F. M. OPITZ.

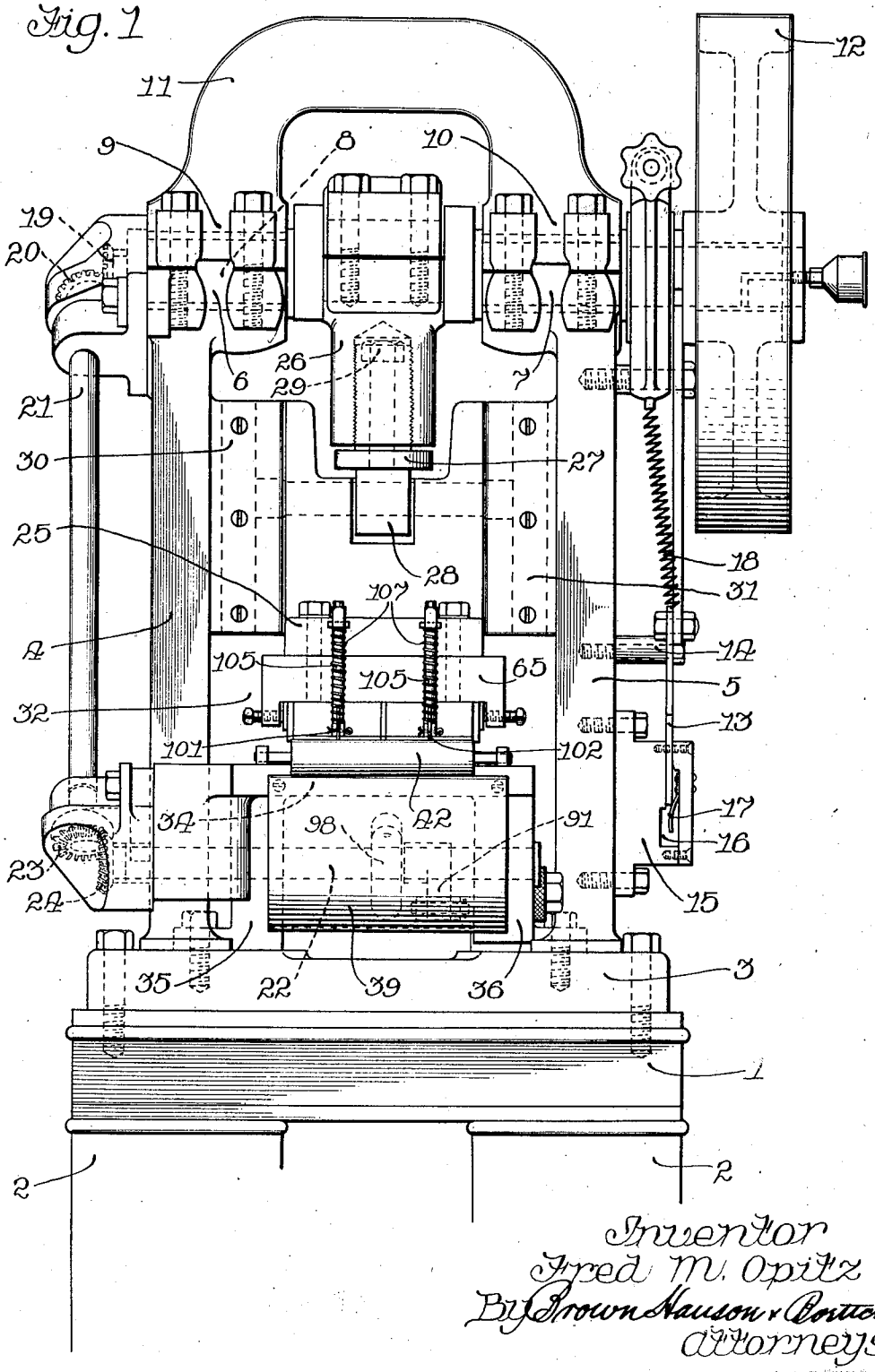
PRESS OR STAMPING MACHINE.

APPLICATION FILED OCT. 11, 1918.

1,341,721. **Patented June 1, 1920.**

7 SHEETS—SHEET 1.

Fig. 1



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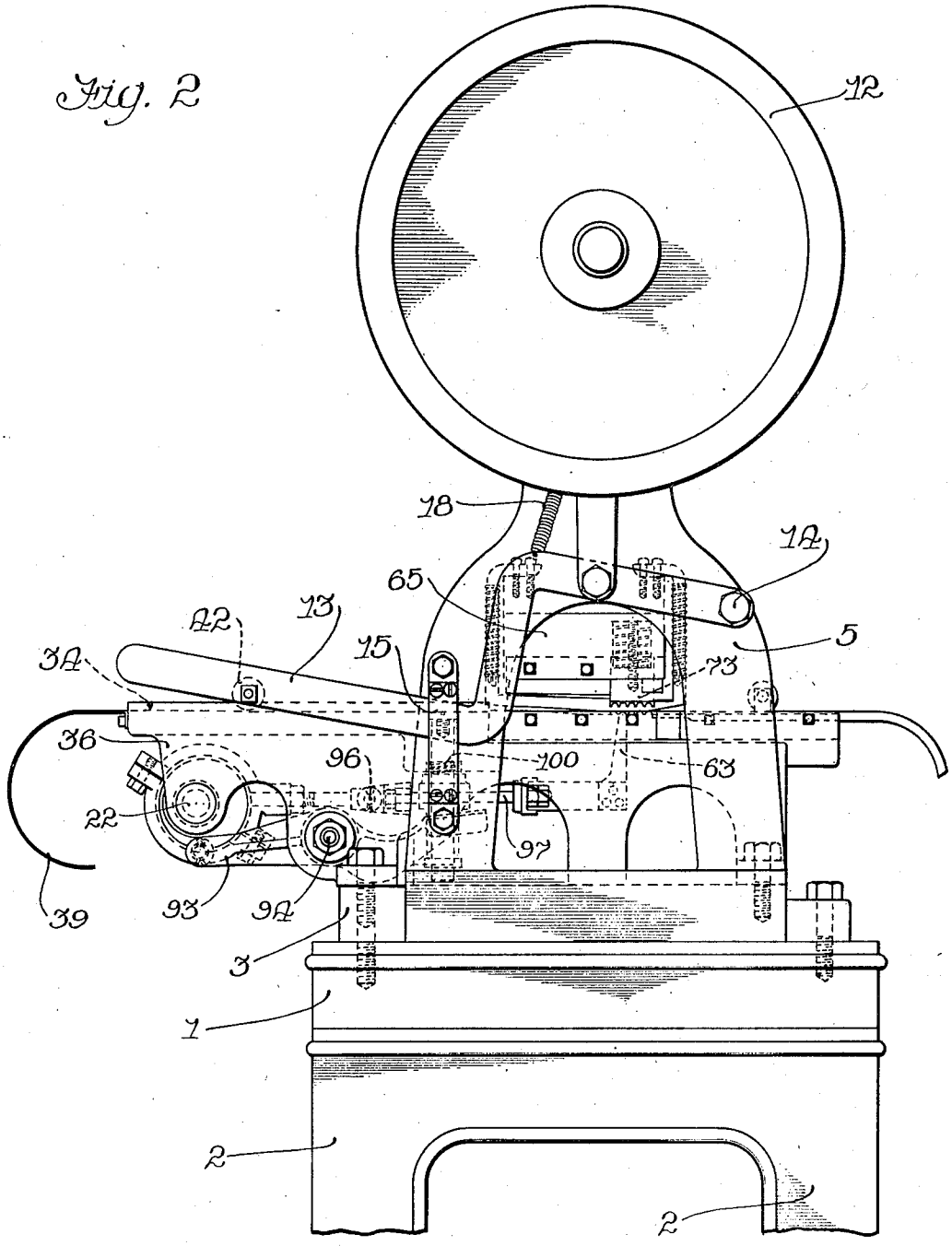
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7 SHEETS—SHEET 2.

