

Feb. 13, 1940.

A. E. HENRICSON

2,190,423

WINDSHIELD FRAME BENDING MACHINE

Filed Dec. 6, 1937

6 Sheets-Sheet 1

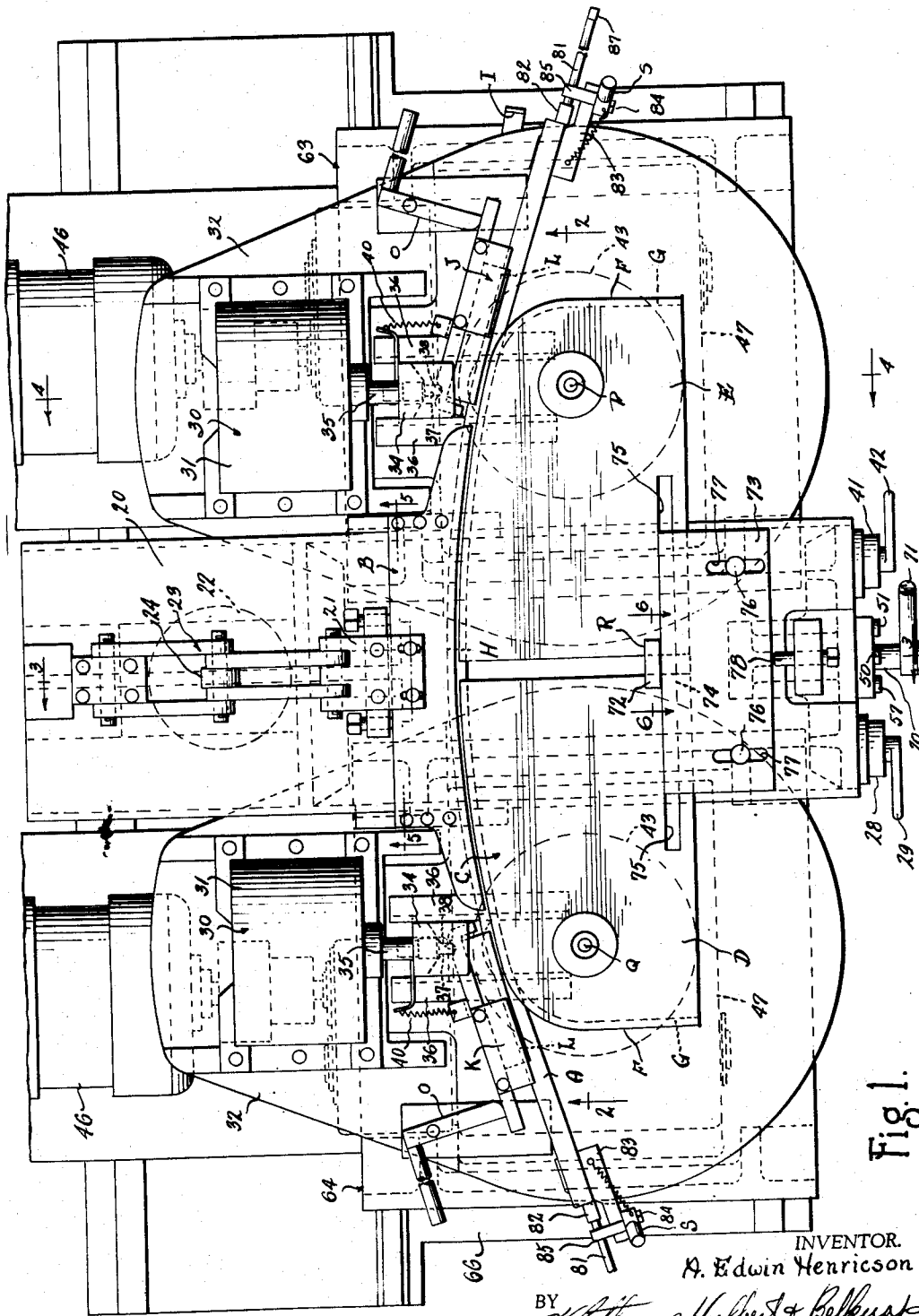


Fig. 1.

