W. CAMERON.

BLANK FEEDING MECHANISM.

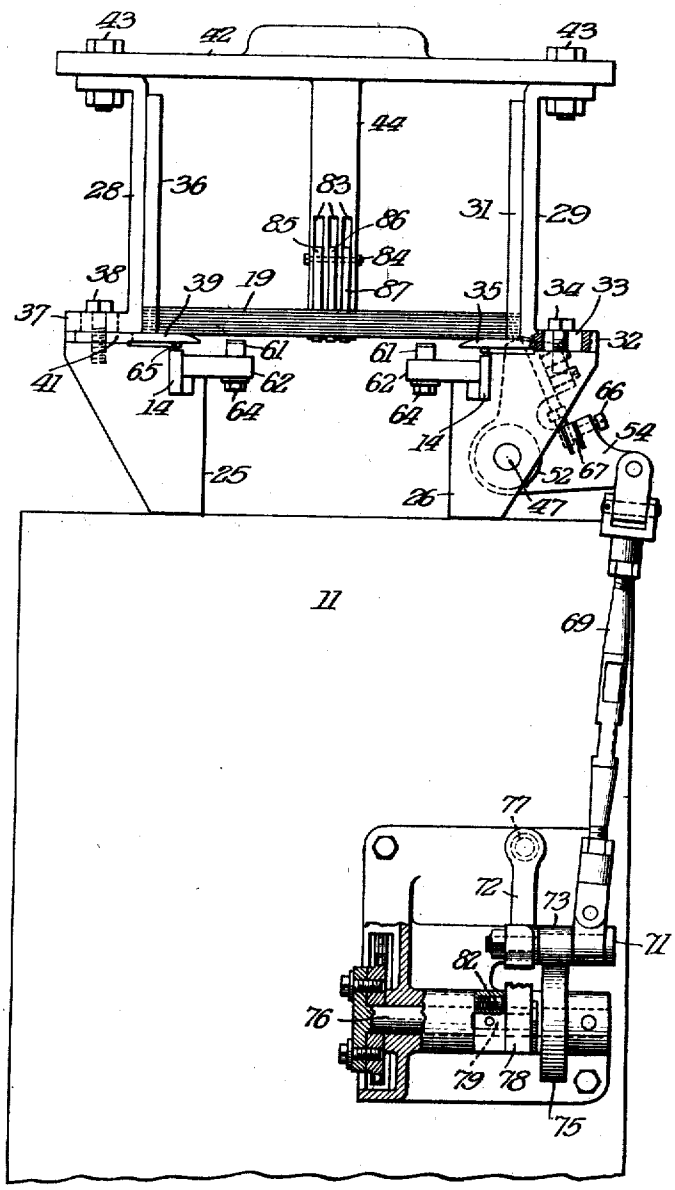
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1,242,520.

Patented Oct. 9, 1917.

5 SHEETS—SHEET 1.

Fig. 1



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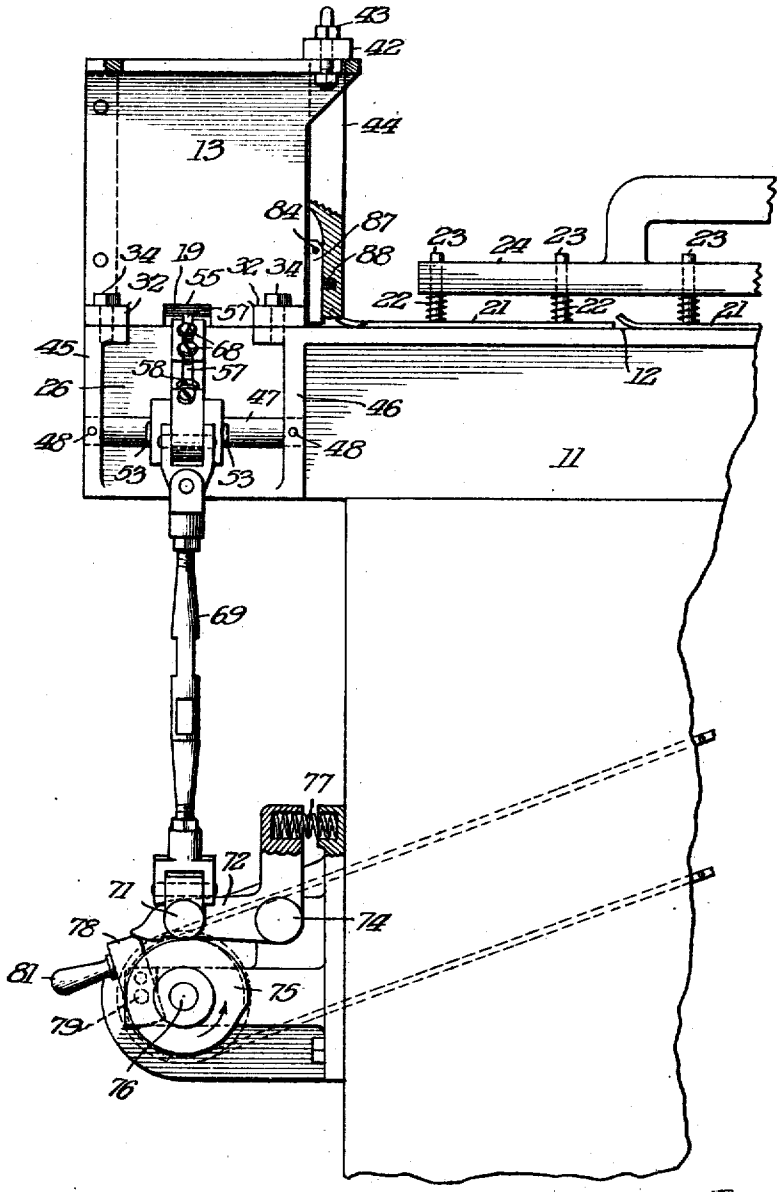
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5 SHEETS—SHEET 2.