Fig. 2



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PRESS OR STAMPING MACHINE.

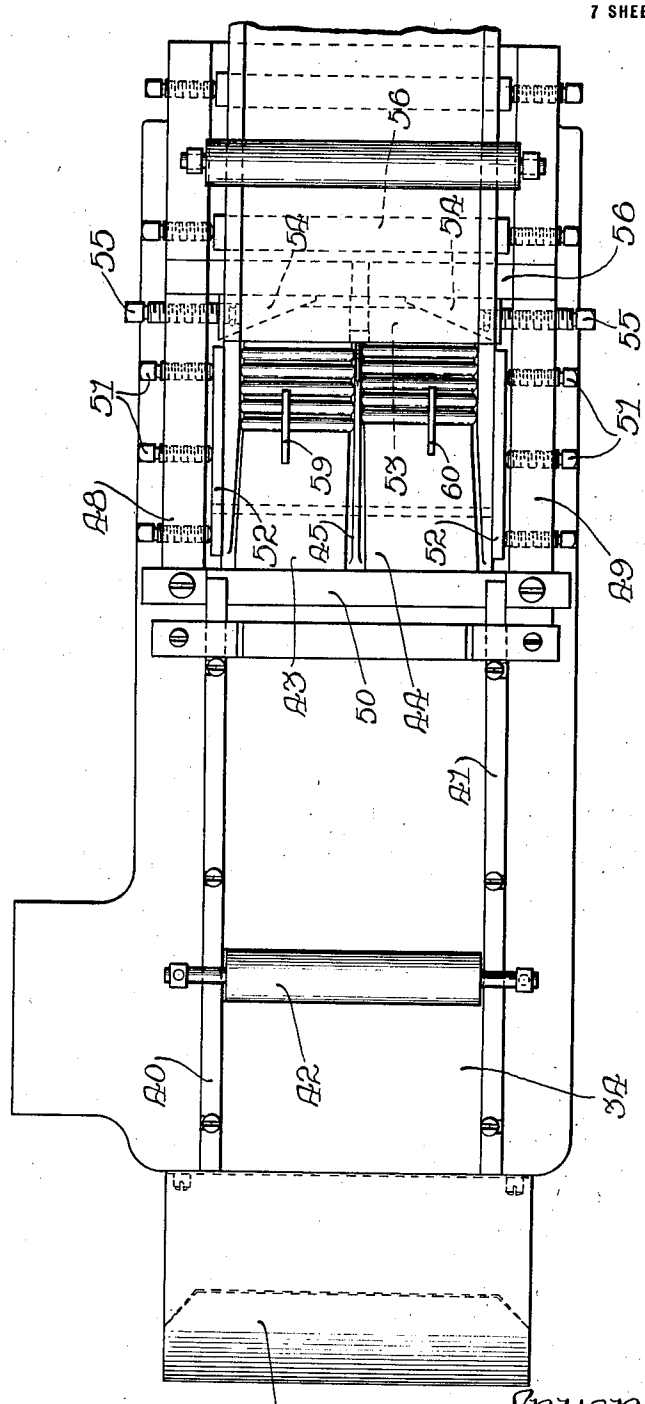
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7 SHEETS—SHEET 3.

Fig. 3



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PRESS OR STAMPING MACHINE.

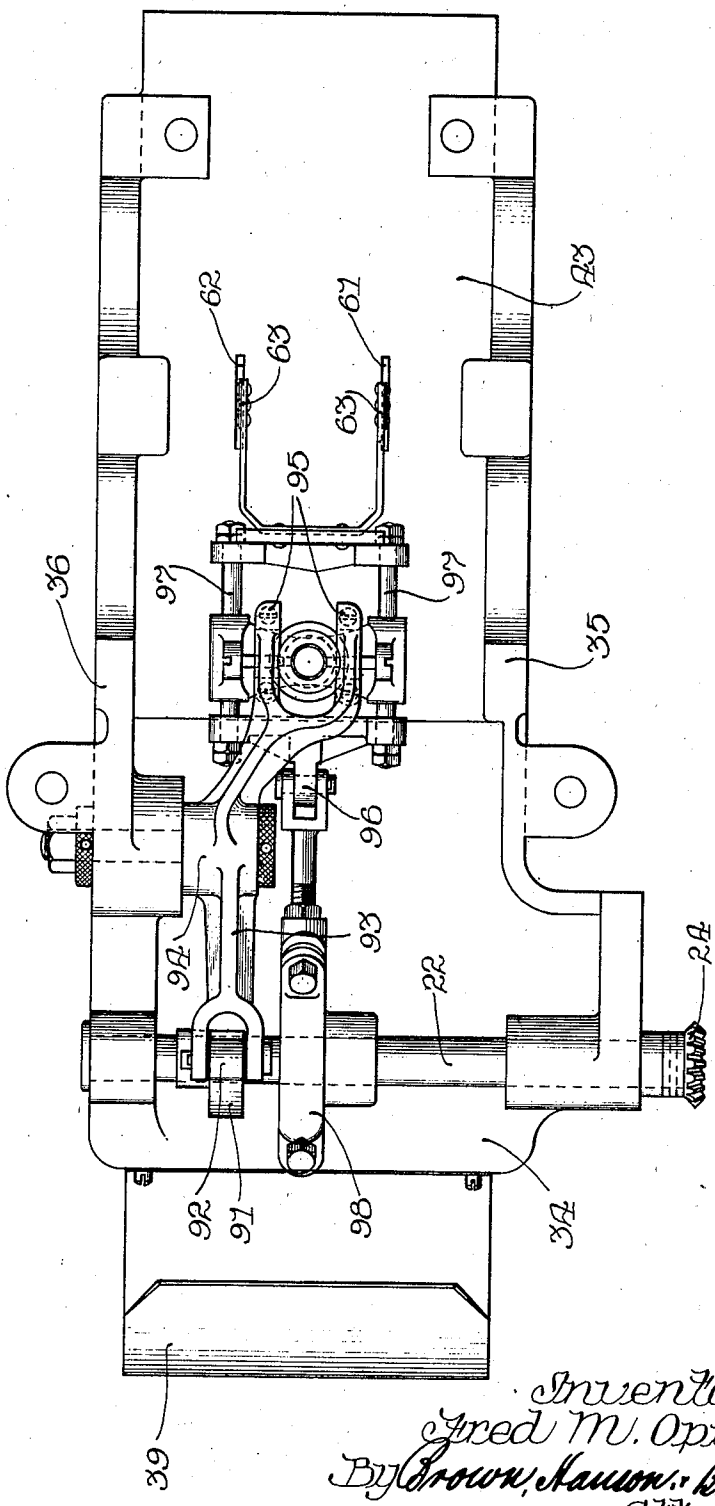
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7 SHEETS—SHEET 4.