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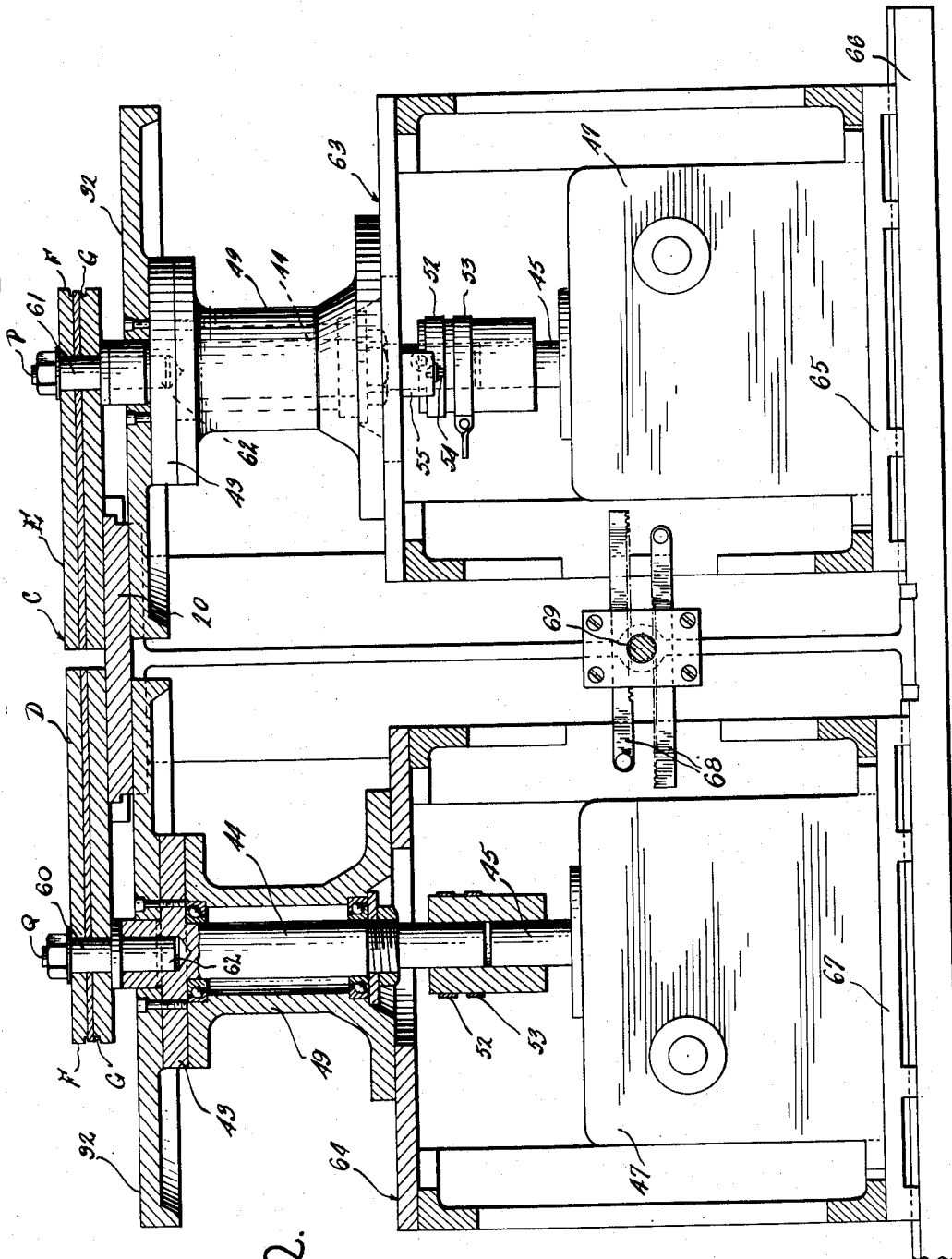
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WINDSHIELD FRAME BENDING MACHINE

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6 Sheets-Sheet 2



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WINDSHIELD FRAME BENDING MACHINE

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6 Sheets-Sheet 3

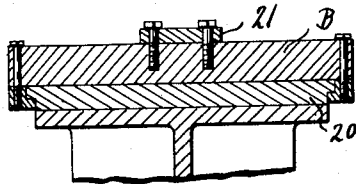


Fig. 5.

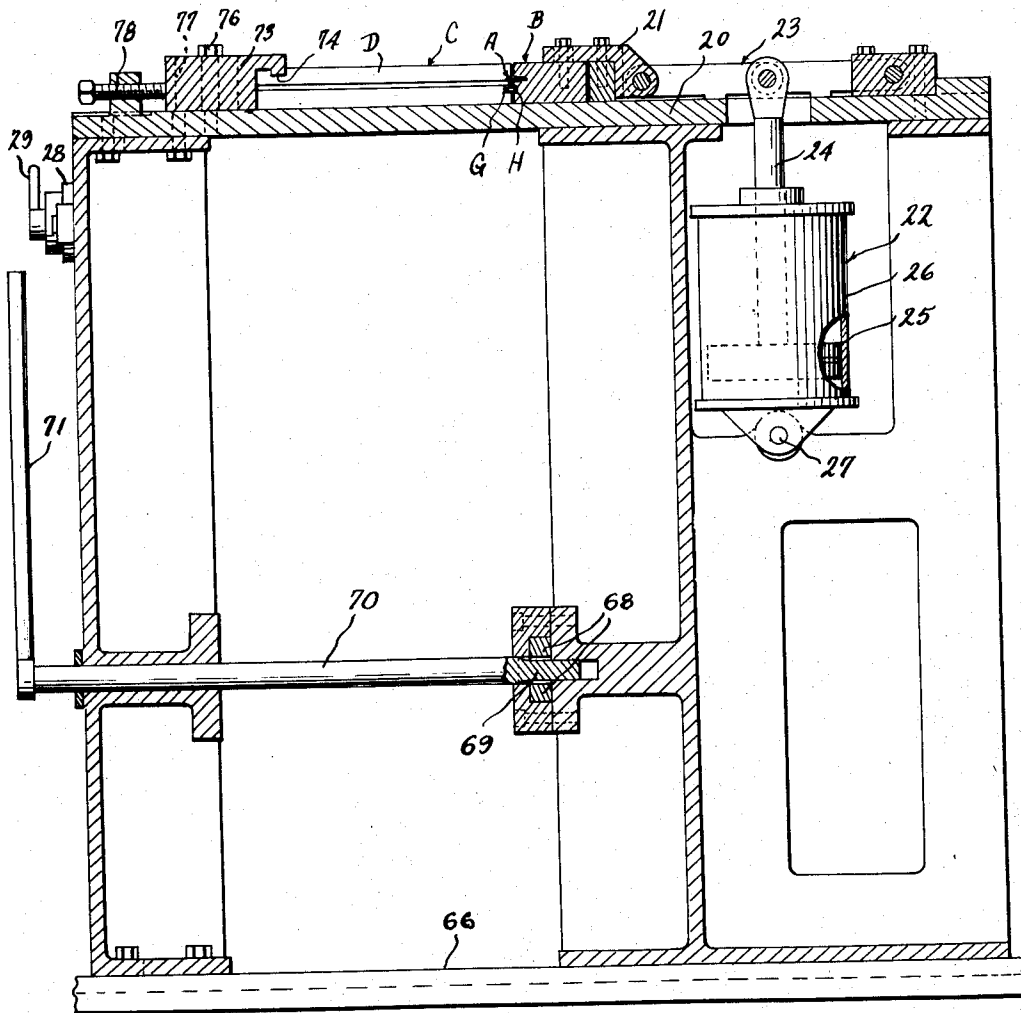
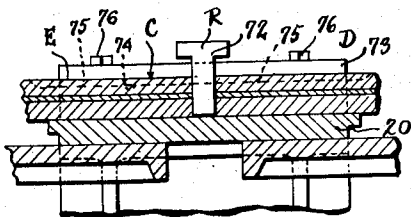


Fig. 6.

