Dec. 25, 1962 M. MAIER, JR 3,070,145

MACHINE FOR FORMING SHEET METAL

Filed Oct. 17, 1958 5 Sheets-Sheet 1

Fig. 1

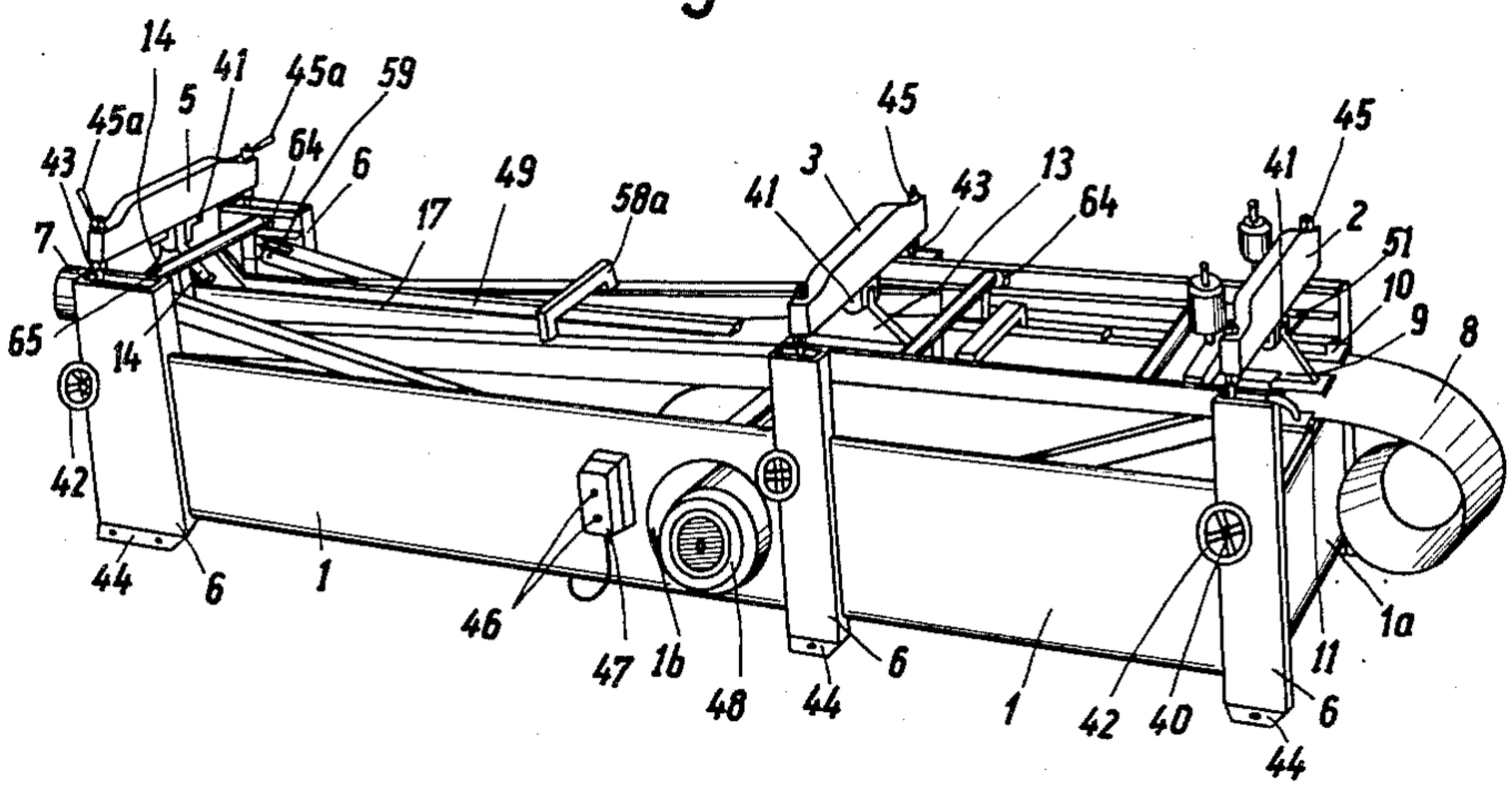
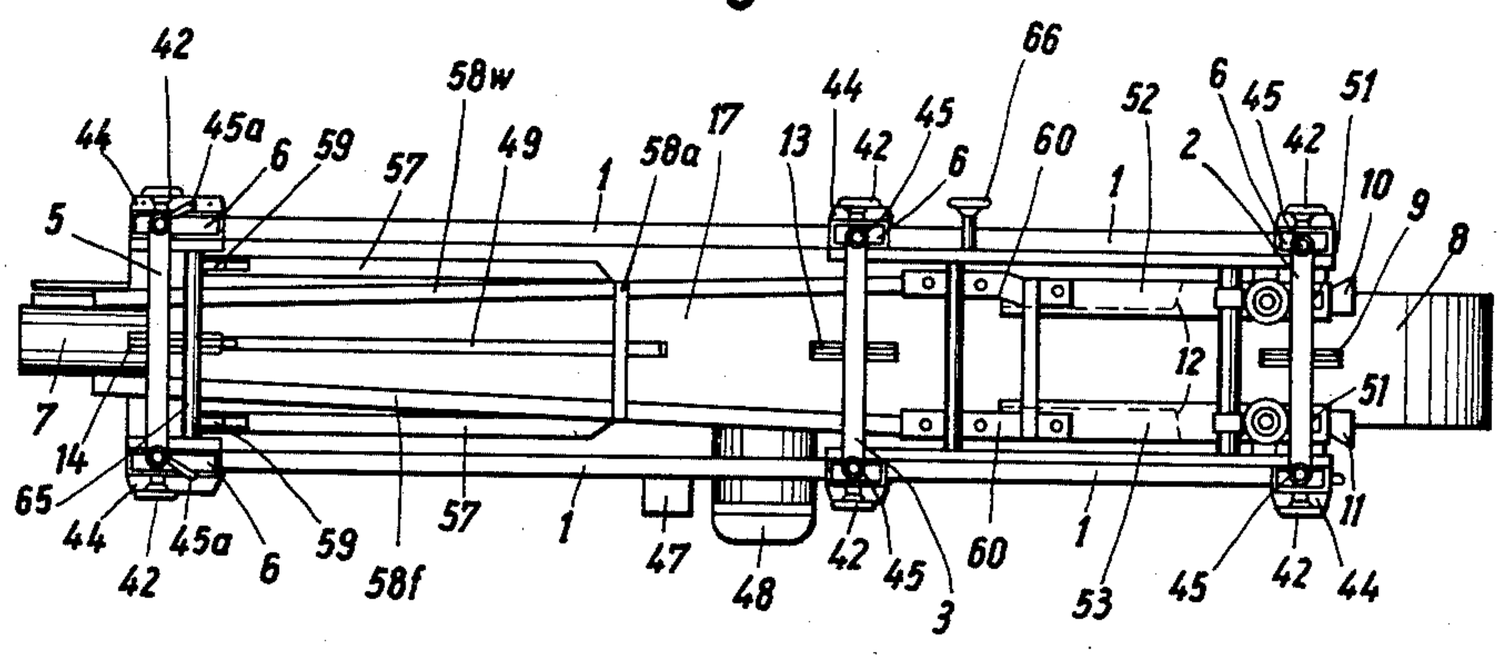