Fig. 2



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5 SHEETS—SHEET 3.

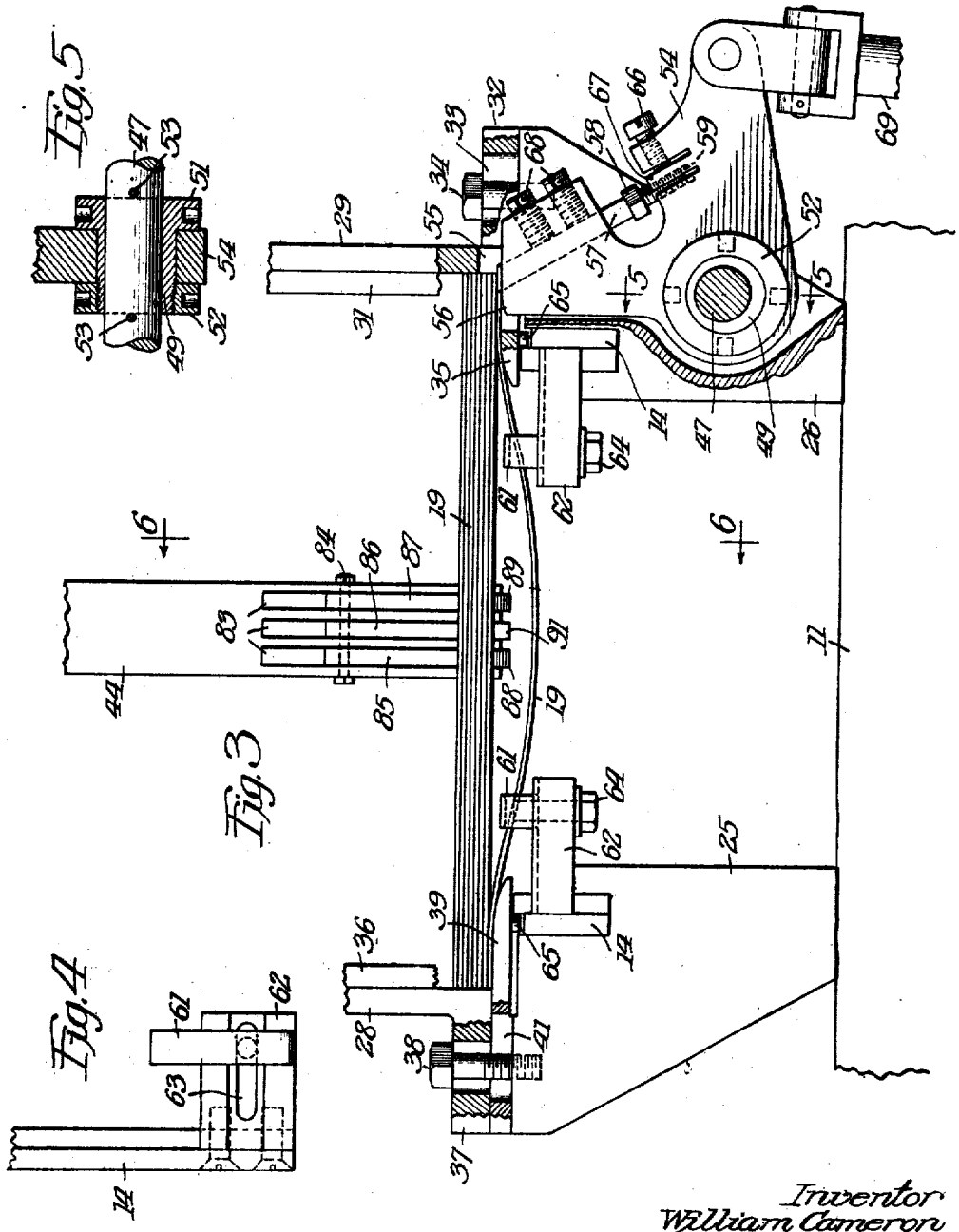


Fig. 5

Fig. 3

Fig. 4

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