Fig. 3.

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6 Sheets-Sheet 4

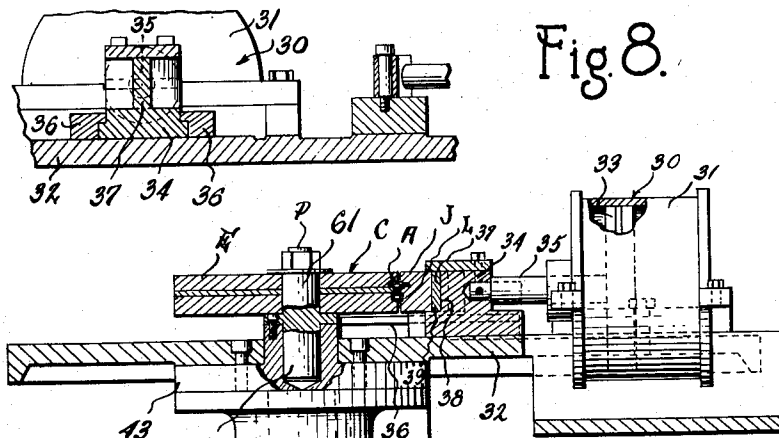


Fig. 8.

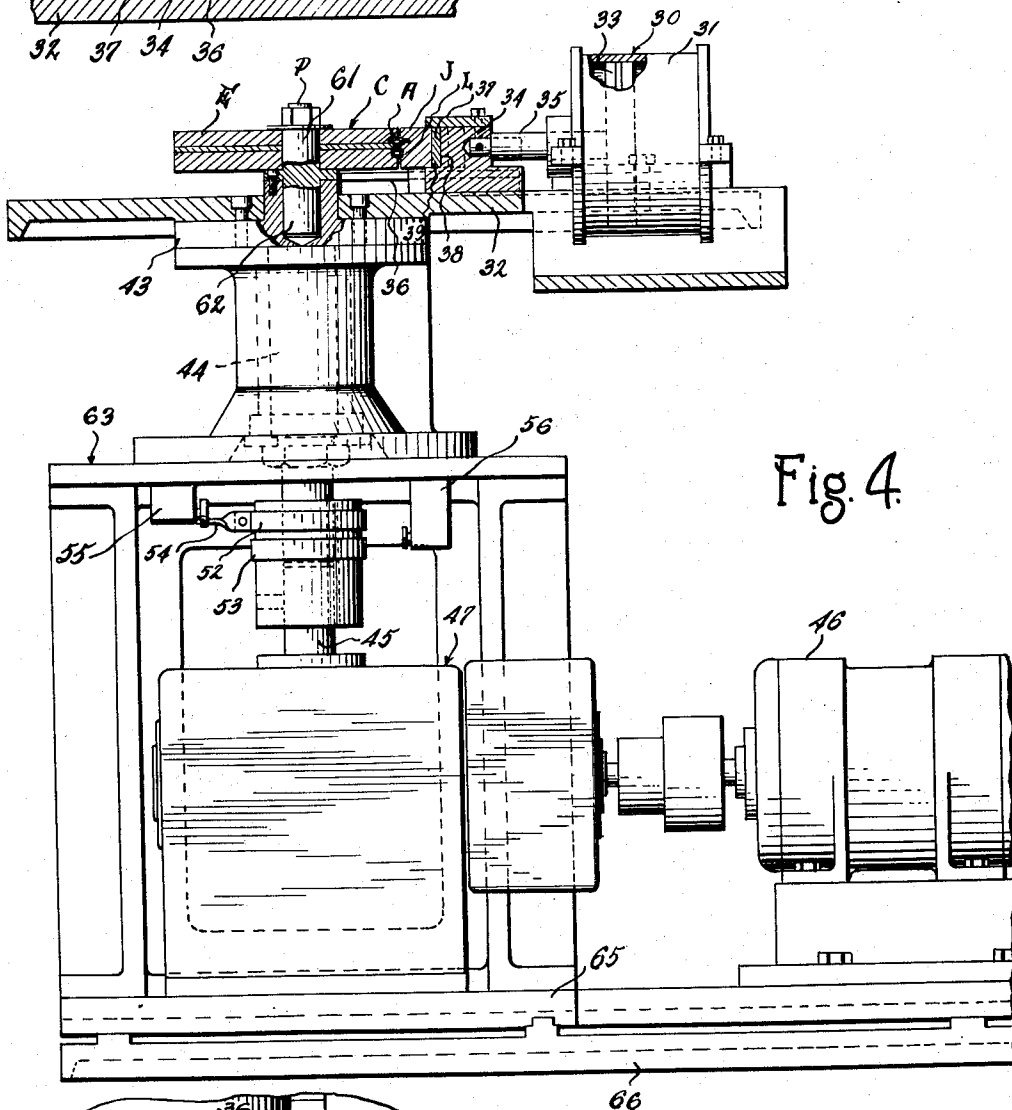


Fig. 4.

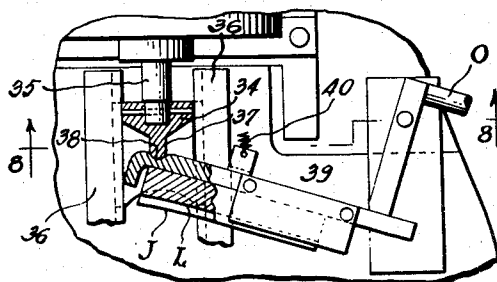


Fig. 7.