Fig. 4



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PRESS OR STAMPING MACHINE.

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7 SHEETS—SHEET 5.

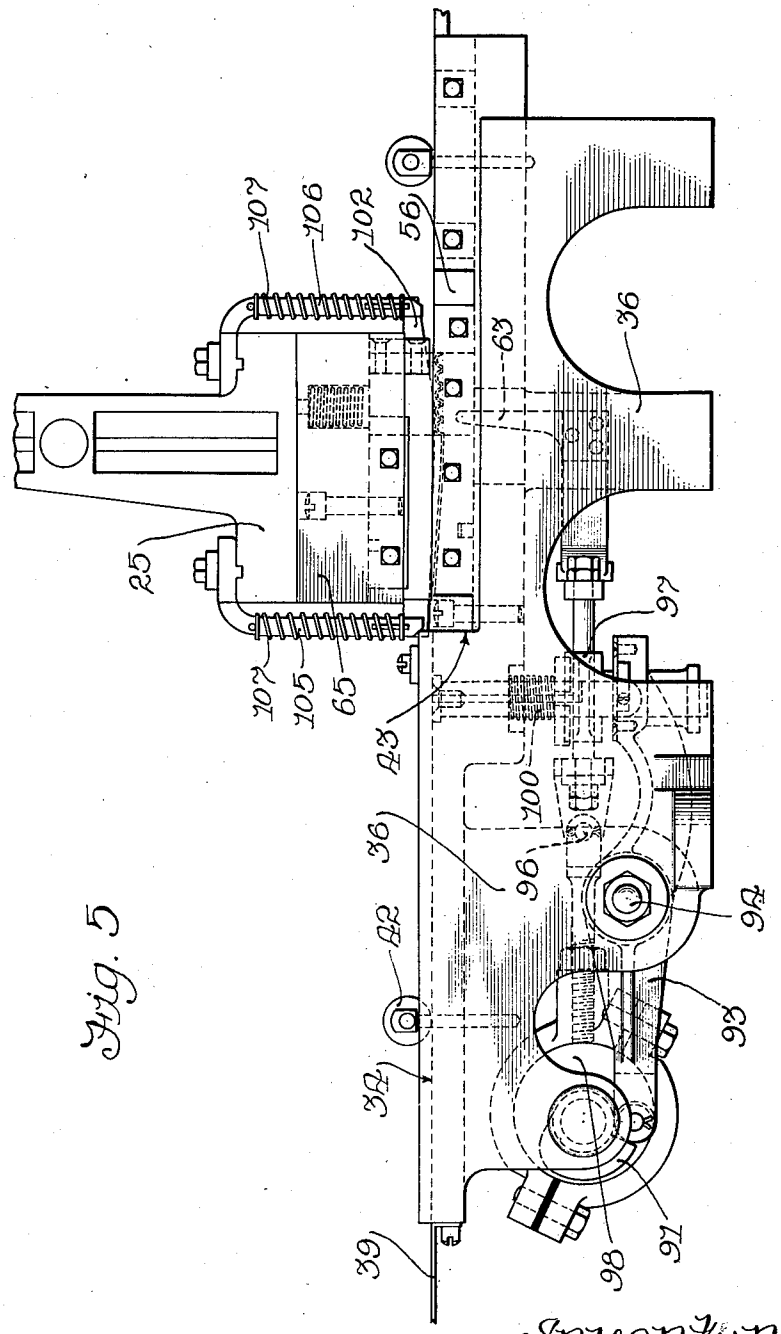


Fig. 5

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PRESS OR STAMPING MACHINE.

APPLICATION FILED OCT. 11, 1918.

1,341,721. **Patented June 1, 1920.**

7 SHEETS—SHEET 6.

Fig. 6

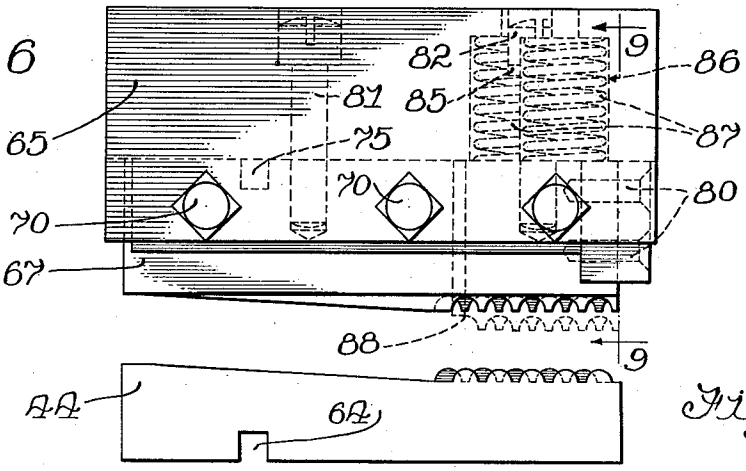


Fig. 7

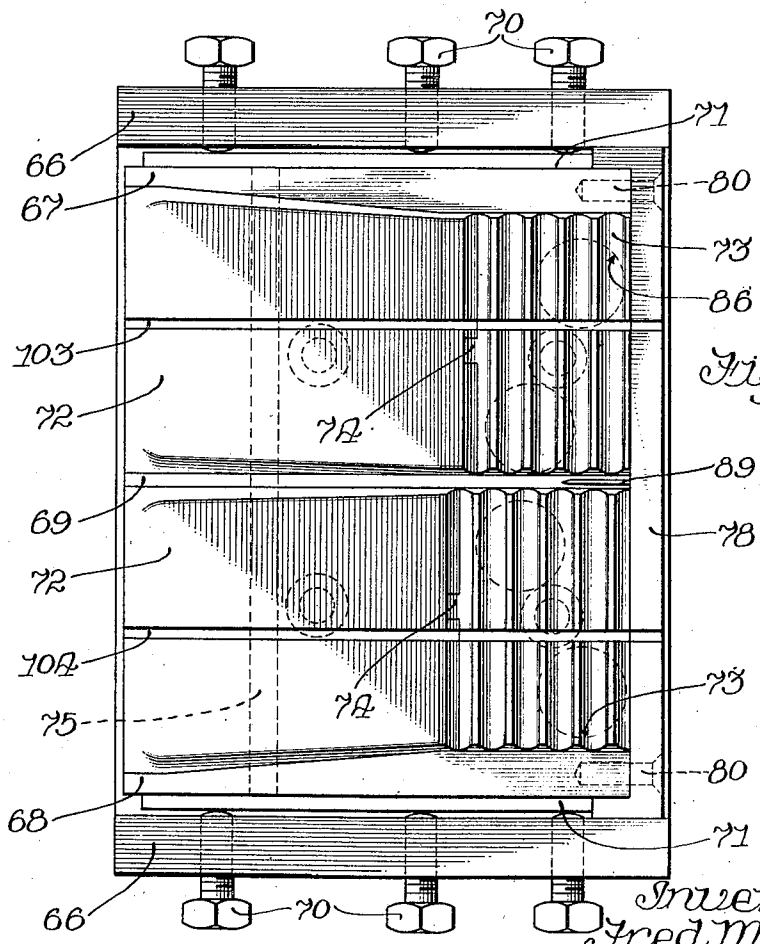


Fig. 8

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PRESS OR STAMPING MACHINE.