Fig. 2



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Dec. 25, 1962 M. MAIER, JR 3,070,145

MACHINE FOR FORMING SHEET METAL

Filed Oct. 17, 1958 5 Sheets-Sheet 2

Fig. 3

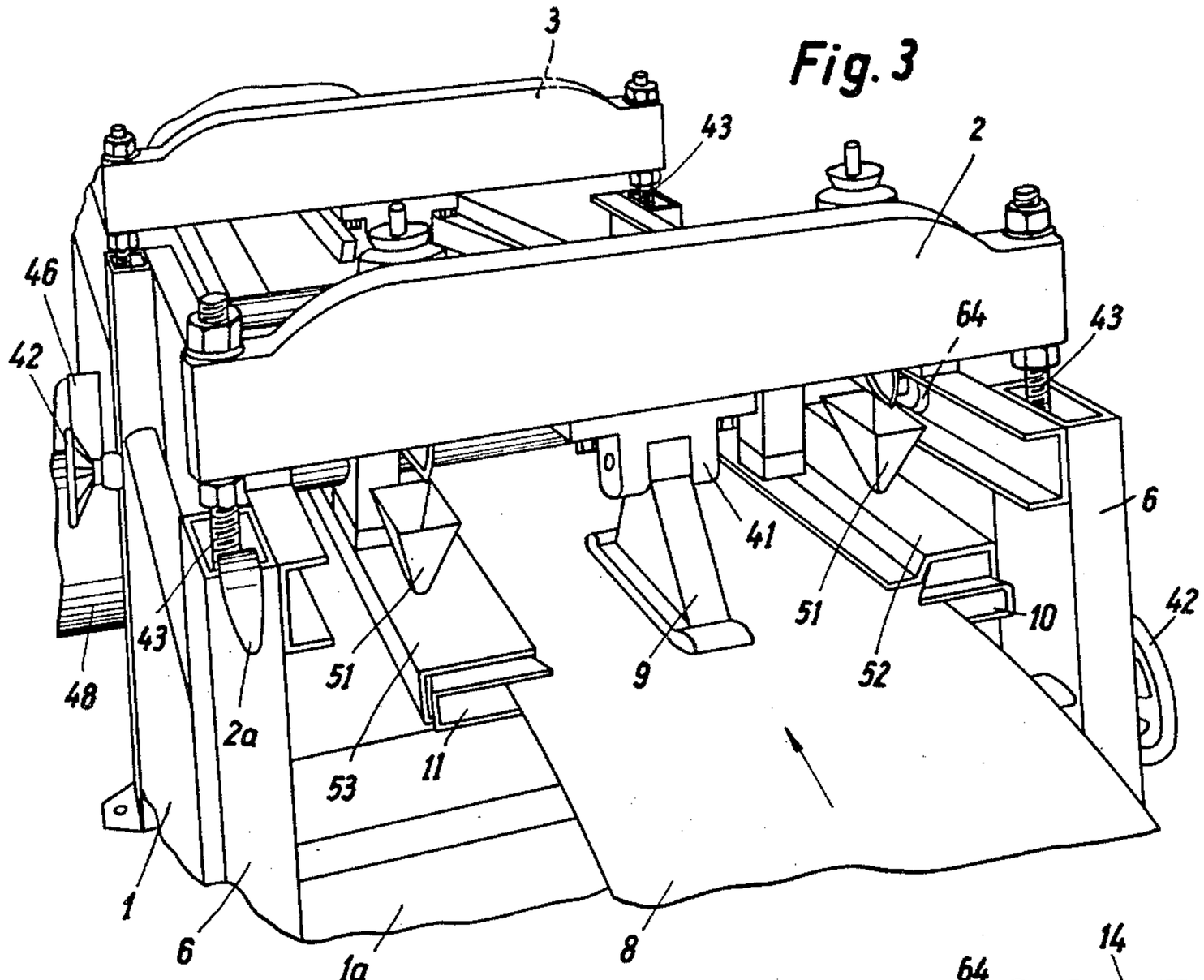
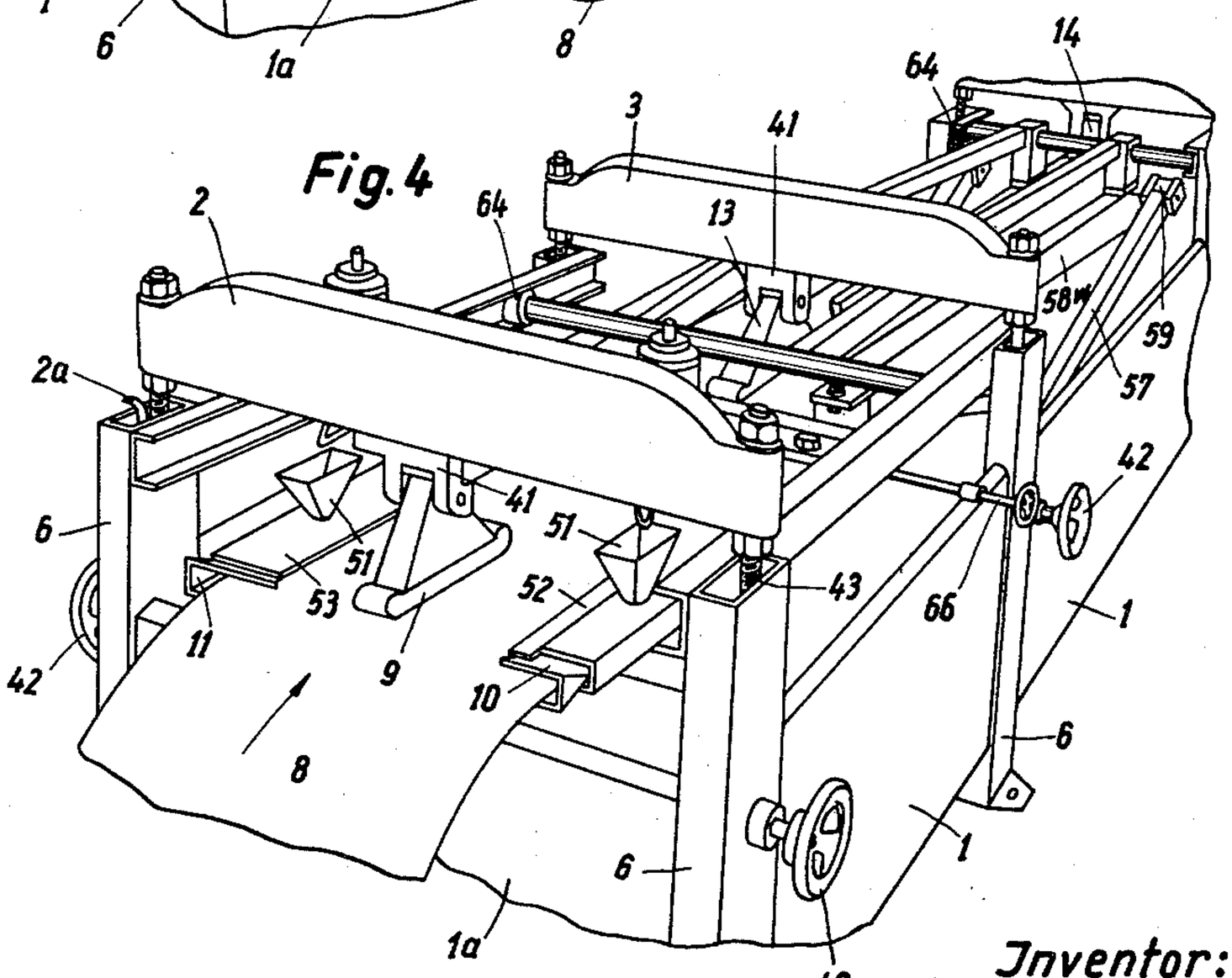