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WINDSHIELD FRAME BENDING MACHINE

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Fig. 9.

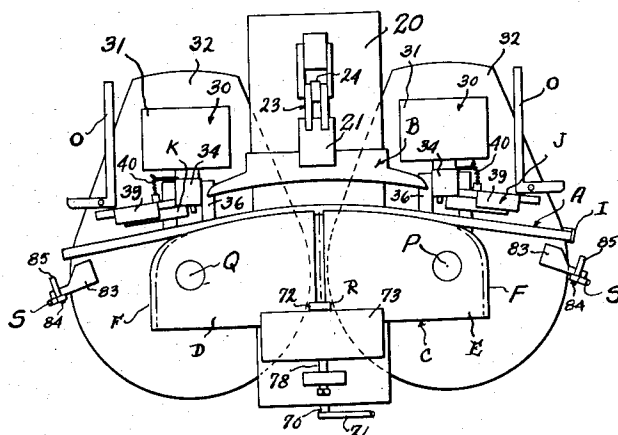


Fig. 10.

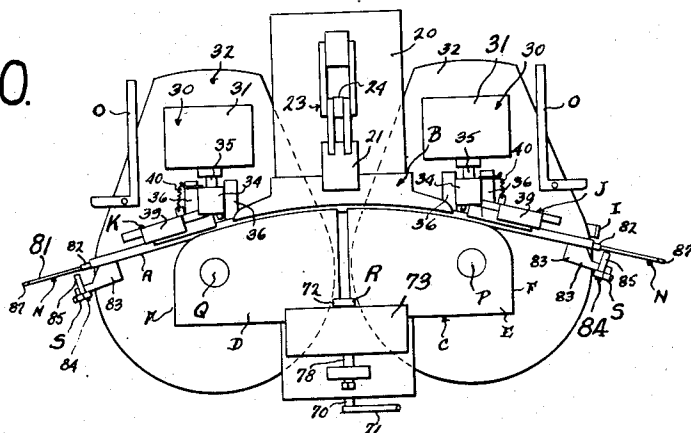
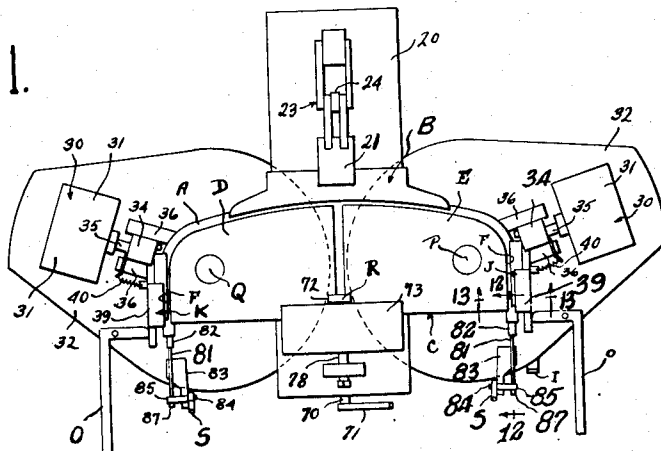


Fig. 11.



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WINDSHIELD FRAME BENDING MACHINE

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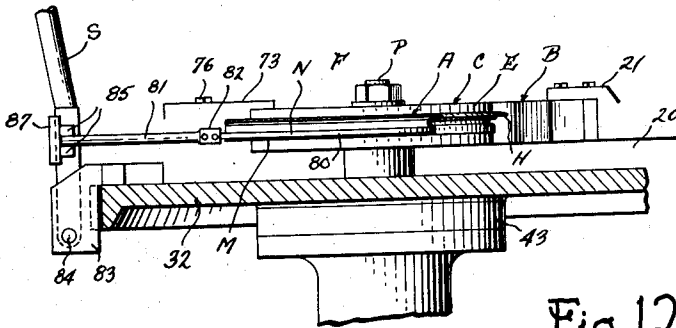


Fig. 12.

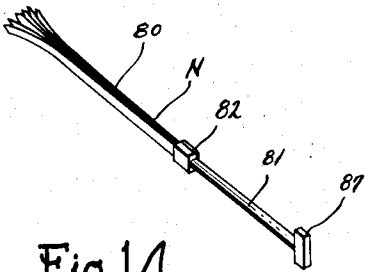


Fig. 14.

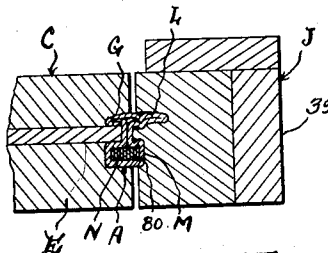


Fig. 13.

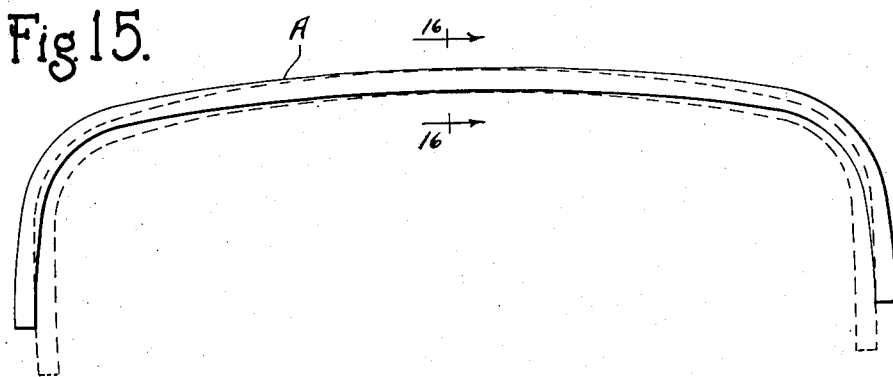


Fig 15.

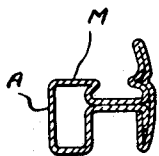


Fig. 16.

