No. 702,046. Patented June 10, 1902.

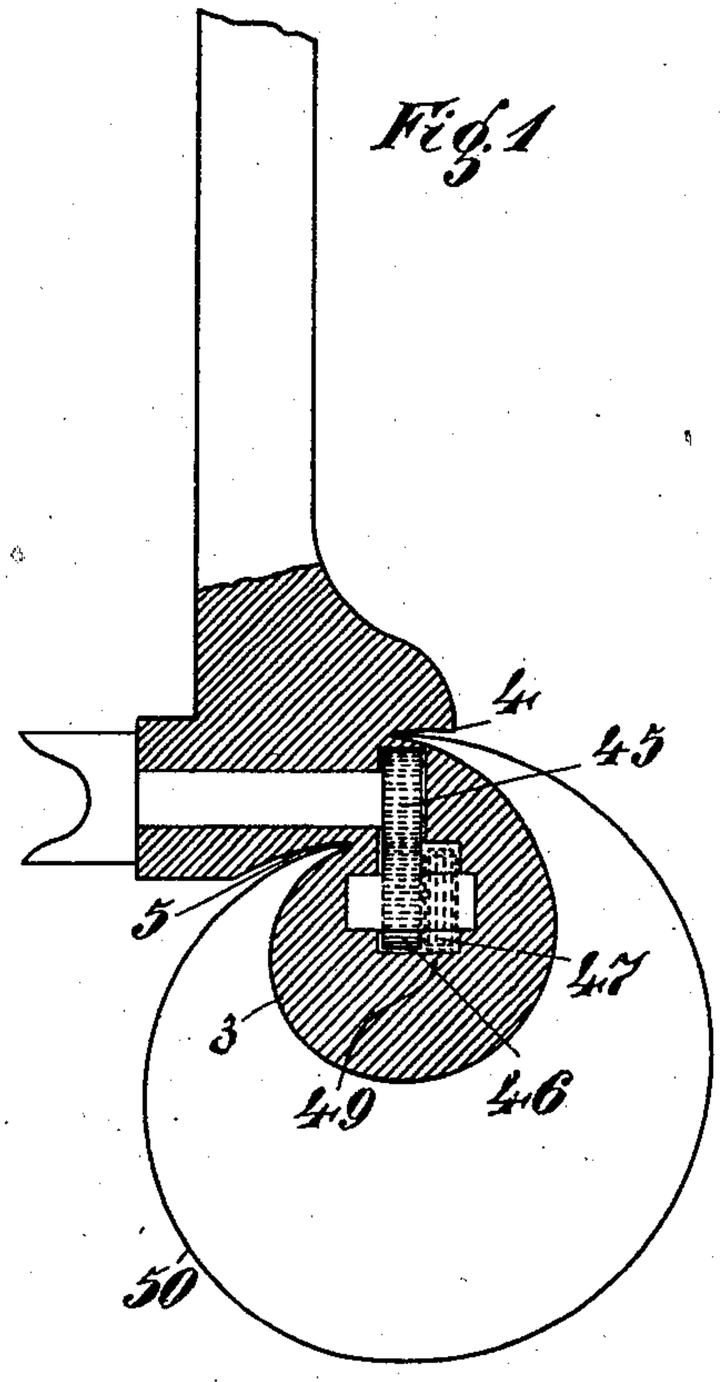
# T. L. CARBONE.

## MACHINE FOR THE PRODUCTION OF FOLDED JOINTS OF SHEET METAL.

(Application filed July 10, 1900.)

(No Model.) 5 Sheets—Sheet 1.

Fig. 1




Witnesses.

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## MACHINE FOR THE PRODUCTION OF FOLDED JOINTS OF SHEET METAL.

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(No Model.) 5 Sheets—Sheet 2.