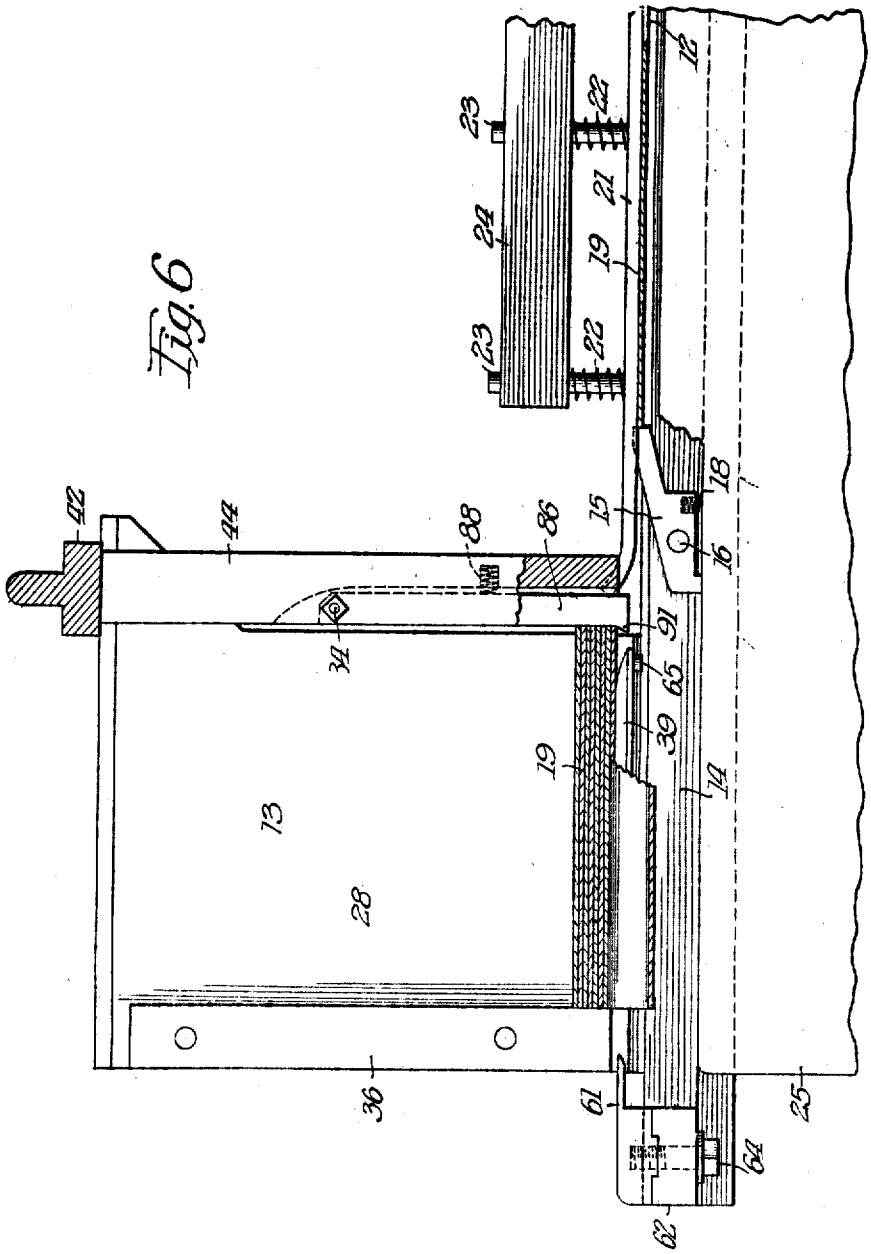
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Fig. 6



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5 SHEETS—SHEET 5.