APPLICATION FILED OCT. 11, 1918.

1,341,721. **Patented June 1, 1920.**

7 SHEETS—SHEET 7.

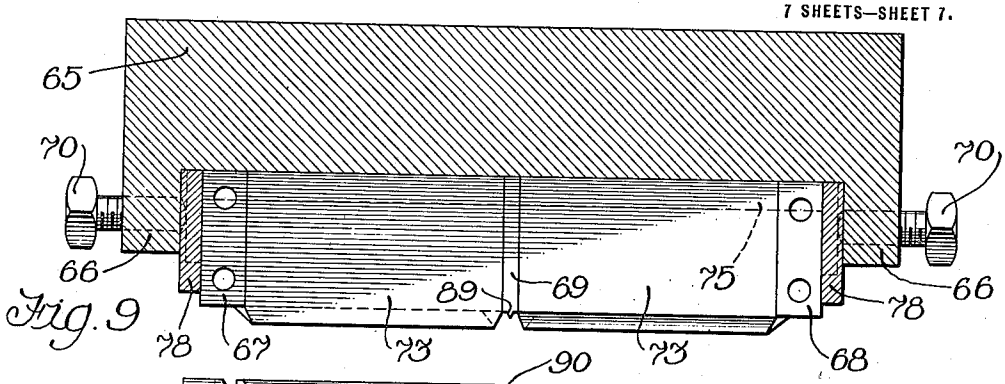


Fig. 9

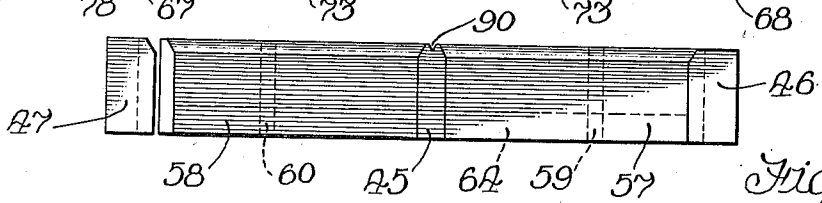
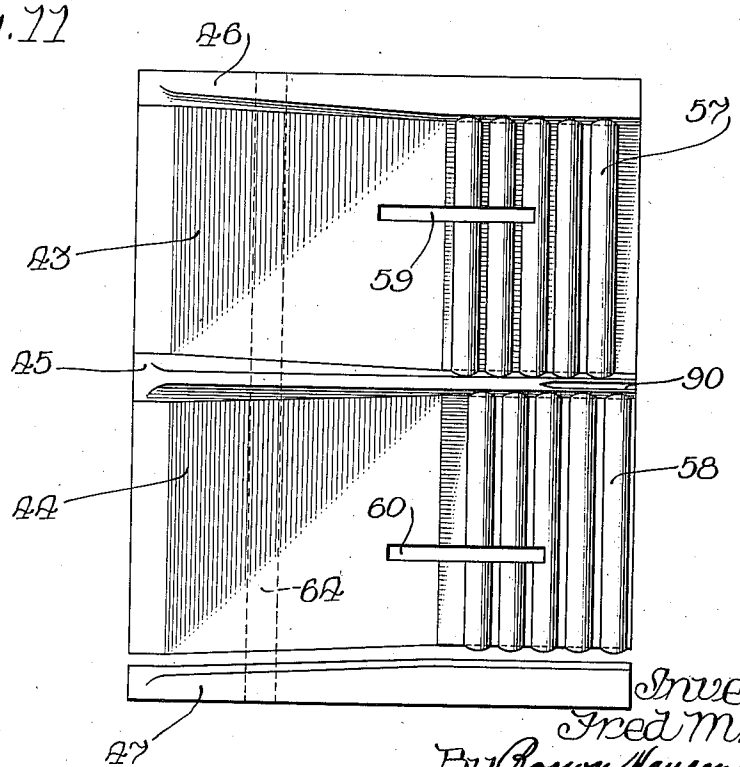


Fig. 10

Fig. 11



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UNITED STATES PATENT OFFICE.

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PRESS OR STAMPING-MACHINE.

1,341,721. Specification of Letters Patent. Patented June 1, 1920.

Application filed October 11, 1918. Serial No. 257,765.

To all whom it may concern:

Be it known that I, FRED M. OPITZ, a subject of the Emperor of Germany, and a declarant of intentions of becoming a citizen of the United States, having taken out my first papers, residing at Racine, in the county of Racine and State of Wisconsin, have invented a certain new and useful Improvement in Presses or Stamping-Machines, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to presses or stamping machines and dies therefor.

This invention is particularly adapted for use in connection with the method of forming sheet metal as disclosed and claimed in my co-pending application, Serial Number 257,764, filed October 11, 1918, and although particularly useful in connection with the formation of radiator tubes for automobiles and the like, I do not intend to limit the invention to such use.

It is desirable to utilize comparatively thin sheets of metal in the formation of radiators of this class as the radiator must be strictly limited in size, light in weight and highly efficient and dependable in operation. Such a radiator must be sufficiently strong from a structural standpoint to withstand the hard usage to which it is subjected.

I am aware that radiator tubes formed of sheet metal blanks have been made heretofore in the art. In the construction of tubes of this class lateral corrugations are usually formed on each side of a central flange or seam. Heretofore in the art radiator tubes of this class have been formed by maintaining this central flange or seam and any other uncorrugated portion of the blank at the original thicknes of the sheet metal, the corrugations being produced by stretching and thereby reducing the thickness of the metal within the corrugated portion.

My invention aims to provide an improved stamping machine and dies therefor, which are adapted for shrinking the metallic sheet along the central seam and the margin to provide the surplus metal required in the corrugated area of the sheet, the thickness of the metal in the corrugated area thereby formed being substantially the same as the original thickness of the metal. This is a highly advantageous feature in that the strength of the radiator tubes formed of such sheet metal blanks will be materially increased, the original thickness of the sheet metal used remaining substantially the same.

My invention aims further to provide a novel, simple and improved stamping machine which is economically maintained and is effective in operation.

Heretofore in the working of sheet metal, particularly sheet metals of the thinner gages, the matter of handling the metal by the operator has been a serious difficulty as it tends to buckle and break. Further the least obstacle or least defect in the operation of the machine will result in impeding the advancement of the sheet metal blanks thereby necessitating great care in dealing with such metals.

I have further provided a stamping machine having an improved feeding mechanism, whereby the sheet metal blanks will be automatically fed into the machine by an amount equal to the pitch distance between the corrugations formed in the metallic sheet.

I have still further provided for maintaining the metallic sheet flat on the bed of the press for a considerable distance before and behind the stamping dies, and also improved stripping means for preventing accidental movement of the metallic sheet upwardly during the upward movement of the ram.