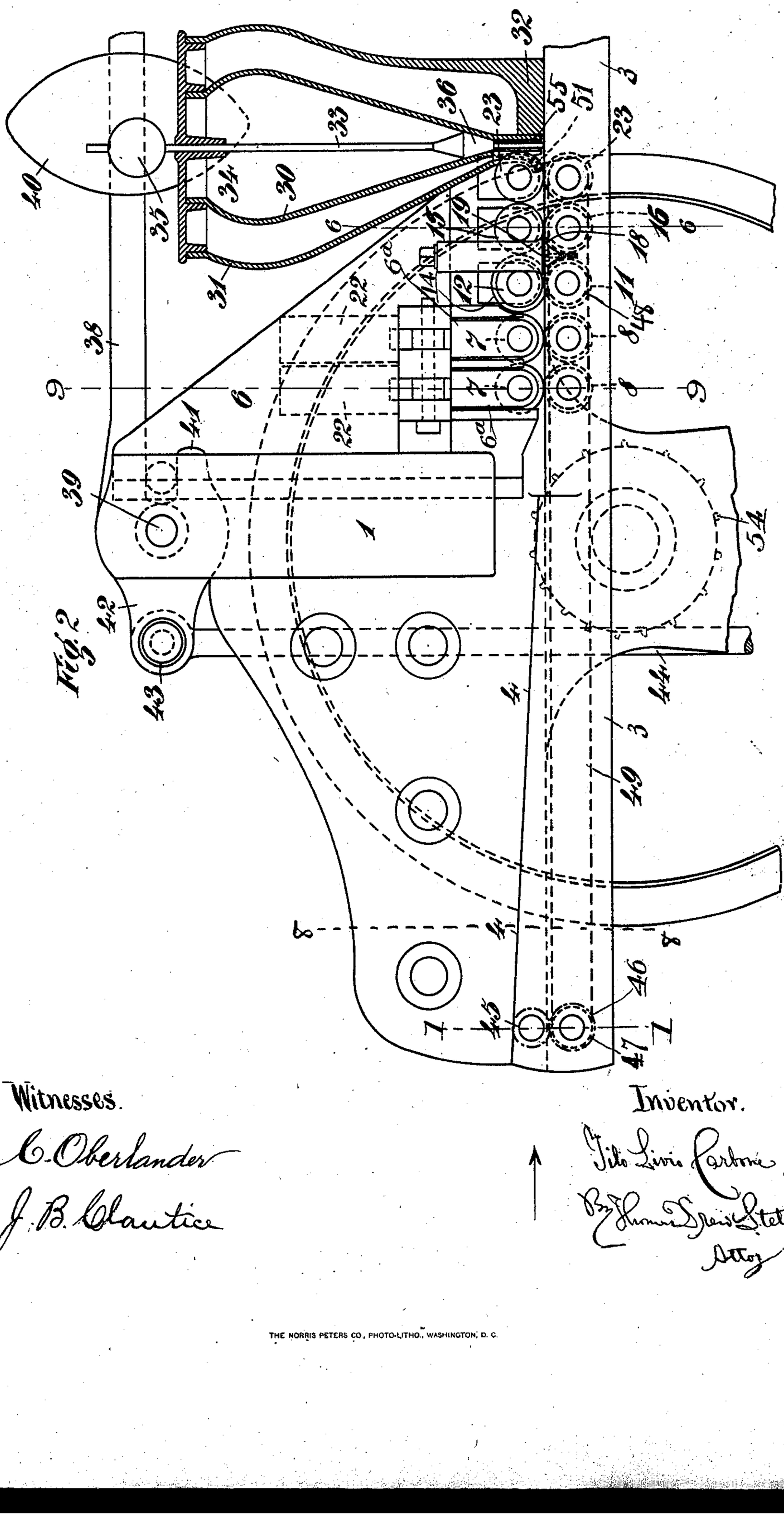


Fig. 2.