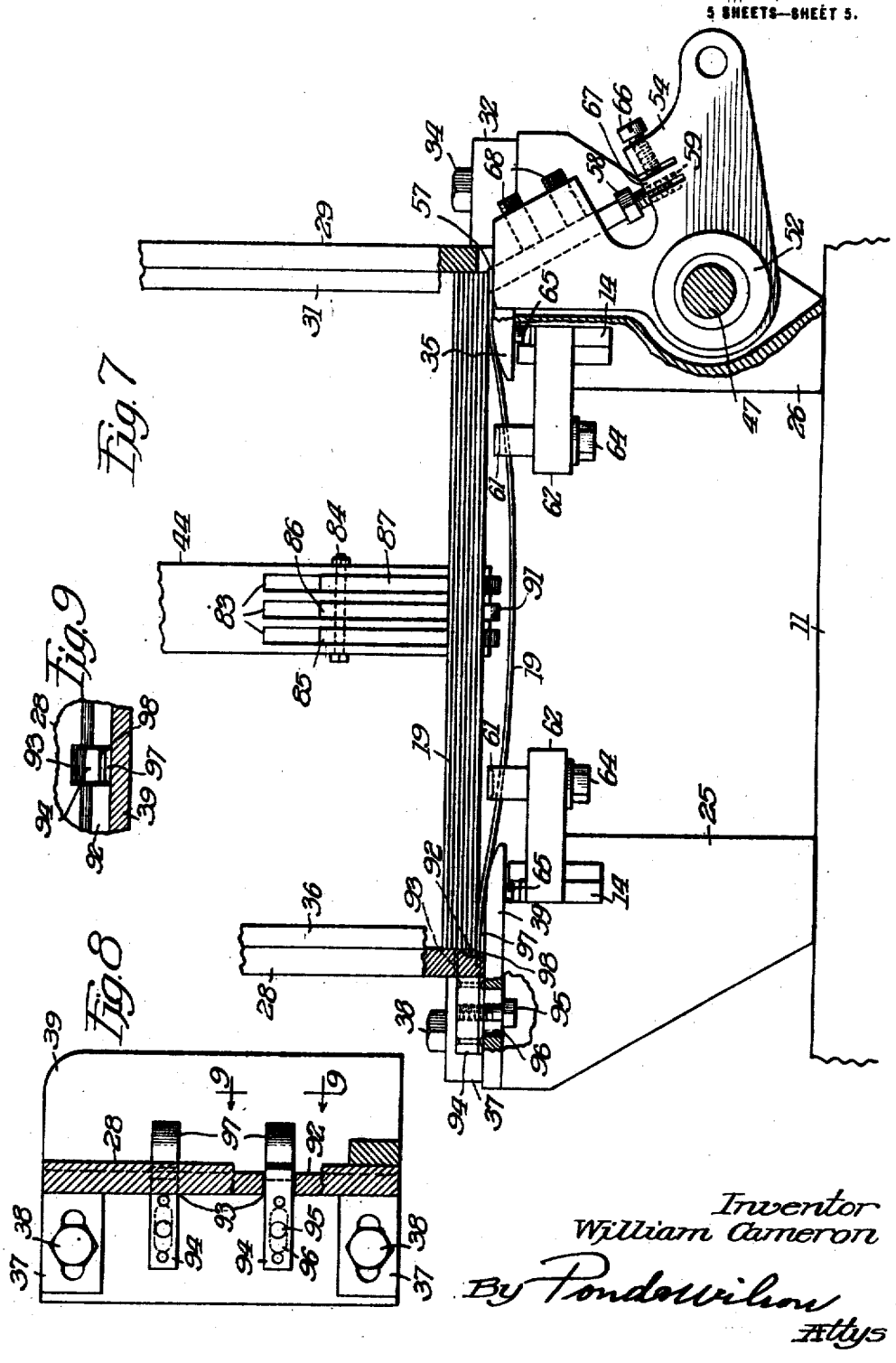


Fig. 7

Fig. 9

Fig. 8

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UNITED STATES PATENT OFFICE.

WILLIAM CAMERON, OF CHICAGO, ILLINOIS.

BLANK-FEEDING MECHANISM.

1,242,520. Specification of Letters Patent. Patented Oct. 9, 1917.

Application filed March 6, 1917. Serial No. 152,535.

To all whom it may concern:

Be it known that I, WILLIAM CAMERON, 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 Blank-Feeding Mechanism, of which the following is a specification.

My present invention relates in general to blank-feeding mechanisms, but the embodiment thereof disclosed in the present case is more particularly adapted for separating and feeding sheet metal blanks from a stack to a machine which operates upon the blank, such, for instance, as a machine for forming tin can bodies from flat sheet metal blanks.

I am aware that prior to my invention it has been proposed to separate the lowermost blank of a stack in a magazine by means of one or more suction cups which were elevated into engagement with the lower face of the lowermost blank and subsequently depressed or moved downwardly, the suction between the cup and the blank with which it was engaged being relied upon to draw the blank downwardly into position to be engaged and carried or fed from the magazine by reciprocatory feeding devices. Various objections, however, have arisen to the use of these vacuum or suction blank separating devices; among which may be mentioned the fact that these devices do not always make an air tight contact with the blank, particularly when the suction cups have become somewhat worn, with the result that the blank is not removed from the magazine, and the machine to which the blanks are supposed to be fed in succession, receives no supply and runs idle. Again, it frequently happens that the two lowermost blanks in the magazine will cling together as the result of burs on their edges or cohesion between their surfaces, and the suction cups will draw down two blanks instead of one, as desired, and these two blanks are fed into the machine together, sometimes with disastrous results. Furthermore, the use of vacuum cups necessitates that each machine shall be equipped with a vacuum-creating device connected with the suction cups, which device is not only expensive to manufacture and install but also requires the expenditure of considerable power to operate it.

One of the primary objects of my present invention is to provide a blank-separating and feeding mechanism which will eliminate the use of suction cups and their attendant mechanisms with their inherent disadvantages and inaccuracies, and which will positively and accurately separate the blanks, one at a time, from the remaining blanks in the magazine and feed them from the magazine to the machine designed to operate upon them.

More specifically my invention contemplates mechanism for separating the lowermost blank in a magazine from the remainder by exerting a pressure longitudinally upon the blank so as to buckle or bend the blank downwardly intermediate its ends into position to be engaged and carried away by blank-feeding devices.

Another object of my invention is to provide novel mechanism for exerting this longitudinal pressure upon the lowermost blank in the magazine and to so construct this mechanism that it will be capable of adjustment to various types and thicknesses of blanks to be operated upon, and to provide for throwing out or shutting off the operation of the blank-separating mechanism when desired without stopping the whole machine.

Another object of my invention is to provide means structurally independent of the mechanism which exerts longitudinal pressure upon the blank to be separated, which will facilitate the separation of the lowermost blank in the stack from the remainder and will prevent the return of the separated blank to its original position if for any reason the timing of the various mechanisms should become defective.

Still another object of my invention is to provide novel feeding mechanism for conveying the separated blanks away from the magazine, to so construct the same that the feed fingers may be adjusted to suit the requirements of different sizes or types of blanks, and also to provide devices which will prevent return movement of the blank with the reciprocatory feeding devices in case the blank should not be advanced into the machine as it should be.

Other objects and many of the attendant

advantages of my invention will be readily appreciated as the same becomes better understood by reference to the following description when considered in connection with the accompanying drawings.