In accordance with the teachings of my invention the ram of the press operates at frequent intervals to bring the upper and lower dies into coöperative engagement. The metallic sheet is thereby shaped to form a double gutter therein, which gutter is formed gradually by reason of the novel construction of the dies. The sheet is then advanced to the corrugated part of the dies whereby the semi-circular corrugations are formed and wherein the margins are shrunk to form the surplus metal for the corrugations. By thus shrinking the metallic sheet to provide the surplus metal a

stronger radiator will be obtained and fewer difficulties will be involved. It is also possible to use metals of thinner gages than have been heretofore used as the metal is not appreciably stretched at any point. I have also found that by shrinking or folding the metal about the form the desired shape will be provided without damaging the metal in any way.

In order that those skilled in the art may be fully acquainted with the nature and scope of my invention I shall describe a specific embodiment of the invention in connection with the accompanying drawings which form a part of the present specification, and wherein the elements, when not otherwise shown in detail are to be understood to be of the usual or any approved construction well known in the art.

Figure 1 is a front elevational view of my improved stamping machine;

Fig. 2 is a side elevational view of the same;

Fig. 3 is a plan view of the base of the machine showing the lower die secured therein;

Fig. 4 is a bottom plan view of the base of the machine showing the mechanism for feeding the sheet metal blank therealong.

Fig. 5 is an enlarged side elevational view of the same;

Fig. 6 is a side elevational view of the upper die;

Fig. 7 is a side elevational view of the lower die;

Fig. 8 is a bottom plan view of the upper die;

Fig. 9 is a vertical sectional view taken on the line 9—9 of Fig. 6;

Fig. 10 is a front elevational view of the lower die; and

Fig. 11 is a plan view of the same.

Referring first to Figs. 1 and 2 it will be seen that I provide a stationary table 1 supported upon suitable legs 2—2. A base plate 3 is mounted upon the stationary table 1, this base plate carrying a pair of upright frame members 4 and 5 suitably spaced thereon as shown in Fig. 1. Bearings 6 and 7 for the crank or driving shaft 8 are provided in the tops of the upright frame members 4 and 5 respectively. Suitable bearing sleeves provided for the crank shaft 8 are held in place in the bearings 6 and 7 by the caps 9 and 10 respectively which form a part of the bridge piece 11.

A belt pulley 12 is fixed to one end of the crank or driving shaft 8, power being applied to this shaft through the belt pulley 12 by means of a suitable driving belt (not shown) upon depression of the operating lever 13. The inner end of the operating lever 13 is pivoted at 14 as shown in Fig. 2 to the upright frame member 5. The outer end of this lever passes through a guiding member 15 which is bolted to the upright frame member 5, the lever extending forwardly from this guiding member so that the operator may have ready access thereto.

The guiding member 15 comprises a block or base member which is bolted to the upright frame member 5 and a bridge member which is then fastened by suitable set screws to the base member, the lever 13 being guided in coöperating channel portions provided in these members. An additional groove or channel 16 is provided in the base member of the guide into which the lever 13 is moved by a leaf spring 17 upon being depressed, this spring being secured in the channel or cut away portion of the bridge member. Upon depressing the lever 13 it will be moved into the channel 16 by means of the spring 17, the shoulder formed by this channel preventing retrograde movement of the lever. The machine will then continue to operate until the lever 13 is moved from the channel 16 against the tension of the spring 16, whereby the spring 18 will return the lever 13 to its normal position, thereby preventing rotation of the cam shaft 8 until the operating lever 13 is again depressed.

The opposite end of the cam or driving shaft 8 carries a bevel gear 19 as shown in Fig. 1, such bevel gear meshing with a bevel gear 20 provided on the intermediate shaft 21. The counter shaft 22 which serves to drive the feeding or sheet metal advancing mechanism, as will be hereinafter described, is driven through the bevel gears 23 and 24 carried on the intermediate shaft 21 and the counter shaft 22 respectively.

The ram 25 is driven up and down by the crank shaft 8 through the connecting rod 26 the exact position of the ram being obtained by means of an adjusting screw 27 which threads into the lower free end of the connecting rod 26 as shown in Fig. 1. The adjusting screw 27 is provided with a suitable bore for receiving the upwardly projecting shank of the coupling 28, this shank being threaded to receive a suitable nut 29 thereon, which serves to lock the adjusting screw 27 and the coupling 28 together as a unit. It will now be apparent that the ram 25 may be adjusted vertically by threading the adjusting screw 27 either into or out of the connecting rod 26 accordingly as to whether it is desired to raise or lower the ram. The ram 25 is guided in its vertical movement by means of a pair of suitable guide strips 30 and 31 projecting inwardly from the upright frame members 4 and 5 respectively.

In forming radiator tubes in accordance with the process disclosed in my copending application, Serial Number 257,764, filed October 11, 1918, I provide for feeding a sheet metal blank of suitable width and thickness and preferably of copper or brass

through a set of dies, the novel construction of which will hereafter be fully disclosed. The upper die 32 of this set of dies is adapted to be carried upon the lower face of the ram 25 as shown in Fig. 1, being securely bolted thereto by suitable bolts 33.

The bed 34 of my improved press is provided with a pair of supporting members 35 and 36 formed integral therewith and extending downwardly from the opposite sides thereof. The lower edges of the supporting members 35 and 36 are provided with suitable flanges extending at right angles therefrom, whereby the supporting member and consequently the bed 34 may be suitably bolted to the base plate 3, this base plate being mounted upon the stationary table 1, as hereinbefore set out. The supporting members 35 and 36 are provided with bosses 37 and 38 respectively which form suitable bearings for the opposite ends of the counter shaft 22, which countershaft is driven from the main driving or crank shaft 8 as hereinbefore described.

A guiding member 39 having its outer free end semi-circular in form is provided with a small flange along its inner edge as shown in Figs. 2 and 5 whereby it may be suitably bolted to the front edge of the bed 34, thus forming a suitable shelf for guiding the metallic sheet onto the bed of the press. For guiding the metallic sheet along the bed of the press I have provided a pair of guiding strips 40 and 41, which are interchangeable to accommodate different widths of sheet metal therebetween. A pressure roll 42 extends the full distance between the guiding strips 40 and 41, the pressure of this roll being adapted to keep the metallic sheet flat for a considerable distance before entering between the dies.

The rear portion of the bed 34 is depressed as shown at 43 in Fig. 5, so that when the lower die is mounted thereon as will now be described, the upper face of the die will be substantially continuous with the front portion 34 of the bed.

The lower or female die comprises a pair of die blocks 43 and 44, with a centering bar 45 arranged therebetween and side plates 46 and 47 arranged adjacent the outer edges of the die blocks 43 and 44 respectively as shown in Figs. 3 and 11. The several parts of the die are mounted between a pair of parallel rail members 48 and 49 formed integral with and extending upwardly from the opposite sides of the depressed portion 43 of the bed 34, as shown in Fig. 3. The front edge of the die thus formed is adapted to engage a block 50 which extends substantially the entire width of the bed of the press and is bolted in parallel engagement with the shoulder formed by the depressed portion 43, this block serving to properly aline the several parts of the die longitudinally on the bed of the press. The several parts of the die are securely held against transverse displacement by means of a plurality of set bolts 51 which thread through the rail members 48 and 49 as shown in Fig. 3 and engage suitable shims 52 which are placed adjacent the outer edges of the side plates 46 and 47, tightening of the set bolts 51 obviously serving to securely clamp the several parts of the lower die between the parallel rail members 48 and 49.