Fig. 4



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MACHINE FOR FORMING SHEET METAL

Filed Oct. 17, 1958 5 Sheets-Sheet 3

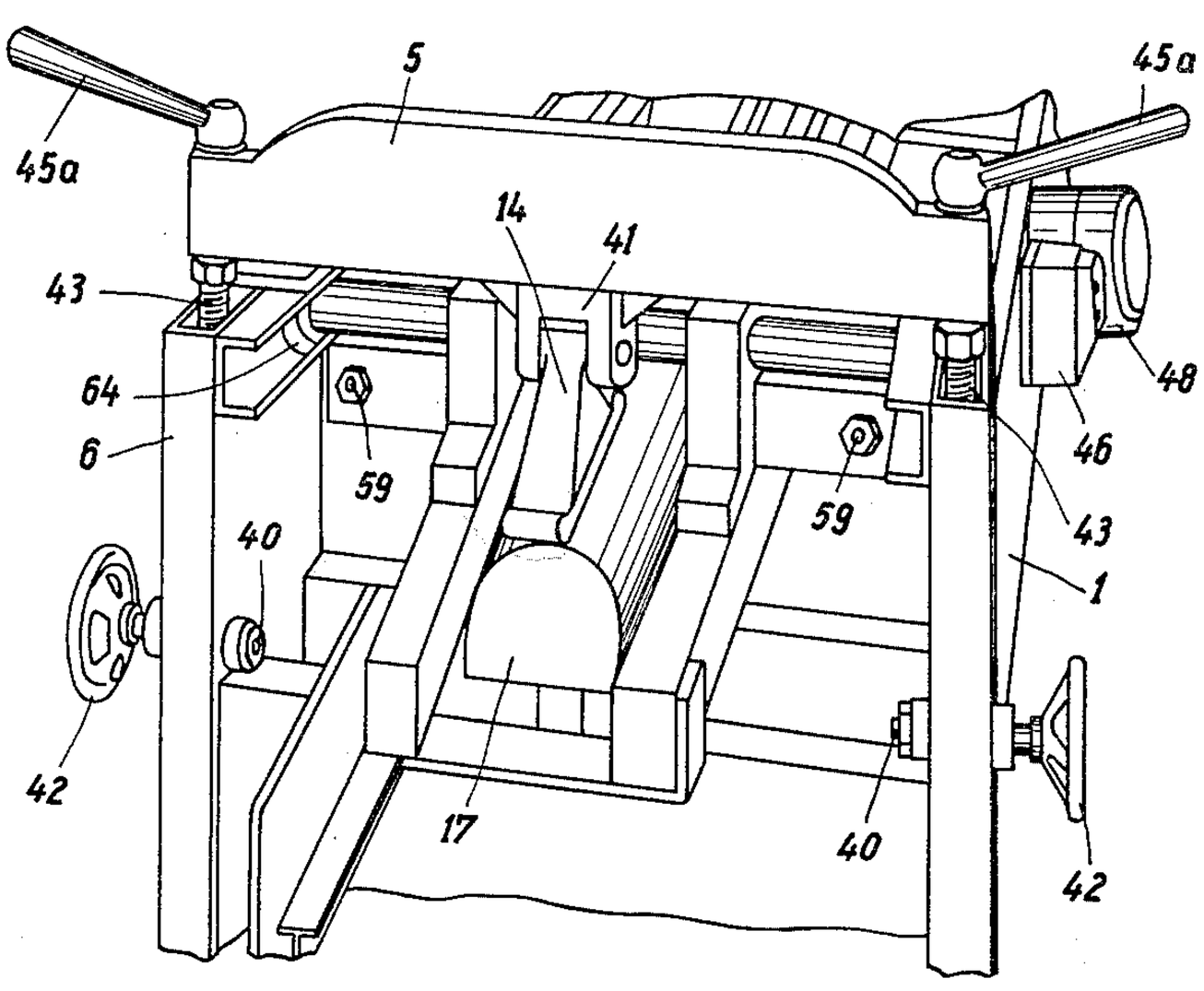
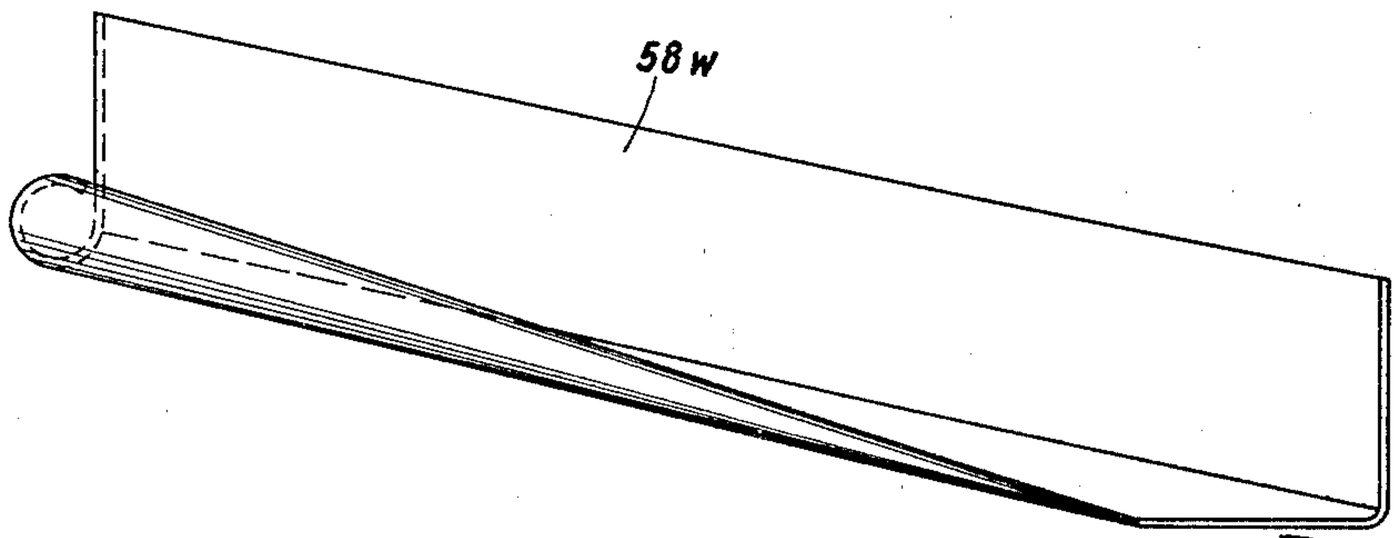


Fig. 5

Fig. 6



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MACHINE FOR FORMING SHEET METAL