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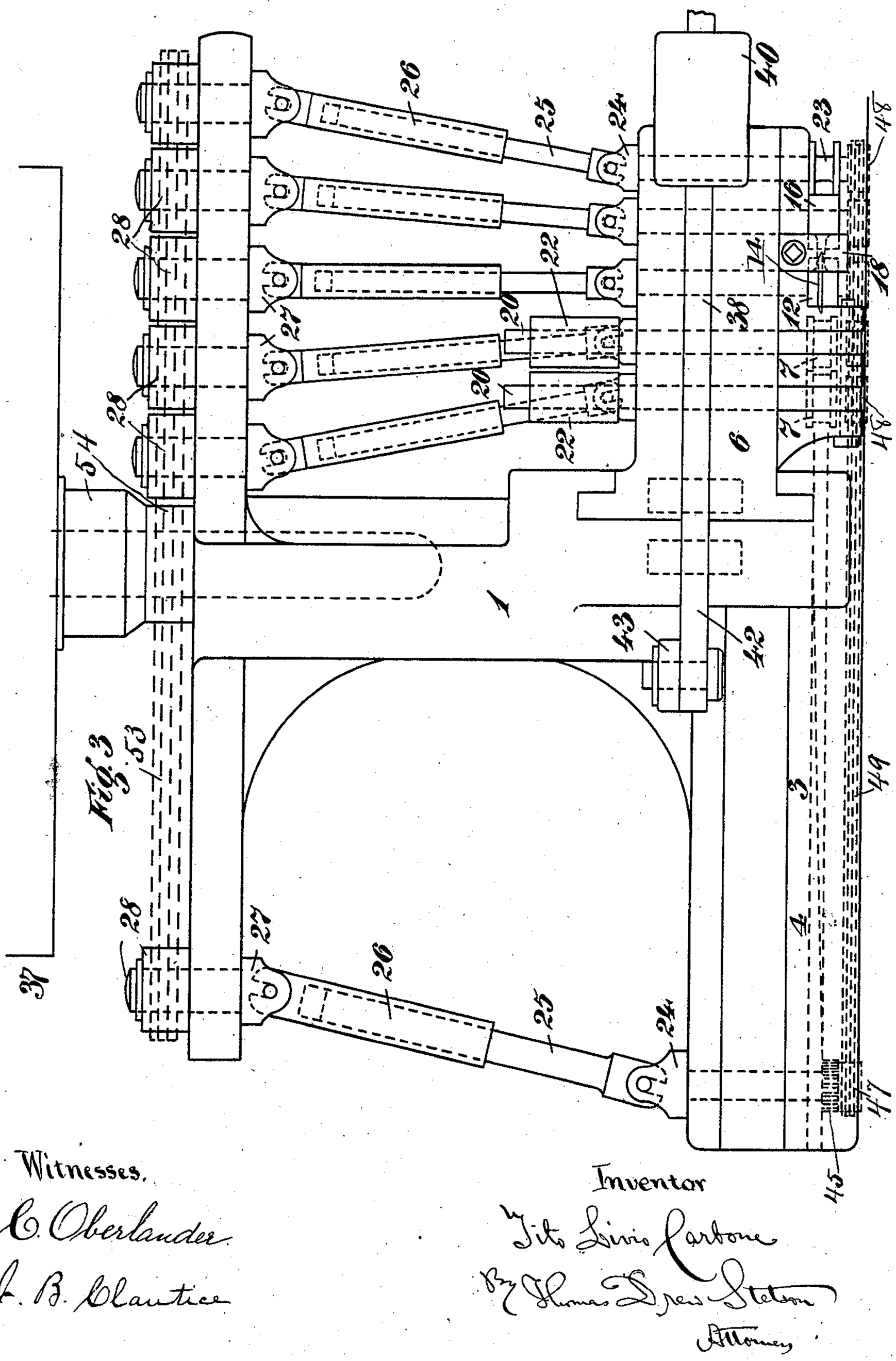
## MACHINE FOR THE PRODUCTION OF FOLDED JOINTS OF SHEET METAL.

(Application filed July 10, 1900.)

(No Model.) 5 Sheets—Sheet 3.

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## MACHINE FOR THE PRODUCTION OF FOLDED JOINTS OF SHEET METAL.

(Application filed July 10, 1900.)

(No Model.) 5 Sheets—Sheet 4.

Fig. 4.