The inner ends of the die blocks 43 and 44, centering bar 45 and side plates 46 and 47 are maintained securely in engagement with the transversely extending block 50 by means of an alining member 53 shown in dotted lines in Fig. 3.

The upper and lower portions of the outer edge of the alining member 53 are tapered inwardly, these inwardly tapered portions being engaged by the wedge shaped members 54 upon tightening the set bolts 55. The inner ends of the set bolts 55 are securely held in the wedge shaped members 54 so that upon tightening the bolts these members will be moved inwardly, thereby wedging the alining member 53 into engagement with the outer ends of the several parts of the die, in order to securely clamp the die between the block 50 and the alining member 53. It will now be apparent that longitudinal displacement of the lower die or any of the parts thereof is effectively prevented as the outer edges of the wedges 54 engage a block 56 which extends between the rail members 48 and 49 being either formed integral with the bed of the press or suitably secured thereto.

The upper faces of the die blocks 43 and 44 are inclined from the corrugated portions 57 and 58 to the front of the die as shown in Figs. 7 and 11, so that the gutter formed thereby in the metallic sheet as it is advanced into the machine will be formed gradually. The corrugations 57 in the face of the die block 43 are offset with respect to the corrugations 58 in the face of the die block 44 one-half the pitch distance so that when the tubes are assembled into a core, a number of round cylindrical passages for the air between the corrugations of adjacent tubes will be provided, as clearly set out in my copending application hereinbefore referred to. Slots 59 and 60 extend vertically through the die blocks 43 and 44 respectively, these slots registering when the dies are in place on the bed of the press, with slots 61 and 62 which extend vertically through the bed of the press, thereby forming continuous slots through which the upwardly extending advancing fingers 63 may be moved in order to engage the corrugated portion of the metallic sheet as it is formed and thereby feed the sheet through the dies as will be hereinafter described.

As shown in Figs. 10 and 11, the inner edges of the side plates 56 and 47, the opposite edges of the centering bar 45 and the opposite edges of the die blocks 43 and 44 are tapered slightly to give the necessary clearance to the dies. This taper has been somewhat exaggerated in the drawings. The several parts of the lower die are alined with respect to each other by means of a suitable key coöperating with keyways provided in the lower edges of the side plates, die blocks and centering bars, respectively, these keyways registering when the several parts of the die are properly set up and alined, thereby forming a continuous groove or channel 64 in the under face of the die for the reception of a suitable key therein.

The upper die 32 comprises a die block or bolster 65 which is adapted to be bolted or otherwise suitably secured to the under face of the ram 25, as shown in Fig. 1. The die block or bolster 65 is provided with a pair of flanges 66 formed integral therewith and extending downwardly from the opposite sides thereof, the side plates 67 and 68, centering strip 69 and die blocks being suitably clamped between these flanges by means of the bolts 70. Suitable shims 71 are preferably placed adjacent the outer faces of the side plates 67 and 68, these shims being engaged by the inner ends of the set bolts 70 upon clamping the die in the bolster 65, thereby placing any wear upon the shims 71 instead of upon the side plates 67 and 68, the shims being readily replaced when worn out.

The side plates 67 and 68 of the upper die member in conjunction with the side plates 46 and 47 of the lower die member perform a highly useful and necessary function in the operation of these dies as will be better apparent from the description hereinafter. It may be noticed, however, that the margins of the gutters are formed along the converging portions of the plates and that along the parallel portions of these plates the margins are stamped or flattened out after the corrugating die portions 73 and 57 and 58 have operated.

The trough or gutter forming portions 72 of the upper dies are formed independently of the corrugated portions 73 in order that the corrugated portions 73 may have vertical movement relative to the gutter forming portions as will be described. The trough or gutter forming portions 72 and the corrugated portions 73 which form the upper dies are arranged in pairs, the corrugated portions being maintained in proper alinement with the gutter forming portions by means of the tongues 74 projecting from the inner edges of the corrugated members 73, these tongues being adapted to engage in suitable slots provided in the inner edges of the trough or gutter forming members 72, as shown in Fig. 8. The upper faces of the several parts of the upper die are provided with keyways substantially as described in connection with the lower die, these keyways registering when the die is set up and thereby forming a continuous groove or channel in the upper face of the upper die for the reception of a suitable key for alining bar 75 therein.

The trough or gutter forming portions 72 of the upper die are inclined from the outer edges of the die to the corrugated portions 73, this inclination being substantially parallel with the inclination of the coöperating portions of the lower die, so that upon the coöperation of the upper and lower dies the metallic sheet will be bent gradually adjacent its opposite edges and adjacent the opposite edges of the central flange or seam formed by the coöperation of the centering bar 45 of the lower die with the centering strip 69 of the upper die, thereby forming a double gutter in the sheet as it is fed between the dies. The opposite edges of the gutter forming portions 72 corrugated portions 73 and side plates 67 and 69 are preferably tapered slightly in practice to coöperate with the slightly tapered edges of the lower die, thereby giving the necessary clearance to the dies, as will be well understood by those skilled in the art.

A cross bar 78 extends across the outer ends of the corrugated portions 73, the centering strip 69 and the side plates 67 and 68, suitable flanges extending inwardly from the opposite ends of this cross bar engaging the outer faces of the side plates 67 and 68 respectively, as shown in Figs. 6 and 8. The side plates 67 and 68 are secured to the cross bar 78 by means of suitable machine screws 80, as shown in dotted line in Figs. 6 and 8. The gutter forming portions 72 of the upper die are bolted to the die block or bolster 65 by means of suitable bolts 81, the upper ends of the openings provided in the bolster 65 for these bolts being suitably counterbored as shown in dotted lines in Fig. 6 to receive the enlarged heads of these bolts.

The corrugated portions 73 of the upper die are secured to the die block or bolster 65 by suitable bolts 82, the openings provided in the bolster 65 for these bolts being counter sunk to receive the heads of the bolts. These openings are countersunk to sufficient depth as shown at 85 in Fig. 6 to allow some play between the heads of the bolts 82 and the bottom of the counter bores in which they are received, so that the corrugated portions 73 which are mounted in the bolster 65 by these bolts may have vertical movement relative to the die block 65, the purpose of which will hereinafter be made apparent.

Pockets 86 are bored out in the bolster 65

adjacent the corrugated members 73, these pockets being adapted for the reception of suitable springs 87 therein. The lower ends of the springs 87 engage the upper surfaces of the corrugated members 73 so as to maintain these members in the position shown in dotted lines at 88 in Fig. 6.