Filed Oct. 17, 1958 5 Sheets-Sheet 4

Fig. 7

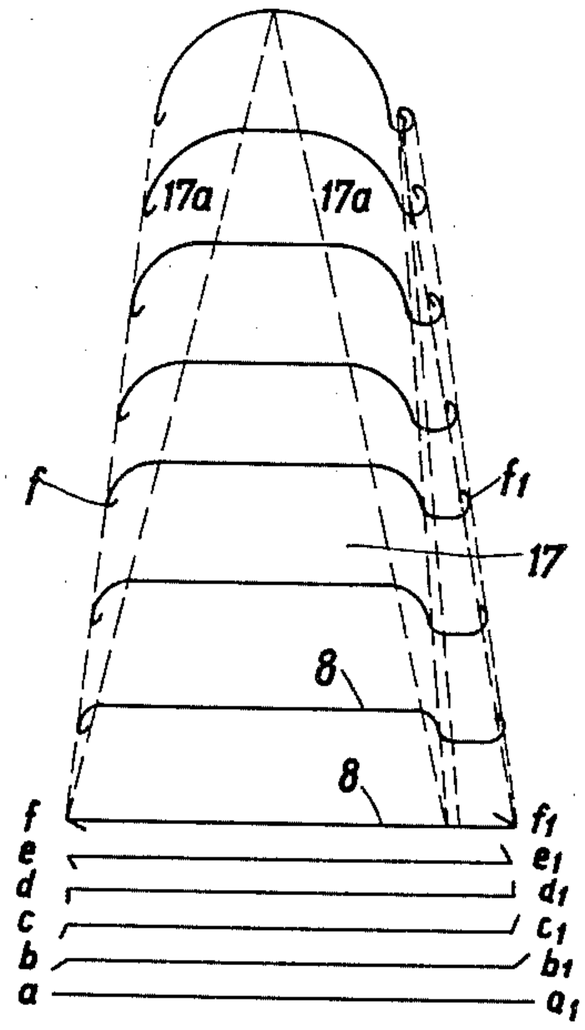
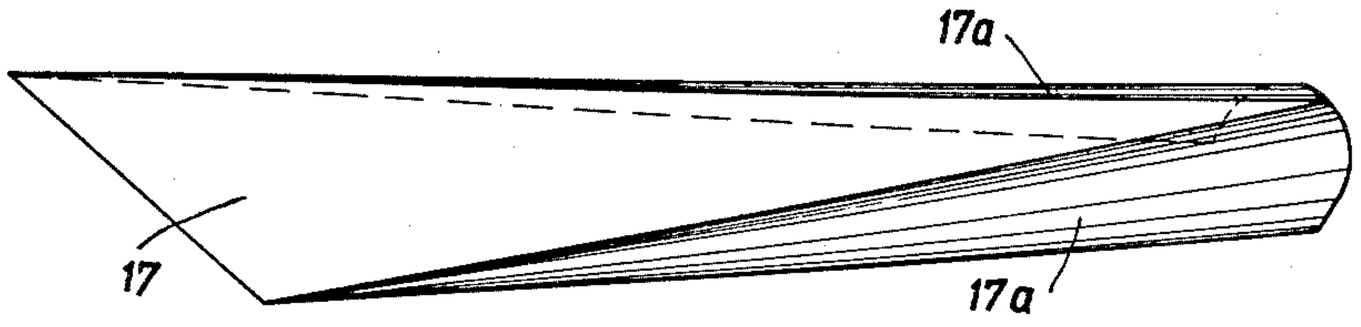


Fig. 8



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MACHINE FOR FORMING SHEET METAL