Referring to the drawings,—

Figure 1 is an elevation, looking at the front end of a blank-feeding mechanism embodying my invention;

Fig. 2 is a side elevation, looking toward the left of Fig. 1;

Fig. 3 is an enlarged fragmentary view similar to Fig. 1, certain parts being broken away to show the position of the operating mechanism;

Fig. 4 is a fragmentary plan view of a novel feeding finger;

Fig. 5 is a fragmentary sectional view on the line 5—5 of Fig. 3;

Fig. 6 is a sectional view on the line 6—6 of Fig. 3;

Fig. 7 is a view similar to Fig. 3, showing an additional feature for insuring separation of the lowermost blank;

Fig. 8 is a plan view of the bottom of the magazine at one side, the side wall being shown in section; and

Fig. 9 is a fragmentary view on the line 9—9 of Fig. 8.

From an inspection of the drawings it will be observed that my improved mechanism is mounted upon one end of a machine, a portion of the frame construction of which is designated by reference character 11. While the machine may be of any type adapted to operate upon sheet metal blanks I have illustrated a portion of a can body-forming machine, the frame of which is formed to provide a pair of tracks or slideways 12 upon which the blanks are fed to the body-forming mechanism (not shown). The blanks are fed from the magazine, designated generally by reference character 13, along these tracks or slideways by means of a pair of reciprocatory feed bars 14 equipped with a plurality of feed dogs 15 pivoted upon laterally projecting studs 16 and normally held with their feed ends 17 projecting above the tracks by means of light expansion springs 18, all as shown in Fig. 6. The blanks 19 are fed along intermittently by these feed dogs and are held against return movement by clamping bars or plates 21, which are urged downwardly to yieldingly clamp the blanks between the bars 21 and the guideways 12 by means of springs 22 surrounding the pins 23 which project from the bars 21 upwardly loosely through openings formed in a guide frame 24.

The magazine 13 which is adapted to contain a stack of blanks to be fed to the machine is mounted upon the longitudinally extending members 25 and 26 of the machine frame 11. This magazine consists of a pair of side pieces 28 and 29 respectively, between which the blanks 19 are longitudinally disposed one upon another. The side piece 29 is provided at the rear with a vertically extending strip 31 which maintains one end of the stack in vertical alinement and is also provded with a pair of outwardly extending ears 32 each equipped with an elongated hole 33, through which a bolt 34 passes and is threaded into the member 26 to adjustably secure the side member 29 in position. A bottom member 35, preferably cast integrally with the side member 29, extends inwardly a limited distance from the side member to form a portion of the bottom of the magazine. The opposite side member 28 is likewise provided with a vertical strip or bar 36 and has laterally extending ears 37 through which bolts 38 extend to secure the side member in position. The bottom member 39, however, which projects inwardly from the side member 28 is preferably formed independently of the side member and is provided with an elongated slot 41 through which the bolts 38 pass so that this bottom member may be adjusted transversely of the magazine relatively to the side member 28 to accommodate the magazine to blanks of various lengths and thicknesses. The upper ends of the side members 28 and 29 are securely but adjustably connected together adjacent their rear edges by a cross bar 42 which is attached to the side members by bolts 43. This cross bar is provided with a downward extension 44 disposed in close proximity to the rear face of the stack of blanks in the magazine and carries devices which facilitate the separation of the lowermost blank, which devices will be later described. It should be noted, however, at this point that the bar 42 is capable of adjustment forwardly and rearwardly of the magazine so as to dispose the downward extension 44 close to the rear face of the stack of blanks irrespective of the width of the blanks disposed in the magazine.

It will be manifest from the foregoing that I have provided what might be termed a magazine having an open bottom, that is, the bottom members extend inwardly only a limited distance from the side members 28 and 29 so as to suppport the stack of blanks adjacent its ends, the central portion of the magazine being open at the bottom to permit downward bending or buckling of the lowermost blank so that it may be engaged and fed from the magazine.

For the purpose of separating the lowermost blank in the magazine from the remaining blanks I have provided mechanism for bending or buckling the lower blank, which will now be described: In webs 45 and 46 extending laterally outward from the member 26 I have mounted a shaft 47 which is fixedly held in its bearing in these webs