Assume that the metallic sheet is advanced along the bed 34 of the press and into position between the upper and lower dies prior to starting the machine, the dies having been properly alined in the press and the exact position of the ram 25 for the particular thickness of metallic sheet that is to be stamped having been previously obtained. Upon depressing the lever 13, the crankshaft 8 will be rotated through the belt pulley 12 to drive the ram 25 up and down. Upon the downward movement of the ram 25 the coöperation of the gutter forming portions 72 of the upper die with the gutter forming portions 43 and 44 of the lower die, neither stretches nor shrinks the metallic sheet but bends the same along its opposite edges and along the opposite edges of the centering bar 45, to form a double gutter therein, this gutter being formed gradually as it is fed forward to the corrugating part of the dies. The sheet is then advanced to the corrugated part of the die where the semicircular corrugations are formed. As the metallic sheet is advanced into position between the corrugated part of the dies, the corrugated members 73 of the upper die will engage the metallic sheet before the gutter forming portions, due to their being extended beyond the gutter forming portions 72 by means of the springs 87. Further downward movement of the ram 25 causes the corrugated members 73 to shrink the metallic sheet along the outside and central margin as there must be greater lineal length of material in the corrugated area than in the margins, the sheet within the area to be corrugated being simultaneously folded about the corrugations of the lower corrugated members 43 and 44, the springs 87 being of sufficient strength to permit this.

As the ram 25 reaches the bottom of its downward stroke, the gutter forming portions are brought into coöperation to continue the double gutter along the sheet, the projection 89 of the centering strip 69, this projection being somewhat exaggerated in the drawing, is brought into coöperation with the groove 90 in the centering bar 45 of the lower die, thereby giving the metal along the central margin a slight crease.

During the corrugating operation, the thickening of the metal along the margins and end walls results in forming on the surfaces of these parts a great number of small surface wrinkles. The forming of a very slight crease by the coöperation of the projection 89 with the groove 90, is to insure that all of the surface wrinkles have been flattened out along the central margin where the fold is to be formed. Hence this slight crease need be formed only to the extent of insuring that there are no transverse wrinkles lying across the central part, which wrinkles or creases, if they did exist, would tend to form a ragged or uneven fold.

As the ram 25 begins its upward movement, a cam 91 mounted upon the countershaft 22 is timed to engage a roller 92 journaled in the outer forked end of the lever 93, this lever being pivotally mounted within its length as at 94. The opposite free end of the lever 93 is provided with a forked arm 95 which formed arm is adapted to be swung upwardly thereby and into engagement with the horizontally extending stems 97 of the advancing fingers 63. The advancing fingers 63 are thereby lifted upwardly about the pivot 96, through the slots 61 and 62 extending through the bed of the press and the registering slots 59 and 69 extending through the lower die and into engagement with the corrugations formed in the metallic sheet. Further upward movement of the advancing fingers lifts the metallic sheet from the lower die so that the sheet may be advanced therealong. Upon lifting the metallic sheet from its engagement with the lower die, a cam block 98 mounted upon the counter shaft 22 is timed to move the horizontally extending stems 97, and consequently the upwardly projecting advancing fingers 93 horizontally through the slots 59—61 and 60—62 respectively, thereby advancing the metallic sheet along the bed of the press, preferably by an amount equal to the pitch distance between the corrugations. Upon advancing the metallic sheet the cam 91 is timed to disengage the roller 92 thereby allowing a spring 100 to move the horizontal stems 97 of the advancing fingers 63 and consequently the advancing fingers themselves downwardly and out of engagement with the metallic sheet, the inner end of the lever 93 being moved downwardly about the pivot 94 and into position for the next step, which step and all subsequent steps are substantially repetitions of the step just described.

In order to keep the metallic sheet flat when it is in position between the dies and to prevent its following the upper die, upon the upward movement of the ram 25, which would not only bend the metal, probably breaking the same, but would make it difficult for the advancing fingers 63 to properly engage in the corrugations of the metallic sheet, I have provided a pair of stripping arms 101 and 102. The stripping arms 101 and 102 extend longitudinally through suitable grooves 103 and 104 provided in the under face of the upper die as shown in Fig. 8. The opposite ends of these stripping arms

are guided in vertical slots provided in the posts 105 and 106, the upper ends of these posts being bolted or otherwise suitably secured to the ram 25. Suitable springs 107 are arranged about the posts 105 and 106 respectively, between suitable collars 108 provided on the posts and the stripping arms 101 and 102 which play in the lower slotted ends of the posts.

When the upper and lower dies are brought into coöperation upon the downward movement of the ram 25, the stripping arms 101 and 102 are forced against the tension of the springs 107 up into the grooves 103 and 104 respectively provided in the under face of the upper die, the stripping arms thereby in no way interfering with the proper forming of the sheet metal. As the ram 25 begins its upward movement the stripping arms 101 and 102 are forced downwardly by the springs 107, thereby holding the metallic sheet in engagement with the lower die until the advancing fingers are moved upwardly by the cam 91, whereupon the metallic sheet is lifted in order to advance the same through the dies, as has been described.

It is to be observed that spring means 87 hold the corrugating portion 73 of the upper die member in advance of the gutter forming portions 72 and the margin flattening plates 67, 68 and 69. The purpose of this is to permit the operation of shrinking the sheet and corrugating the bottom of the gutter at the same time, before actually engaging the metal along the marginal portions. During the process of shrinking the margins and end wall portions, there is a tendency to form a great number of surface wrinkles which must be flattened out to some extent in order to keep the margins flat and even. The corrugation forming means first engages the sheet and gutter and causes the sheet to shrink sufficiently to provide the surplus of metal required for corrugating the bottom portion and thereafter the margin portions 67, 68 and 69 are engaged to flatten out the surface wrinkles which have occurred during shrinkage and to smooth out the wrinkles along a line at the center of the folding margin.

It will now be apparent that the machine of my invention, although particularly adapted for use in connection with the formation of radiator tubes and the like, may be used for other purposes.

The feature of shrinking a metallic sheet to provide the surplus metal required in the corrugated area of the sheet the thickness of the metal in the corrugated area thereby formed being substantially equal to the original thickness of the metal, is a highly important aspect of my invention.

While I have described my invention in connection with the details of a particular embodiment, I do not intend thereby to limit the invention to such details as I am aware and contemplate that modifications and changes may be made without departing from the invention which is set out in the appended claims.

I claim:

1. In a sheet metal working machine the combination of a bed for supporting the material, a stationary die projecting above said bed, a reciprocating die coöperating with said stationary die, and feed mechanism for effecting a step by step advance of the material between the dies, said feed mechanism including a member for lifting the sheet clear of the projecting stationary die and advancing the sheet a predetermined step for each reciprocation of the reciprocating die.

2. In combination, a stationary die, having corrugations, a reciprocable die having a coöperating surface to form corrugations upon a strip of metal, a crank shaft for reciprocating said latter die, a countershaft geared to said crank shaft, a finger passing through said stationary die and adapted to engage the corrugations formed on said strip of metal, and cam means driven by the countershaft for moving the finger to advance the strip by one corrugation for each movement of the reciprocable die.

3. In combination, a stationary die having corrugations, a reciprocable die having a coöperating surface to form corrugations upon a strip of metal, a crank shaft for reciprocating said latter die, a countershaft geared to said crank shaft, a finger passing through said stationary die and adapted to engage the corrugations formed on said strip of metal, cam means on the countershaft for raising the finger to lift the work off of the lower die and other cam means for moving the said finger forward to advance said strip.

4. In a stamping machine, a stationary die, a reciprocating stamping die adapted for coöperation therewith, a crankshaft for driving said reciprocating die, the coöperation of said dies forming a gutter having bottom walls, end walls and marginal portions in the blank and then corrugating the bottom wall, advancing fingers adapted to be projected through said stationary die, a countershaft driven by said crankshaft, cam means carried by said countershaft for lifting said advancing fingers into engagement with the corrugations formed by the coöperation of said dies and a second cam means carried by said countershaft for moving said advancing fingers and consequently the corrugated blank longitudinally along the bed of the machine.