Filed Oct. 17, 1958 5 Sheets-Sheet 5

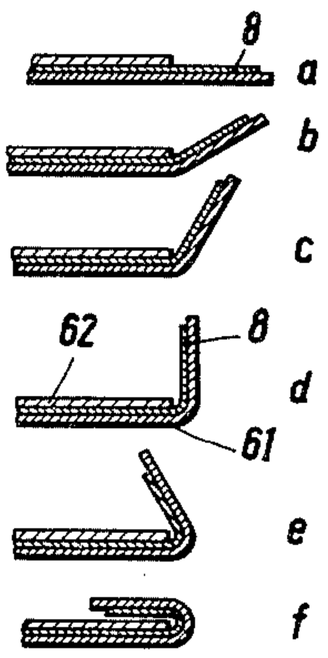

Fig. 9

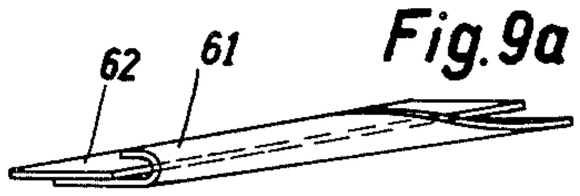

Fig. 9a

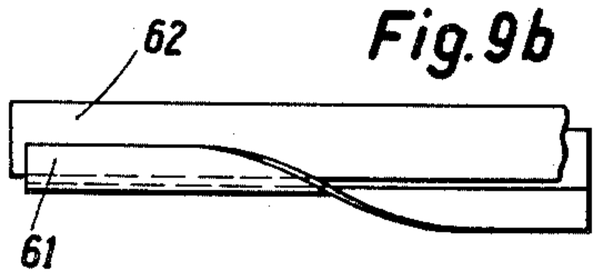

Fig. 9b

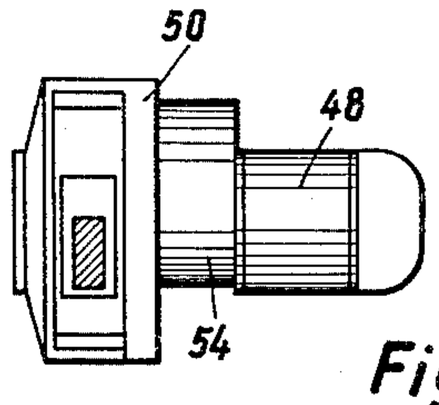

Fig. 10

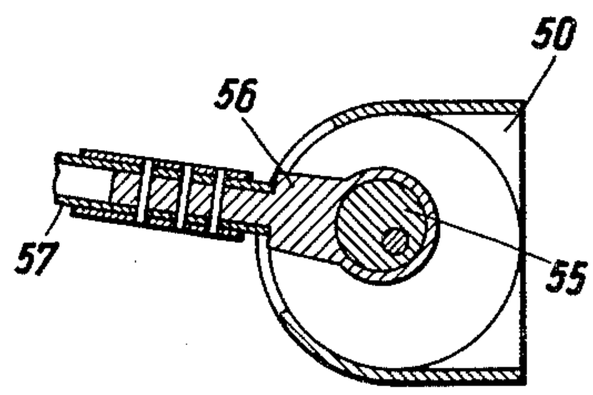

Fig. 11

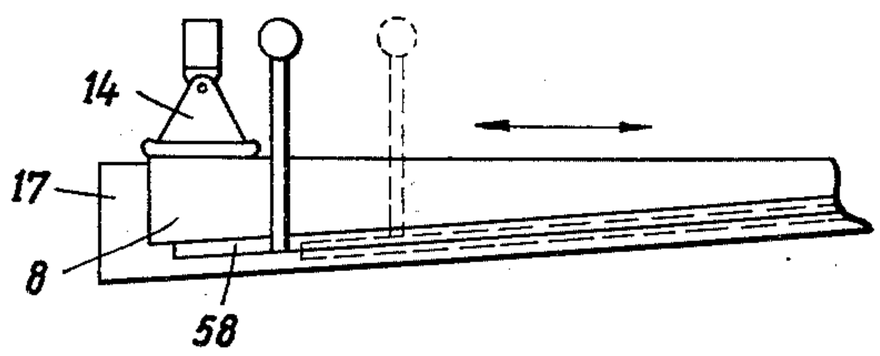

Fig. 12

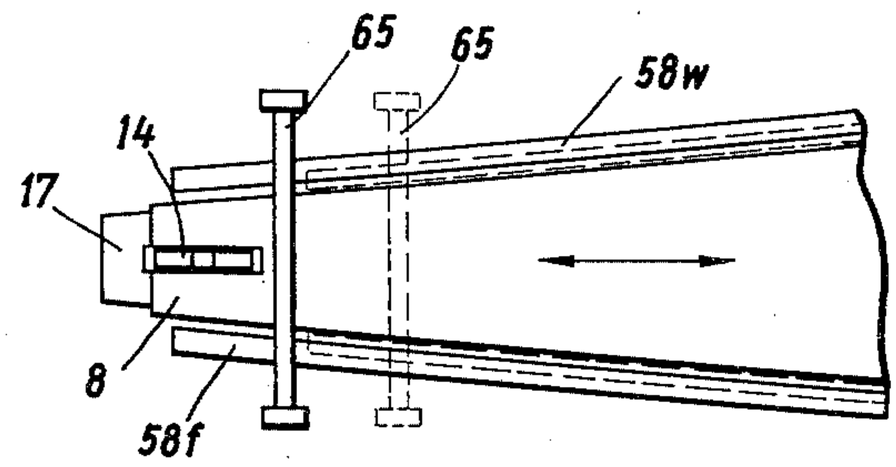

Fig. 13

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MACHINE FOR FORMING SHEET METAL

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Filed Oct. 17, 1958, Ser. No. 767,978
Claims priority, application Germany Aug. 25, 1958
7 Claims. (Cl. 153—21)

This invention relates to a machine for forming sheet metal. It is concerned with the forming of any length of strips of sheet metal and aims at the formation of semicircular and any other circular and conical shapes, starting with flat strips normally unwound from wound stock. My method and machine is used, for instance, for the making of gutters for conveying away rain.

In known apparatus, sheet metal is generally guided between profiled forming rollers or templates provided with pressure rollers. In addition to the complicated and expensive roller arrangement and the inevitable open spaces between the surfaces of individual rollers, which spaces are often the cause for lateral movements of the sheet metal strip about to be formed, these known machines have the disadvantage that the sheet metal worker must apply considerable force to propel the metal strip past the many bends of the successive forming rollers with their successively increasing deviations, often amounting to a full 360°. Generally, the referred to known machines do not permit the simultaneous forming of the water bead and reinforcement bead, so that twists and warps of the sheet metal are insufficiently checked.

In another known type of forming machines, in which the sheet metal strip must be guided past pressure rollers and templates under heavy surface pressure, the same unfavorable conditions prevail.

It has also been attempted to cut sheet metal strips, prior to forming, to the required length and to move the cut sections vertically to their longitudinal extension through a series of rollers, but this procedure also requires great force plus the added labor of bending, at the end of the forming process, the beads on both sides of each section, which requires additional great bending forces and will inevitably lead to twists and other distortions of the sections, or, in other words, to structural alterations.