by pins 48. Upon the shaft intermediate its ends thereof is rotatably mounted a bearing sleeve 49 having an eccentric periphery, as best shown in Figs. 3 and 5, one end of the sleeve being expanded to provide an annular flange or head 51 adapted to be engaged by a spanner wrench, and the other end being threaded to receive a nut 52, also adapted to be engaged by a spanner wrench. The sleeve is held against longitudinal movement on the shaft 47 by a pair of pins 53, or other suitable means carried by the shaft. Upon the sleeve 49 there is loosely fitted a member 54 which resembles in general outline a bell crank lever comprising a substantially vertical arm and a substantially horizontal arm. The upper end of the vertical arm extends into the magazine through a slot or opening 55 formed in the side member 29 of the magazine and its upper face lies substantially flush and preferably slightly above the upper face of the bottom member 35, so that the lowermost blank in the stack will rest upon and be partially supported by this face. The upper inner corner of the vertical arm is also preferably rounded off slightly, as indicated at 56, on an arc concentric with the shaft 47, so that as the member 54 is oscillated upon the shaft the surface in contact with the lowermost blank will remain in a substantially horizontal plane, consequently the stack will not be moved vertically by oscillatory movements of the member. The upper arm of the member 54 is also provided with a longitudinal slot disposed at an angle to the vertical and adapted to receive a bar or finger 57 which is slid longitudinally into the slot from the upper end thereof and is supported at its lower end upon the head of an adjustable setscrew 58 threaded into a split socket 59 formed in the horizontal arm of the member 54. The upper end of the finger 57 projects above the upper face of the member 54 a limited distance which is substantially equal to the thickness of the blank in the magazine. Consequently, as the member 54 is oscillated back and forth from the position shown in Fig. 1 to that shown in Fig. 3 this projecting portion of the finger will engage with the end of the lowermost blank in the magazine and exert a longitudinal pressure upon the blank, which will move its engaged end inwardly with respect to the other blanks and cause the blank to buckle or bend downwardly intermediate its ends as shown in Fig. 3, longitudinal movement of the blank being limited by abutment of its opposite end against the opposite side member 28 of the magazine. It will thus be manifest that at each actuation of the member 54 the lowermost blank in the magazine will be separated and bent downwardly into position to be engaged and carried rearwardly from the magazine by feed fingers 61 carried by the reciprocating slide-bars 14. These slide bars are reciprocated longitudinally by mechanism (not shown), the construction and operation of which is well known in the art, and by reference to Figs. 3, 4 and 6, it will be observed that these feed fingers 61 are carried by blocks 62 fixedly attached to and projecting inwardly from the slide bars 14. Each block 62 is provided with an elongated slot 63 and the feed fingers may be adjusted laterally with respect to the block 62 by loosening the nuts 64 which are threaded onto the bolts passing from the fingers 61 through the slots 63. These feed fingers are adjusted laterally to accommodate them to blanks of various lengths and various thicknesses with which the magazine may be loaded, and when properly positioned they will overlie the downwardly bent blank as the slide bars are moved toward the right, viewing Fig. 6. The downwardly bent blank will be carried by these fingers to the right outwardly from the magazine onto the slides 12 beneath the yielding plates 17 into the position of the blank 19, shown in section in Fig. 6. Upon return movement of the slide-bars they will pass freely beneath the blanks in the magazine and the mechanism is so timed that the next blank will be bent downwardly into the path of the fingers while the fingers are to the left of the magazine, as shown in Fig. 6, so that upon the next movement of the slide-bars to the right the next blank in the magazine will be fed toward the operating mechanism in the same manner. During the removal of the second blank from the magazine the previously removed blank will be fed onwardly by the feed dogs 15, which snap upwardly behind the blank when the slide-bars reach their extreme outward position as shown in Fig. 6. For the purpose of preventing accidental return of a removed blank with return movement of the slide-bars, the bottom members 35 and 39 of the magazine are provided with downwardly projecting studs 65 against which a return blank would abut, so that return movement of the blank would be prevented.

As previously explained the projecting finger 57 may be adjusted longitudinally to project more or less above the upper face of the member 54 by means of the adjusting screw 58, and when the proper adjustment has been secured this screw is locked by means of a setscrew 66 threaded into the horizontal arm of the member 54 and engaging the side wall 67 of the split socket 59 so as to press this wall tightly against the screw 58 and prevent accidental rotation thereof. The finger 57 is further locked in adjusted position by a pair of setscrews 68 threaded into the member 54 into engagement with the finger 57.

In order to provide for bodily adjustment

of the member 54 so that the height of the upper surface 56 may be regulated I have utilized the previously described eccentric bearing sleeve 49. Normally the nut 52 is threaded onto this sleeve so that the member 54 is rigidly clamped to the sleeve between the nut 52 and the flange 51. Whenever it is desirable to adjust the member 54 the nut 52 is loosened and the sleeve 49 is turned on the shaft 47, and also relatively to the member 54, until this member is disposed in the required position, whereupon the nut is again tightened, thus securely locking the eccentric sleeve to the member 54. When the member 54 is oscillated the sleeve moves with the member and oscillation takes place about the shaft 47 while the sleeve 49 and member 54 remain rigidly locked together.

The oscillatory member 54 is actuated by means of a link 69 having a universal connection at its upper end with the horizontal arm of the member 54 and a universal connection at its lower end with a stud 71 extending laterally from a lever 72 and also carrying an anti-friction roller 73. The lever 72 is pivoted at 74 to a bracket on the machine frame, and the roller or cam follower 73 is normally urged into engagement with a cam 75 on a constantly rotating shaft 76 by an expansion spring 77 interposed between the upper end of the lever 72 and the machine frame, as shown in Fig. 2. It will be obvious therefore that at each revolution of the shaft 76 a complete oscillation of the member 54 will be effected, the movement inwardly of the magazine being slow and gradual by reason of the shape of the cam so that the end of the blank engaged by the finger 57 will not be injured and the return or idle movement being relatively rapid as the follower 73 travels off from the high portion of the cam. In order that the blank separating mechanism may be thrown out of operation without stopping the whole machine, I have provided a block 78 pivoted at 79 to the bearing in which the shaft 76 rotates and adapted to be moved manually by means of a handle 81 beneath the end of the lever 72 so as to elevate this lever and position the cam follower 73 out of the path of the cam 75. A small spring bolt 82 adapted to engage in a depression in the block 78 will yieldingly lock the block in operative position beneath the lever 72 so that the blank-separating mechanism will remain idle while the rest of the machine is running until such time as the block is moved outwardly from beneath the lever into the position shown in Fig. 2.