5. In a corrugating machine, the combination of a stationary die, a reciprocating die coöperating therewith to form corrugations in the sheet, power means for operating

said reciprocating die, and means including a finger for periodically engaging the corrugations formed by said dies to advance the sheet between said dies.

6. In combination, a stationary die, a reciprocating die adapted for coöperation therewith, said dies comprising gutter forming and corrugated portions whereby the coöperation of said dies will form a gutter having bottom walls, end walls and marginal portions in the blank, the bottom wall of the gutter thus formed being continuously and progressively corrugated simultaneously with the formation of the gutter.

7. In a machine for forming corrugated sheet metal tubes having uncorrugated portions, the combination of a die forming a support for the sheet and permitting longitudinal contraction of the sheet during the corrugating operation, and a second die cooperating with the first named die to form corrugations in one portion of the sheet and to shrink other portions of the sheet.

8. In a machine for forming corrugated sheet metal tubes having uncorrugated portions, the combination of a support for the blank permitting relative longitudinal movement between the ends thereof, during the corrugating operation, and a member coöperating with said support to form transverse corrugations in one portion of the blank and thereby shrink adjacent portions of the blank.

9. In a machine for forming corrugated sheet metal tubes having uncorrugated portions, the combination of a die having means for supporting a blank having a gutter portion and marginal portions, and a second die coöperating with the first named die for forming transverse corrugations in the gutter portion to contract the blank and thereby shrink the marginal portions.

10. In a sheet metal working machine, the combination of a support for receiving a blank having a gutter portion and marginal portion, and means operating upon the gutter portion to corrugate the same and thereby contract the blank and shrink the marginal portions thereof.

11. In combination, a stationary die, a reciprocating die adapted for coöperation therewith, said dies comprising gutter forming and corrugating portions, power driven means for moving said reciprocating die into coöperation with said stationary die, whereby the uncorrugated portions of the blank will be shrunk to provide a surplus of metal required within the corrugated portions and means for simultaneously engaging the blank at the corrugating portions of the dies whereby the blank will be corrugated to take up said fullness or surplus of metal.

12. In combination, a stationary die comprising gutter forming and corrugating portions, a reciprocating die adapted for cooperation therewith, said reciprocating die comprising a die block having a gutter forming member mounted therein, a corrugating member mounted in said die block independently of said gutter forming member, spring means tending to maintain said corrugating member extended beyond said gutter forming member so that upon the cooperation of said reciprocating and stationary dies said corrugating member will engage the blank prior to the engagement of the gutter forming member therewith in order to fold the blank about the corrugations of said stationary die.

13. In combination, a stationary die comprising gutter forming and corrugating portions, a reciprocating die adapted for coöperation therewith, said reciprocating die comprising a die block having a gutter forming member mounted therein, a corrugating member mounted in said die block independently of said gutter forming member, spring means tending to maintain said corrugating member extended beyond said gutter forming member so that upon the coöperation of said reciprocating and stationary dies said corrugating member will engage the blank prior to the engagement of the gutter forming member therewith in order to fold the blank about the corrugations of said stationary die, the coöperation of the gutter forming member of the reciprocating die with the gutter forming member of said stationary die forming a gutter in the blank and simultaneously increasing the thickness of the uncorrugated portions of said blank.

14. In combination, a pair of coöperating die members having gutter forming means and separately operating corrugating means for forming a sheet or strip of metal into a gutter with transverse depressions, and spring means to cause engagement of the corrugating means before the engagement of the gutter forming means.

15. In combination, a pair of coöperating die members, having inclined gutter forming means for forming a pair of gutters with an intermediate margin, corrugating means for shrinking the side walls and the margin of the gutter to form transverse corrugations and means for smoothing out the metal at the intermediate margins along a folding line.

16. In combination, a pair of coöperating die members having means for shrinking the marginal portions of a blank to produce a fullness or surplus of metal at other portions of the blank and means for simultaneously forming transverse corrugations in said other portions to take up said fullness or surplus of metal.

17. In combination, a pair of coöperating

die members having means for bending a sheet or strip of metal into the form of a gutter having bottom walls and side walls, the side walls thus formed lying at substantially right angles to the general plane of the bottom wall of the gutter and means for crushing the bottom walls inwardly in a semi-circular depression, said means simultaneously crushing the side walls edgewise to form a complete transverse semi-circular corrugation.

18. In combination, a pair of coöperating die members having gutter forming means for forming a sheet into a gutter having a bottom wall and side walls, the side walls thus formed lying substantially at right angles to the bottom wall, means for foreshortening the gutter to thicken the side walls thereof, and for simultaneously corrugating the bottom wall of the gutter whereby the metal of said corrugations will be maintained at substantially the original thickness.

19. In combination, a pair of coöperating die members having gutter forming means for forming a sheet or strip of metal into a gutter having a flat bottom wall and flat side walls, the side walls thus formed lying at substantially right angles to the bottom wall, means for forming flat marginal flanges substantially parallel to the bottom wall, means for foreshortening the entire gutter and for simultaneously forming corrugations in the bottom wall of the gutter, said corrugations extending to and through the side walls of the gutter.

20. In combination, a pair of coöperating die members having corrugating means for corrugating a sheet or strip of metal over a limited part of its width, with depressions and ridges of suitable form, said corrugating means leaving the margins of the sheet uncorrugated and said die members having means for forming the margins into flanges or walls at the edges of the corrugations, at substantially right angles to said corrugations.

21. In a bending machine for operating upon sheet material the combination of a pair of die members having coöperating portions for corrugating one portion of the blank to effect a shrinking of another portion of the blank and separate coöperating portions for flattening said shrunken portion, and resilient means for effecting engagement of the corrugating portions prior to the engagement of the flattening portions.

22. In a device of the class described, a die member comprising a downwardly and forwardly inclined surface and lateral surfaces inwardly and forwardly converging to form a gutter, said latter member having flat shoulder surfaces for forming a margin on the gutter, a portion of said die member farther forward having parallel lateral surfaces and a level bottom surface with the corrugations rising from said bottom surface, a coöperating die member, one of said members being reciprocable and means for advancing a strip of metal between said dies in a step by step motion, each step being equal to the pitch distance between corrugations.

23. In a device of the class described, a die member comprising a downwardly and forwardly inclined surface and lateral surfaces inwardly and forwardly converging to form a gutter, said member having flat shoulder surfaces for forming a margin on the gutter, a portion of said die member farther forward having parallel lateral surfaces and a level bottom surface with corrugations rising from said bottom surface, a coöperating die member having separate gutter forming and corrugation forming portions, spring means holding the corrugation forming portion in advance of the gutter forming portion to engage the sheet and to form corrugations before the gutter forming portion engages the sheet.

24. In combination, die members having gutter forming portions, corrugating portions and margin flattening portions, and means for causing the corrugating portions to engage each other prior to the engagement of the gutter forming and the margin flattening portions.

In witness whereof I hereunto subscribe my name this 8th day of October, A. D. 1918.

FRED M. OPITZ.