In all the known machines only products of certain cross sections or profiles could be formed. Further, the known machines had to be operated by one or two persons who had to use a long-armed handle or crank and were subject to quick fatigue. With the prior constructions, it often happened that the braking and holding pressure of brake shoes used was too great and that excessive pressure was exerted on bearing shafts, which, in turn, lead to deformations of cross beams and connecting links and raised the danger of damaging the forming devices.

The primary object of my invention is to generally improve the manufacture of rain gutters and other shapes of sheet metal, and more particularly, to simplify, cheapen and speed up such manufacture.

Other objects of my invention will appear from the following description.

To the accomplishment of the objects of the present invention, my invention consists in the method steps and machine elements and their relation one to the other, as described in the specification and sought to be defined in the claims.

The specification is accompanied by drawings in which:

FIG. 1 is a perspective view of a forming machine embodying features of the invention;

FIG. 2 is a top view of the machine;

FIGS. 3 and 4 are perspective views of the entrance end of the machine;

FIG. 5 is a view of the exit end of the machine;

FIG. 6 shows a bead forming rod;

FIG. 7 shows the individual forming phases from the beginning to the end of the forming operations, illustrating the development of the water bead on the left side of the template used, and the development of the reinforcement bead on the right side of the template;

FIG. 8 shows the template;

FIG. 9 shows cross sections *a*—*f* of bead tongues and the phases of the respective bead formation;

FIG. 9*a* is a view of the bead tongues for the so-called reinforcement and water bead;

FIG. 9*b* is a top view thereof;

FIG. 10 is an elevation of the combined motor, gear drive, and housing for the eccentric;

FIG. 11 shows the drive of the eccentric for the forming unit; and

FIGS. 12 and 13 are explanatory of the wedge effect during the forming operation, viewed from one of the sides and from above, respectively.

Referring to the drawings in greater detail, the forming machine which may also be used for forming shapes other than those shown consists of a box-shaped frame **1**, **1***a* of sheet steel (FIG. 1). There is an opening **1***b* in one of the longitudinal walls **1** for the purpose of securing, near the center cross beam **3**, an electric or hydraulic motor **48** which is rigidly connected with a gear drive housing **54** and a housing **50** for an eccentric (FIG. 10) to a screw plate (not shown) connecting the frame walls **1**. A motor switch **47** with push button controls **46** is provided beside the motor **48**.