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UNITED STATES PATENT OFFICE

2,190,423

WINDSHIELD FRAME BENDING MACHINE

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Application December 6, 1937, Serial No. 178,423

9 Claims. (Cl. 153—46)

This invention relates generally to metal working machines and refers more particularly to improvements in apparatus for bending strip stock.

5 It is one of the principal objects of this invention to provide a machine embodying mechanism capable of bending strip stock to a predetermined longitudinal contour with a relatively few operations which are effected with such rapidity that the production of the strips is appreciably increased.

10 Another advantageous feature of this invention resides in the provision of a machine capable of longitudinally bending strip stock having a prefashioned cross sectional contour without overstressing the metal or deforming the original cross sectional shape of the strip.

15 With the above, as well as other objects in view, the invention resides in the novel arrangement of parts and the manner in which the latter cooperate to perform the bending operation. This arrangement will be made more apparent as the description proceeds, especially when considered in connection with the accompanying drawings, wherein—

20 Figure 1 is a fragmentary top plan view of a bending machine constructed in accordance with this invention;

25 Figures 2, 3, 4, 5, and 6 are sectional views taken substantially on the planes indicated by the lines 2—2, 3—3, 4—4, 5—5, and 6—6 of Figure 1;

30 Figure 7 is a fragmentary plan view, partly in section, of a portion of the machine;

35 Figure 8 is a sectional view taken substantially on the plane indicated by the line 8—8 of Figure 7;

40 Figures 9 to 11, inclusive, are semi-diagrammatic views illustrating several steps in the operation of the machine;

45 Figures 12 and 13 are respectively sectional views taken substantially on the planes indicated by the lines 12—12 and 13—13 of Figure 11;

50 Figure 14 is a perspective view of one of the plugs employed to prevent collapsing of the strip during the bending operation;

Figure 15 is a side elevational view of the strip fashioned in accordance with this invention; and

55 Figure 16 is a cross sectional view taken substantially on the plane indicated by the line 16—16 of Figure 15.

The machine selected herein for the purpose of illustrating the present invention is adapted to bend a strip of stock of the cross sectional con-

tour illustrated in Figure 16 to the longitudinal contour shown in Figure 15. The finish strip shown by the full lines in Figure 15 may be used as a part of a windshield molding frame for vehicle bodies, although it will be noted from the following description that the machine is by no means limited to the formation of the strip of stock to the particular contour shown herein.

5 Upon reference to Figures 9 to 11, inclusive, it will be noted that a strip of stock A having the desired cross sectional contour is inserted between a clamp B and a form C. The form C comprises two sections D and E supported for movement toward and away from each other. The cooperating sections of the form C are so positioned with respect to each other that the side surface F of one section forms a continuation of the corresponding side surface of the other section and both of these surfaces cooperate to define the longitudinal contour indicated by the dotted lines in Figure 15. It may be pointed out at this time that the machine is designed to actually bend the strip A beyond the final contour indicated by the full lines in Figure 15 in order to compensate for the inherent spring action of the metal from which the strip is formed. The amount of "over-bending" of the strip depends upon the particular characteristics of the metal from which the strip is fashioned and is predetermined so that when the bending pressure is relieved from the strip, the latter will spring back to the predetermined desired final contour.

10 The side surfaces F of the sections of the form C are formed with a recess G shown in Figure 13 as having a cross sectional contour predetermined to cooperate with a recess H in the clamp B to receive the strip A and to substantially engage the latter throughout the cross sectional area of the same. The clamp B is supported opposite the contoured side edges F of the form for movement toward and away from the latter, and serves to effectively secure the central portion of the strip A against the form.

15 The strip A is positioned with the central portion thereof opposite the clamp B by means of a suitable stop I and after being located by this stop, the clamp B is moved from the open position thereof shown in Figure 9 to the closed position illustrated in Figure 10. The inner side surface of the clamp B corresponds in longitudinal contour to the central portion of the form C and when in the position thereof shown in Figure 10, effectively clamps the central part of the

strip A against the adjacent surface of the form C.

A pair of shoes J and K are supported upon opposite sides of the clamp B in the plane of the form C for movement toward and away from the latter. The shoes are elongated in the direction of length of the strip A and the inner ends of the shoes are pivotally supported for swinging movement in the plane of the form C in the manner shown in Figure 7 to permit the shoes to follow the arcuate end portions of the form C. Attention is also called to the fact at this time that the bending surfaces of the shoes are formed with longitudinally extending recesses L therein shown in Figure 13 as having a cross sectional contour predetermined to cooperate with the recess G in the side surface of the form to effectively support the strip throughout the cross sectional area of the latter. Thus, it will be seen that the shoes cooperate with the clamp B and form C in preserving the cross sectional contour of the strip during the bending operation and, in the present instance, collapsing of the tubular end portions M of the strip is prevented by inserting a core N in each end of the strip before the latter is bent around the end portions of the form C.

After the shoes and core members N are located in their operative positions with respect to the strip, the free ends of the shoes are clamped into engagement with the strip by swinging the pivoted clamping members O to the positions thereof shown in Figure 1. Upon completion of this operation, the shoes J and K are respectively swung in directions away from the clamp B about the axes P and Q to the final positions thereof shown in Figure 11. As a result, the extremities of the strip A are effectively bent around the side edges F of the form C and, since the longitudinal contour of the latter corresponds to the dotted line shape illustrated in Figure 15, it follows that the strip will be bent to this contour.

Upon completion of the above operation, the pivoted clamping members O are returned to their inoperative positions shown in Figure 10 and the shoes, as well as the clamp B, are moved away from the form C. As a consequence, the strip springs back to the full line position shown in Figure 15 away from the form C, and the cooperating sections of this form are moved slightly away from each other to permit withdrawing the gage R which determines the length of the finish strip. The cooperating sections of the form are then moved toward each other to the dot-dash line positions thereof shown in Figure 9 and the strip is removed from the machine. Prior to removing the strip from the machine, the cores N are, of course, removed from the ends of the strip and this is accomplished by merely swinging the arms S, shown in Figure 12, outwardly.