For the purpose of facilitating the separation of the lowermost blank from the remaining blanks in the stack by the separating mechanism previously described, the lower forward face of the downwardly depending member 44 carried by the crossbar 42 is provided with three longitudinal grooves 83, and in these grooves upon a pivot bolt 84 I have pivotally mounted three members, 85, 86 and 87 respectively. A light expansion spring 88 disposed in a socket in the member 44 back of each of the members 85, 86 and 87 yieldingly urges the lower ends of these members toward the rear face of the stack of blanks into engagement with the edges of the lower blanks. Two of the members; viz., 85 and 87 are serrated near their lower ends, as indicated by reference characters 88 and 89, so that as the lower blank is moved downwardly across these serrated surfaces the serrations will tend to sustain or support the blanks above the lower one and facilitate the separation of the lowermost blank. The central member 86 extends below the stack of blanks and is provided with a forwardly projecting toe 91 which, as soon as the lower blank has been bent downwardly, snaps into position between this lower blank and the superposed blanks so as to assist in supporting the upper blanks and also to prevent the lower blank from returning to its normal position. It will thus be manifest that the members 85, 86 and 87 by their conjoint action assist in the separation of the lowermost blank from the stack and also prevent the same from returning in case it should not be buckled downwardly a sufficient distance by the oscillatory member, or in case the timing of the oscillatory member should result in releasing the blank before it is engaged by the feed fingers.

While the construction above described will separate most blanks accurately and satisfactorily I have found that in a few instances where the blanks are inaccurately cut or are left with quite a bur along the edges it is sometimes rather difficult to separate the lowermost blank from the next blank above. With a view of making the machine universally adaptable so that it will work with efficiency and accuracy upon blanks of all characters, even though they be imperfectly cut, I have provided a slightly modified construction which is illustrated in Figs. 7, 8 and 9. Referring to these figures, it will be observed that the side piece 28 of the magazine is undercut at its inner lower edge as indicated at 92 and is provided with a pair of openings 93 spaced from the median line of the plate 28, as shown in Fig. 8, and adapted to accommodate a pair of blocks or members 94. These blocks are adjustably mounted upon the bottom member 39 by means of bolts 95 which extend through elongated slots 96 in the bottom member and the blocks are so positioned that the inner vertical ends thereof are disposed substantially in alinement with the inner face of the side plate 28. Each block consists of two pieces riv-

eted or otherwise fastened together, the lower piece being extended inwardly beyond the vertical face of the inner end of the block proper so as to be disposed within the magazine, as indicated by reference character 97. These inward extensions form bearing surfaces upon which the stack of blanks rests adjacent its end so that these two surfaces 97 together with the upper end of the oscillatory member 54 form a three-point bearing or support for the stack of blanks. Just above the upper face of the extensions 97 each blank is provided with a transverse slot or groove 98 substantially equal in vertical depth to the thickness of a blank. It will be obvious that these slots are disposed in alinement with the end of the lowermost blank in the magazine, and that the relatively thin supporting extensions 97 insure this alinement irrespective of warping or other irregularities in the blank, since the major portion of the weight of this end of the stack is carried by these extensions.

With this construction when the oscillatory member 54 is moved in a counterclockwise direction on its shaft, viewing Fig. 7, the finger 57 when first brought into engagement with the end of the lowermost blank will slide this blank longitudinally toward the left, viewing this figure, thereby causing its opposite end to enter the grooves 98 until such movement is limited by abutment against the undercut portion of the side wall 28. Since the grooves 98 are only wide enough to receive one blank it will be evident that this longitudinal movement of the lowermost blank, while the next superposed blank is held against such movement, will overcome any tendency of the lowermost blank to cling to the next blank either by reason of cohesion or because of interlocking burs on the edges of the blanks, with the result that when the longitudinal movement of the lowermost blank is stopped by the side plate 28 further movement of the finger 27 will cause this blank to buckle or bend downwardly into the position shown in Fig. 7 so that it will be picked up and carried away by the feed fingers 61. It will be manifest, therefore, that these slots permit a limited longitudinal movement of the lowermost blank with respect to the remaining blanks, which movement effectually overcomes the tendency of the lowermost blank to cling to the next superposed blank and thus insure a perfect separation of the lowermost blank at each actuation of the oscillatory member 54.

It is believed that the construction and operation of one embodiment of my invention will be fully understood from the foregoing without further description, and it should be obvious that the details of construction illustrated and described are capable of considerable modification and variation without departure from the essence of the invention as defined in the following claims:

I claim:

1. In a blank feeding mechanism, the combination of a magazine adapted to support a stack of blanks, a movable member provided with a non-penetrating blank-engaging projection mounted at one end of the magazine, a stationary abutment at the opposite end of the magazine, means for moving said projection toward said abutment in the plane of and against the end of an interposed blank to thereby buckle said blank intermediate its ends by longitudinal compression of the blank and means for engaging with the buckled portion of said blank whereby the blank is removed from the magazine.

2. In a blank feeding mechanism, the combination of a magazine adapted to support a stack of blanks, a movable member provided with a blank-engaging projection adapted to engage an edge only of a blank mounted at one end of the magazine, a stationary abutment at the opposite end of the magazine, means for moving said projection toward said abutment in the plane of an interposed blank and against the edge thereof to thereby buckle said blank intermediate its ends by pressure applied against the ends only, and means whereby the effective stroke of said projection in the plane of the blank may be regulated.