When the motor is started, pulling, beading and forming devices will be operated, as will be described further below.

The box-shaped frame **1**, **1***a* is braced internally and supported by legs **6** which have angular floor plates **44** and which together with the two longitudinal walls **1** constitute a unitary body which may be fastened to the floor by means of screws or the like. The legs **6** form hollow bodies, for example, of oblong cross sections to permit the insertion of connecting rods **43** (see FIGS. 3 and 4) which are adapted to swing slightly. These rods are connected at their upper ends with cross beams **2**, **3** and **5** by means of adjusting screws **45** to permit accurate vertical adjustment and to determine the swinging range. Each of the cross beams has mounted thereon a respective brake shoe **9**, **13**, **14** which is pivotally held by a bracket **41**.

In cooperation with the brake shoe **9**, the rear or entrance end cross beam **2** performs the task of permitting the sheet metal strip **8**, which is inserted at that end, to move freely forward toward the exit end, blocking movement of the strip **8** only in the direction toward the entrance end, an action which is common to all brake shoes of this type. The cross beam **3** which is located at the point where the forming template **17** begins, that is, at about the longitudinal center of the machine, continues the forward feed of the strip **8** as soon as the strip has advanced to the brake shoe **13** of the cross beam **3** and the brake shoe **13** has obtained a hold on the strip and exerts a rearward blocking action thereon. Cross beam **2** may be put out of action by moving the holding latch **2***a* forward (see FIGS. 3 and 4) and thus preventing the cross beam **2** from swinging and the brake shoe **9** from performing a braking action.

Below the entrance cross beam **2** and on both sides of the brake shoe **9** which, as has been stated, controls the feeding and the blocking action at the entrance end, profiled supports of a beading slide unit **52**, **53** are provided with inlet tongues **10** and **11** for the strip **8** entering the machine at that point. The supports of the beading slide unit are equipped with funnels **51** for a lubricant. The

strip 8 may loosely hang in coiled form behind the cross wall 1*a* of the machine (FIG. 1), or the strip may be hung up on a shaft, in a container, or the like (not shown), attached to the wall 1*a* of the machine frame, to be unwound when the strip is pulled through the machine.

The speed of the drive shaft of the motor 48 is reduced, for instance, from 1400 r.p.m. to 40 r.p.m., by means of a reduction gear connected with the motor shaft and housed in the associated gear housing 54 (FIG. 10), so that during the operation of the machine an eccentric 55 (FIG. 11), fixedly mounted on the drive shaft of the gear drive and pivotally connected by means of a connecting member 56 to a forked rod 57, reciprocates the beading slide unit 52, 53 and a pulling unit 58 to which the rod 57 is fastened by the bolts 59 (FIGS. 2 and 4). The slides are guided in guideways 64. The length of the reciprocation corresponds to the diameter of the eccentric.

These movements cause a positive continuous step by step forward movement of the metal strip 8 and also, as will be described hereinafter in detail, the forming of the strip 8, including the rolling of a water bead (*a*—*f*, FIG. 7) along one edge, and of a reinforcement bead (a_1—f_1) along the other edge, of the strip.

The forming takes place as follows:

First, the holding latch 2*a* is secured so that the cross beam 2 with the brake shoe 9 is put out of operation, permitting the strip 8 to be inserted into the machine between the tongues 10 and 11 below the brake shoe 9 until the strip contacts the inner bending tongues 12 (FIG. 2) of the beading slide unit 52, 53. Then, the motor 48 is started by means of the switch 47, and the holding lock 2*a* is released to allow the cross beam 2 and the brake shoe 9 to perform their respective operations. With the pulling slide 58 set in motion, strip 8 will, during the return stroke of the slide 58, enter the beading slide 52, 53, the latter being flexibly connected to the pulling slide 58 by means of the arms 60.

In the course of its forward travel, the strip 8 arrives forward of the inlet tongues 10 and 11 at, and moves over the inclined bead bending tongues 12 which sequentially produce the shapes *a*—*f* and a_1—f_1 (FIG. 7), whereupon the strip with its edges bent on both sides will enter the pulling slide unit 58 so that during the further advance of the strip 8 toward the exit end of the machine the reinforcement bead is finished in the forming rod 58*w*, while the forming rod 58*f* finishes the water bead.

According to FIGS. 7 and 8, the template 17 (when making rain gutters) consists of a body, the cross sectional shape of which gradually changes from one longitudinal end to the other as illustrated in FIG. 8. The template may quickly be exchanged so that products of other shapes and cross sections may readily be manufactured in the same machine.

FIGS. 12 and 13 show schematically how the sheet metal strip is given the desired shape. The two elements imparting the final form (template and forming rods) may be compared with two truncated cones. The template 17, when seen from above and from one of the sides, appears as a truncated cone, and the forming rods, with the strip 8 held by them and folded around the template, define a hollow truncated cone the inner surface of which abuts against the outer surface of the template 17 in the absence of the sheet metal strip 8. The template is fixedly connected with the frame of the machine in such a manner that the plane upper surface of the template lies horizontally in the machine (FIG. 12). The forming rods are fixedly connected with each other by cross rods 65 near the front or exit end of the machine and by a cross rail 58*a* at their rear ends and thus form a single unit, that is, the pulling slide unit 58. The forming rods are placed in the drawing slide 58 in such a manner that their front ends point upwardly and their lower edges run parallel to the lower edge of the template (see FIG. 12). As can be seen from FIG. 13, the outer

edges of the bead forming devices are parallel to the outer edges of the template 17.