Referring now more in detail to the particular construction of the machine, it will be noted from Figure 3 that the clamp B is slidably supported upon a plate 20 in the plane of the form C and is adjustably connected to a holder 21 which, in turn, is operatively connected to suitable fluid pressure actuated means 22 through the medium of the linkage 23. The linkage 23 comprises a pair of toggle links having the outer ends respectively pivotally connected to the holder 21 and machine frame and having the inner ends pivotally connected to a piston rod 24 having the lower end secured to the piston

25 of the fluid pressure actuating means 22. The piston 25 is reciprocally mounted in a vertical cylinder 26 having the lower end pivotally connected to the machine frame, as at 27. The cylinder 26 is located in a fluid pressure system 5 (not shown) and the operation of the piston 25 is controlled by a valve 28 having a lever 29 conveniently positioned for manipulation by the operator. The arrangement is such that in one position of the valve, fluid under pressure is admitted to the cylinder 26 at the underside of the piston 25 and the latter is moved upwardly relative to the cylinder. Upward movement of the piston effects a corresponding movement of the adjacent ends of the toggle linkage by the rod 24 and since one end of the linkage is pivotally connected to the machine frame, it follows that the clamp B is moved away from the form C. On the other hand, when fluid pressure is admitted to the cylinder 26 at the top side of the piston 25 to move the latter downwardly, the toggle linkage 23 is straightened and the clamp B is moved toward the form C to clamp the stock therebetween.

It has previously been stated that after the central portion of the stock is secured to the form C by the clamp B, the shoes J and K on opposite sides of the clamp are moved into engagement with the strip of stock. In detail, each shoe is actuated by fluid pressure means 30 having a cylinder 31 secured to a table 32 and having a piston 33 operatively connected to a sliding head 34 through the medium of a rod 35. The head 34 is slidably mounted on the table 32 in the plane of the form C and is guided throughout its sliding movement by means of the ways 36 secured to the table 32. The inner end of the head 34 is provided with a projection 37 engageable in a recess 38 formed in the shoe holder 39 adjacent the inner end thereof and permitting swinging movement of the shoe in the plane of the form C. The shoe holder 39 for each shoe is yieldably maintained into engagement with the adjacent sliding head 34 by means of a suitable spring 40, and the outer ends of the holders are adapted to be engaged by the pivoted clamps O which cooperate with the fluid pressure means 30 to maintain the shoes in contacting relation with the strip of stock throughout the length of the shoes.

It will, of course, be understood from the foregoing that two tables 32 are provided, one for each shoe assembly and that the actuating means for the shoes including the clamps O are respectively carried by the two tables to form in effect separate units. However, the fluid pressure actuating means for the shoes are simultaneously operated to move the shoes in unison toward and away from the form C. In other words, the cylinders 31 are connected in a common fluid supply system which is controlled by a valve 41 having an operating lever 42 located adjacent the operating lever 29 for convenient manipulation. The arrangement is such that when it is desired to move the shoes into clamping engagement with the stock, fluid pressure is supplied to the cylinders 31 at the rear sides of the pistons 33 and the latter are moved in a direction toward the form C to effect a corresponding movement of the shoes J and K. On the other hand, when it is desired to release the shoes from clamping engagement with the stock, fluid pressure is admitted to the cylinders 31 at the front sides of the pistons 33 cause the

latter to move rearwardly or in a direction away from the form C.

After the shoes have been moved into clamping engagement with the strip of stock in the manner previously set forth, the shoes are respectively swung about the axes P and Q to bend the stock around the opposite ends of the form C. This is accomplished, in the present instance, by oscillating the tables 32 in opposite directions from the position thereof shown in Figure 10 to the position illustrated in Figure 11. Upon reference to Figure 2, it will be noted that each table 32 is secured to a driving flange 43 integrally connected to the upper end of a driven shaft 44 having the lower end coupled to a power take-off shaft 45 which, in turn, is operatively connected to a reversible electric motor 46 through the medium of a speed reducer 47. Attention is called to the fact at this time that the driven shaft 44 for one of the tables 32 is rotatably supported in a hub 48 on the axis P and the shaft 44 for the other table 32 is revolvably supported in a similar hub with its axis coincident with the axis Q.

It will be apparent from the foregoing that each shaft 44 is driven by a separate driving means and that each of the driving means embodies a reversible motor 46. However, the two motors are preferably located in a common electrical circuit and the fields of the motors are reversed in the usual manner to oscillate the tables by a pair of switch buttons 50 and 51 supported on the machine adjacent the fluid pressure controlled means 29 and 42 for convenient manipulation. Of course, the motors are automatically stopped at the end of travel of the tables 32 in each direction and this is accomplished in the manner shown in Figure 4 by providing each shaft 44 with a pair of trip rings 52 and 53. The ring 52 is provided with a radially outwardly extending finger 54 adapted to open the limit switch 55 in one direction of oscillation of the associated table 32 and the ring 53 is adapted to open a second limit switch 56 to discontinue oscillation of the associate table 32 in the opposite direction. It will be observed that both rings may be adjusted to vary the relative positions of the fingers with respect to the limit switches so as to vary the length of oscillation of the tables in either direction. If desired, the circuit (not shown) in which the electric motors are connected may be provided with an emergency switch for discontinuing the operation of the motors at any point in the cycle. In the event the operator desires to accomplish this result, a third switch button 57 is supported adjacent the switch controls 50 and 51.

