step, said feeding mechanism being of such construction that at each operation it advances the sheet a distance equal to double the width of the anvil, means for relatively moving the dies toward and from each other and means for relatively moving the jaws toward each other after their working surfaces engage the sheet, whereby the combined movement of the dies and jaws draw the sheet a predetermined distance toward the anvil.

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