The pulling slide 58 is moved back and forth by means of the rod 57 (FIGS. 4 and 11) which is connected with the slide 58 by means of the bolts 59 which engage the cross rods 65, the reciprocating motion being derived from the eccentric 55. The slide 58 moves horizontally in a straight line. The horizontal overall width of the work piece decreases as it moved forward between the forming rods 58*w* and 58*f*. The central portion of the work piece is being bent in an approximately arcuate shape the radius of curvature of which decreases during forward movement of the work piece as seen in FIG. 7. The resilience of the sheet metal thus urges the beads laterally toward the forming rods. During the forward movement of the slide 58, the strip 8 which is frictionally held by the forming rods is moved forward. Simultaneously, this forward movement, due to the position of the forming rods and the template in relation to each other, lifts the forming rods with the metal strip held by them from the truncated cone shaped template, similar to the action of a cone clutch. The brake shoes which are swingingly suspended loosen their grip on the forward movement of the strip and permit the strip to slide freely forward, while the backward swing of the shoes automatically locks the strip and prevents it from sliding backward (FIGS. 12 and 13).

The forming rods rigidly carried by the pulling slide now move backwards. They exert a wedge-like effect on the sheet metal strip resting on the template and give it the desired shape. The two edges of the strip receive their final shape by the water bead forming rod and the reinforcement bead forming rod respectively.

It should be noted that the metal strip 8 during its forward movement, since it is only moved without being shaped, will be under no tension. The step by step forward motion of the pulling slide leads to the discharge of the completed product 7 from the machine (see FIG. 2). The discharge takes place during a period of no tension.

The same effect would be achieved if the bead forming rods were stationary and the template instead movable, and the same is true for the reinforcement bead forming rod.

Within the area of the center cross beam 3, but ahead of same, there is a hold-down mechanism 49, consisting of a set of rods, which holds the slightly prerounded strip 8, during the latter's forward movement, along a length of approximately 40" onto the template 17 under a light sliding pressure. An individual forward feed caused by the eccentric 55 which corresponds to the diameter of the eccentric, is about 2" long per stroke, which means that long lengths of the product may be completed within a relatively short period of time.

Contrary to all known forming devices and methods, actual forming of the sheet metal strip, in the present case, takes place only during the return movement of the beading slide and forming rods, while during the forward movement the completed articles are discharged.

When working according to my invention and forming, for instance, rain gutters, the output per minute will be approximately 6.5 feet of finished gutter. The lengths obtained may be cut to size either upon the discharge from the machine or at the place of use, so that it is now possible to make seamless gutters of any length quickly and economically without soldering. Another important feature of my machine is to be seen in the fact that forming devices may be exchanged quickly and without effort. For this purpose, the template 17 is fastened to the machine at its front end by means of a simple screw connection, and at its rear end by means of a threaded plug 66 (FIG. 2).

It is believed that the method of my invention as well as the construction and operation of a preferred form of apparatus for practicing the invention will be fully understood from the foregoing detailed description. With

the present invention, it is possible to exchange the forming devices easily and to use the machine for making any desired shape. The work formerly done by hand and usually requiring two persons is no longer manually done. The machine is operated by a motor and does the forming work automatically. My machine operates much faster than any of the known machines. The brake shoes of my machine serve to brake the return movement only of the metal strip and no longer exert an undesirably high pressure on bearings and suspension rods. The material worked upon and the finished product are fed forwardly by the friction hold of the forming devices on the strip. The present invention ensures trouble-free operation.

It will be apparent that while I have shown and described my invention in a single form only, many changes and modifications may be made without departing from the spirit of the invention as defined in the appended claims.

What is claimed is:

1. A sheet forming apparatus, comprising a support; first and second forming means on said support and defining thereon a path for movement of a work piece of sheet material in a predetermined direction, said first forming means being fixed on said support, said second forming means being mounted for reciprocating movement on said support; actuating means for reciprocating said second forming means along said path away from said first forming means in said predetermined direction, and toward said first forming means in an opposite direction, said first and second forming means defining therebetween a channel elongated in said direction, said channel having transversely spaced longitudinal portions which converge in one of said directions, said work piece being adapted to pass through said channel; and brake means on said support for preventing movement of said work piece in said opposite direction, whereby said work piece is held stationary on said support by said brake means during movement of said second forming means toward said first forming means, and while the portions thereof in said converging channel portions are formed by said forming means, and said work piece is released by said brake means during movement of said second forming means away from said first forming means.

2. An apparatus as set forth in claim 1, wherein one of said forming means is of substantially conical shape and defines with the other one of said forming means a channel having substantially the shape of a hollow frustum of a cone.

3. An apparatus as set forth in claim 2, wherein said

frustum of a cone tapers in said predetermined direction.

4. An apparatus as set forth in claim 2, wherein said one forming means is said first forming means.

5. An apparatus as set forth in claim 1, further comprising edge shaping means arranged along said path ahead of said channel in the direction of movement of said work piece, said edge shaping means being connected with said second forming means for joint movement and for shaping an edge portion of said work piece while the same is being held by said brake means.

6. An apparatus for forming a continuous length of gutter trough and the like from a continuous strip sheet, comprising, a machine frame; a plurality of brake shoes mounted of said frame and spaced from each other along a line defining the path of said sheet on said frame, each of said brake shoes being reciprocably pivoted on an axis transverse of said path for circumferential braking engagement with said sheet when the same moves in one direction, and for releasing said sheet when it moves in the reverse direction along said path; a template fixedly mounted on said support along said path, said template being elongated in said directions and having oppositely arranged longitudinally extending face portions converging in said reverse direction; a forming slide mounted for reciprocating movement on said support; and actuating means for reciprocating said slide longitudinally toward said template in said one direction and away from said template in said reverse direction for urging respective portions of said sheet into conforming abutment against said face portions when said slide moves toward said template, and for frictionally entraining said sheet to move in said reverse direction when said slide moves away from said template.

7. An apparatus as set forth in claim 6, further comprising a beading slide on said support connected to said forming slide for joint movement along said path and having a beading tool for shaping engagement with an edge of said sheet when said forming slide moves in said one direction, and for frictionally entraining said sheet when said forming slide moves in said reverse direction.

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