With the above construction, it will be noted that when the parts are in the position thereof shown in Figure 10 and it is desired to complete the bending operation, the operator merely presses the push button 51. This action closes the circuit to the electric motor 46 and causes both tables 32 to swing in opposite directions about their respective axes P and Q to the positions illustrated in Figure 11. Inasmuch as the shoes are carried by the tables, it necessarily follows that these shoes move as a unit with the tables and, in view of the fact that the shoes are yieldably maintained into clamping engagement with the stock, it also follows that the stock is bent around the opposite end portions of the form C.

The sections E and D of the form C are respectively secured to studs 60 and 61 having the

lower ends 62 respectively secured to the shafts 44 on the axes P and Q. The arrangement is such that the section E is carried by the supporting and driving unit for the shoe J, while the section D is carried by the supporting and driving unit for the shoe K. These two units are designated in Figure 2 by the reference characters 63 and 64. The unit 63 is carried by a plate 65 which is slidably mounted on the bed 66 of the machine for movement toward and away from the unit 64. The latter unit, on the other hand, is carried by a plate 67 similar to the plate 65 and which is mounted on the bed 66 in the same manner as the plate 65 for movement toward and away from the unit 63. The two units are interconnected by means of a pair of racks 68 and an intermeshing pinion 69. Upon reference to Figure 2, it will be noted that the upper rack 68 has one end pivotally connected to the unit 64 and that the opposite end of the lower rack is pivotally connected to the unit 63. The racks are suitably supported in intermeshing relationship with the intermediate pinion 69 so that rotation of this pinion in one direction causes the sections of the form to move toward each other and rotation of the pinion in the opposite direction effects a movement of the sections of the form away from each other. Referring now to Figure 3 of the drawings, it will be noted that the pinion 69 is secured to a shaft 70 which extends to the front side of the machine and has an operating lever 71 secured thereto. Thus, it will be seen that by manipulation of the lever 71, the sections of the form may be moved toward and away from each other depending upon the direction of swinging movement of the lever.

Upon reference to Figure 6, it will be noted that the sections of the form are accurately located in their innermost positions by means of a gage 72 adapted to be inserted between adjacent edges of the sections of the form prior to relatively moving these sections toward each other. It will be apparent that the gage acts as a stop to limit relative movement of the sections of the form toward each other and thereby controls the dimension of the finish strip.

Owing to the fact that the only securing means for the sections of the form C is the studs 60 and 61, previously described, it may be desirable to provide some means for preventing oscillation of the sections about the axes P and Q. This is accomplished by a bracket 73 slidably supported on the plate 20 in the plane of the form C at the outer side of the latter and having a portion overlapping the two sections of the form. The latter portion of the bracket is shown in Figure 3 as having a depending tongue 74 adapted to engage in aligned recesses 75 formed in the top surfaces of the sections of the form. The bracket is secured to the plate 20 by means of fastener elements 76 which extend through slots 77 and are threaded into the plate 20. The slots 77 are elongated in a direction transverse to the recesses 75 and provide for accurately positioning the two sections of the form with respect to each other. A suitable vernier adjustment 78 is shown in Figure 3 for the purpose of adjusting the bracket in the direction of length of the slots 77.

Reference was made in the general description of the invention to the fact that collapsing of the opposite end portions of the strip is prevented during the bending operation by inserting a core N in each of the ends of the strip prior to

to bending the end portion of the strip around the form. The core is shown in Figure 14 as comprising a laminated section 80 and a handle portion 81 suitably secured to the laminated section by the coupling 82. The laminated sections 80 of the cores N are adapted to be telescoped into the tubular end portions M of the strip when the latter is in the position thereof shown in Figure 10, and are designed to fill the tubular portions so that there will be no tendency for the latter to collapse during the final bending operation shown in Figure 11. The cores are removed from the ends of the strip after the bending pressure has been released from the strip and before the latter is removed from the machine.

For accomplishing the above result, it will be noted that each table 32 has a bracket 83 secured thereto and that a lever S is pivoted to each bracket by means of a pin 84. The brackets are shown in Figures 9 to 11, inclusive, as being so positioned on their respective tables that during the final bending operations, the handle portions 81 of the cores are received between laterally projecting lugs 85 on the handles S. In other words, the arrangement is such that when the parts are in the position illustrated in Figure 11, the handle portions 81 of the cores assume positions between the lugs 85 on the levers S so that outward movement of these levers about their pivots 84 engages the lugs 85 with the head portions 87 on the extremities of the cores and releases the cores from the ends of the strip.

What I claim as my invention is:

1. In a machine for bending a strip of stock to a predetermined longitudinal contour, a form having sections supported for relative movement toward and away from each other and cooperating in one relative position to provide the form with a side surface corresponding in shape to said predetermined longitudinal contour, a clamp arranged to clamp the intermediate portion of the strip of stock to each of said sections and to provide a continuous support for the strip of stock, shoes supported in the plane of the form for movement as a unit with the sections aforesaid of the form, means for rotating the shoes relative to the form, and means also movable as a unit with the sections for yieldably urging the shoes in a direction toward the side surface of the form throughout rotation of the shoes in one direction relative to the form to bend the strip of stock around portions of the side surface of the form.

2. In a machine for bending a strip of stock to a predetermined longitudinal contour, a form having sections supported for movement toward and away from each other and cooperating in one relative position to provide the form with a side surface corresponding in shape to said predetermined longitudinal contour, a member overlapping the adjacent edges of said sections to provide a continuous support for the strip of stock, a shoe movable as a unit with each section of the form and supported in the plane of the form, yieldable means movable as a unit with each section for urging the shoes in a direction toward the form to clamp a strip of stock against the form, and means for rotating the shoes relative to the form to bend the strip of stock around portions of the side surface of the form.