3. In a blank feeding mechanism, the combination of a magazine adapted to support a stack of blanks, a movable member provided with a blank-engaging projection mounted at one end of the magazine, a stationary abutment at the opposite end of the magazine, means for moving said projection toward said abutment in the plane of an interposed blank to engage an edge of the blank and thereby buckle said blank intermediate its ends, means for adjusting the length of said projection to accommodate the mechanism to blanks of various thicknesses and means for engaging the buckled portion of the blank to remove the same from the magazine.

4. In a blank feeding mechanism, the combination of a magazine having an open bottom and a stationary abutment at one side thereof, a member mounted to oscillate transversely of the magazine adjacent the bottom thereof and in position to partially support a stack of blanks in the magazine, means projecting from said member in position to engage an end edge only of the lowermost blank in the stack and for forcing said blank against said stationary abutment to thereby bend a portion of said blank away from the remaining blanks in the

magazine, and means for removing said blank from the magazine by engagement with said bent portion.

5. In a blank-feeding mechanism, the combination of a magazine, an oscillatory blank-separating member mounted in coöperative relation to said magazine, a cam, an element provided with a cam follower, a connection between said element and said oscillatory member, and manually operable means for withdrawing said follower from the cam to thereby render said oscillatory member inoperative.

6. In a blank-feeding mechanism, the combination of a magazine, an oscillatory member mounted in coöperative relation thereto, a cam, a lever, a cam-follower carried by said lever, means for yieldingly urging said follower into engagement with the cam, a connection between said lever and said oscillatory member, and manually operable means for withdrawing said follower from the cam against the force of said yielding means and holding said follower in withdrawn position.

7. In a blank-feeding mechanism, the combination of a magazine provided with bottom members extending inwardly a limited distance from the sides of said magazine, means for bending a blank in said magazine downwardly between said bottom members, means for feeding said downwardly bent blank away from the magazine, and means projecting downwardly from said bottom members to prevent return movement of said blank with said feeding means.

8. In a blank-feeding mechanism, the combination of a magazine comprising side members and bottom members extending inwardly a limited distance from said side members, means for bending downwardly a portion of a blank in said magazine intermediate said bottom members, reciprocatory feed bars adapted to feed said downwardly bent blank away from the magazine, and abutments projecting downwardly from said bottom members to prevent return movement of said blank with said feed bars.

9. In a blank-feeding mechanism, the combination of a magazine comprising side members and bottom members extending inwardly a limited distance from said side members, means movable transversely of the magazine adjacent the bottom thereof for first moving the lowermost blank in said magazine transversely of the magazine and subsequently bending said blank intermediate its ends, and a groove at the opposite side of the magazine from said member adapted to receive the end of one blank only whereby a separation of said blank is facilitated.

10. In a blank-feeding mechanism, the combination of a magazine comprising side members and bottom members, a groove adjacent the bottom of one of said side members adapted to receive one blank only of a stack in said magazine, and means at the opposite side of said magazine for moving the lowermost blank of the stack transversely of the magazine into said groove and subsequently bending said blank by continued longitudinal pressure upon said blank.

11. In a blank-feeding mechanism, the combination of a magazine comprising side walls and bottom members, one of said side walls being undercut along the inner bottom edge thereof, a pair of members adjustably mounted adjacent to said undercut side wall extending into the magazine so as to provide a two-point support for one end of a stack of blanks in the magazine and provided with transverse grooves adapted to receive one of said blanks only; and means at the other end of the magazine positioned to form a one-point support for the stack of blanks and adapted to move the lowermost blank longitudinally into said grooves at the opposite end of the magazine.

12. In a blank-feeding mechanism, the combination of a magazine adapted to contain a stack of blanks, a plurality of members mounted on one end of the magazine, each member comprising a portion projecting into the magazine at the bottom thereof and provided with a transverse slot directly above said projecting portion, said slots being adapted to receive the end of one blank only at a time, and means at the opposite end of the magazine for moving the lowermost blank longitudinally into said slots and exerting a continuous longitudinal pressure upon said blank to bend the same downwardly intermediate its ends.

13. In a blank-feeding mechanism, the combination of a magazine adapted to contain a stack of blanks, one wall of said magazine being undercut adjacent its lower ends, a pair of members adjustably mounted so as to project through said wall into the magazine, each of said members being provided with a blank supporting portion and a blank separating slot, and means for moving a blank longitudinally into said slots and subsequently bending said blank intermediate its ends.

14. In a blank feeding mechanism, the combination of a magazine adapted to contain a stack of blanks, means located beneath a stack of blanks in the magazine comprising two stationary and one movable member for forming a three-point support upon which said stack rests, and mechanism for moving said movable member toward the stationary members so as to compress a blank between the stationary and movable members and thereby buckle said blank intermediate its ends.

15. In a blank feeding mechanism, the

combination of a magazine adapted to contain a stack of blanks, a pair of stationary members mounted at the bottom of the magazine and at one end thereof, a movable member located at the bottom of the magazine and at the opposite end thereof, said members together forming a three-point support upon which a stack in said magazine rests, and mechanism for reciprocating said movable member toward and from said stationary members to longitudinally compress the interposed blank so as to buckle the same intermediate its ends.

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