3. In a machine for bending a strip of stock to a predetermined longitudinal contour, a form having sections supported for movement toward and away from each other and cooperating in one relative position to provide the form with a side surface corresponding in shape to said predetermined longitudinal contour, a member overlap-

ping the adjacent edges of said sections to provide a continuous support for the strip of stock, a table movable as a unit with each section of the form and supported for oscillation, a shoe mounted on each table in the plane of the form, means also supported on each table for yieldably urging the shoes in a direction toward the form to clamp a strip of stock against the side surface of the form, means movable as a unit with one section of the form and operatively connected to the table associated with the latter section for rotating the table in a direction to move the shoe on said table relative to the form, and means movable as a unit with the other section of the form and operatively connected to the table associated therewith for simultaneously rotating the shoe mounted on the latter table relative to the form.

4. In a machine for bending a strip of stock to a predetermined longitudinal contour, a form having sections supported for movement toward and away from each other and cooperating in one relative position to provide the form with a side surface corresponding in shape to said predetermined longitudinal contour, a clamping member overlapping the adjacent edges of the sections, a shoe movable with each section of the form and supported in the plane of the form for rotative movement relative to the form, means also movable as a unit with each form for yieldably urging the shoes in a direction toward the section to clamp a strip of stock against the side surface of the form, means movable as a unit with one section of the form and operatively connected to the shoe associated with the latter section to rotate the shoe in one direction relative to the form, and means movable as a unit with the other section of the form and operatively connected to the shoe associated with the latter section for rotating said shoe in the opposite direction relative to the form.

5. In a machine for bending a strip of stock to a predetermined longitudinal contour, a form having relatively movable sections having side surfaces grooved to receive a strip of stock, said sections being supported in a common plane with the adjacent edges thereof spaced from each other a sufficient distance to provide the required relative movement of the sections toward each other subsequent to the bending operation to permit removal of the stock from the grooves in the form and having side surfaces cooperating to form a substantially continuous working face on the form corresponding to the predetermined longitudinal contour aforesaid, a clamp movable toward and away from the form in the plane of the latter and having an elongated clamping face overlapping the joint between the adjacent edges of the sections to clamp the intermediate portion of the strip of stock against both sections of said form, a bending shoe movable as a unit with one of the sections and supported at one side of the clamping means for movement relative to the form throughout a path of travel predetermined to bend one end portion of the strip around the working face of the section aforesaid of the form, means also movable with the above named section of the form for moving said shoe throughout the path of travel thereof, a second shoe forming a unit with the other section of the form and supported at the opposite side of the clamping means for movement relative to the second section of the form throughout a path of travel predetermined to bend the opposite end of the strip around the working face of the sec-

ond section of the form, and means for actuating the second shoe independently of the first shoe and forming a unit with the second named section of the form.

- 5 6. In a machine for bending a strip of stock to a predetermined longitudinal contour, a form having relatively movable sections having side surfaces grooved to receive a strip of stock, said sections being supported in a common plane with
10 the adjacent edges spaced from each other a sufficient distance to provide the required relative movement of the sections toward each other subsequent to the bending operation to permit removal of the stock from the grooves in the form and having side surfaces cooperating to form a
15 substantially continuous working face on the form conforming to the predetermined longitudinal contour aforesaid, an oscillatable table movable as a unit with each section of the form, a
20 shoe carried by each table in the plane of the form and cooperating with the side surface of the form to yieldably clamp a strip of stock thereto, and means also movable as a unit with each section
25 of the form for oscillating the tables in a direction to move the shoes relative to the form and thereby bend the strip of stock around the working faces of the sections of the form, the two driving means being independent and free from connection with each other.
- 30 7. In a machine for bending a strip of stock to a predetermined longitudinal contour, a pair of sections having side surfaces grooved to correspond to the cross-sectional contour of the strip of stock and supported for relative movement toward and away from each other with their adjacent
35 edges normally spaced from each other, a clamp overlapping the aforesaid adjacent edges of the sections and arranged to clamp the intermediate portion of the strip of stock to both of said sections and to provide continuous longitudinal support for the strip of stock, a shoe at
40 each side of the clamp grooved to correspond to the cross-sectional contour of the strip of stock and movable in opposite directions from the clamp in the plane of the form, hydraulic means
45 for urging said shoes toward said sections during movement of the shoes relative to the sections for bending the strip to the longitudinal contour of the form, means for releasing the hydraulic pressure on said shoes to permit the
50 strip of stock to be moved out of the grooves in said shoes, and means for moving the two sections toward each other to permit the strip of

stock to be moved out of the grooves in said sections whereby the strip of stock can be readily removed from the machine.

8. In a machine for bending a strip of stock to a predetermined longitudinal contour, a form corresponding in shape to said predetermined longitudinal contour and having a portion of its side surface grooved to correspond to the cross sectional contour of the strip of stock, a support, a shoe mounted upon said support and having one side surface grooved to correspond to the cross sectional contour of the strip of stock, hydraulic means mounted upon said support and arranged to urge one end of said shoe toward said form, a clamp mounted upon said support and arranged to move the opposite end of said shoe toward said form, and means for moving said support relative to said form whereby said shoe is moved along a portion of the side surface of said form to bend the strip of stock to the predetermined longitudinal contour.

9. In a machine for bending a strip of stock to a predetermined longitudinal contour, a form comprising sections arranged in a common plane and cooperating with each other to provide the form with a substantially continuous side surface corresponding in shape to the predetermined longitudinal contour, both of the sections supported for movement toward and away from each other to increase and decrease the length of the form, a single clamping member located in the plane of the form opposite the joint between the adjacent edges of the sections and effective to clamp an intermediate portion of the strip against the side surfaces of both sections, a shoe movable with such section of the form and supported in the plane of the form for movement relative to the form along the side surfaces of the sections, means also movable as a unit with each section of the form for yieldably urging the shoes into frictional engagement with the adjacent portions of the strip of stock, a prime mover movable as a unit with one section of the form and having a drive shaft operatively connected to the shoe associated with the latter section to move said shoe relative to the form, and a second prime mover movable as a unit with the other section of the form and operatively connected to the shoe associated with this latter section for moving the latter shoe independently of the other shoe.

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