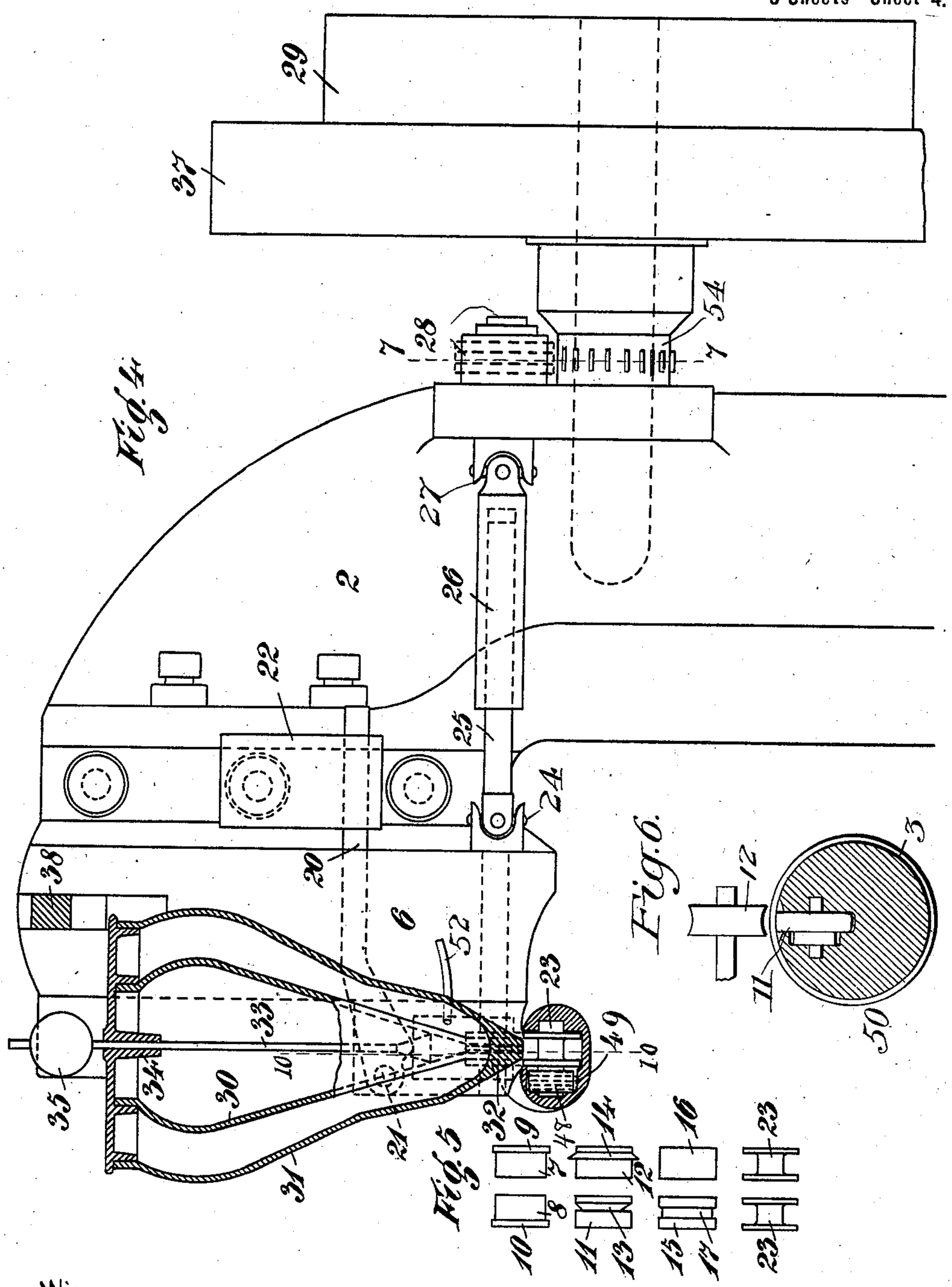


Fig. 6.




Witnesses.

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## MACHINE FOR THE PRODUCTION OF FOLDED JOINTS OF SHEET METAL.

(Application filed July 10, 1900.)

(No Model.) 5 Sheets—Sheet 5.

Fig. 7.

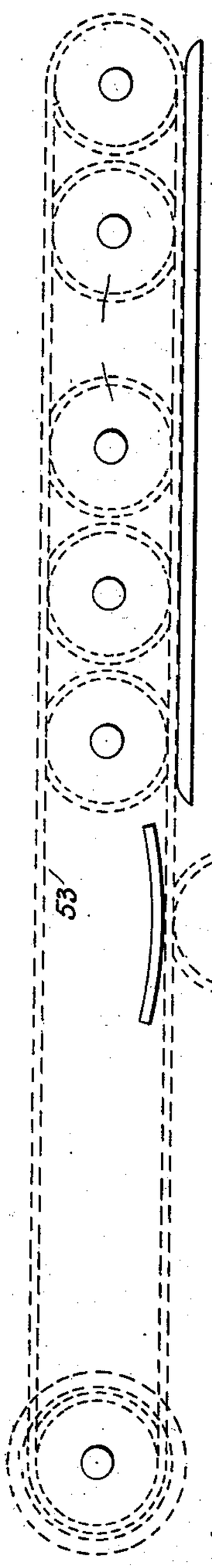



Fig. 10.

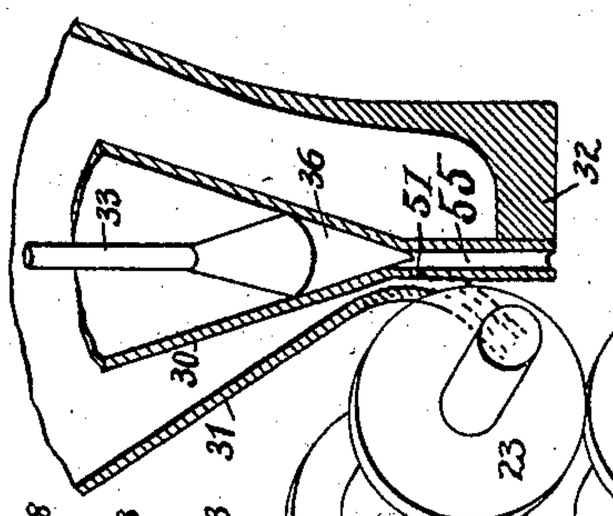



Fig. 20.

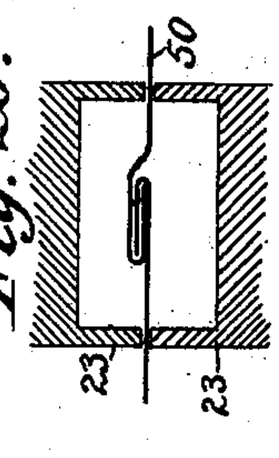


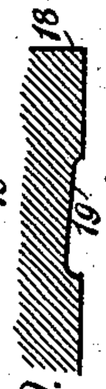

Fig. 15.


Fig. 16.


Fig. 17.


Fig. 18.


Fig. 19.



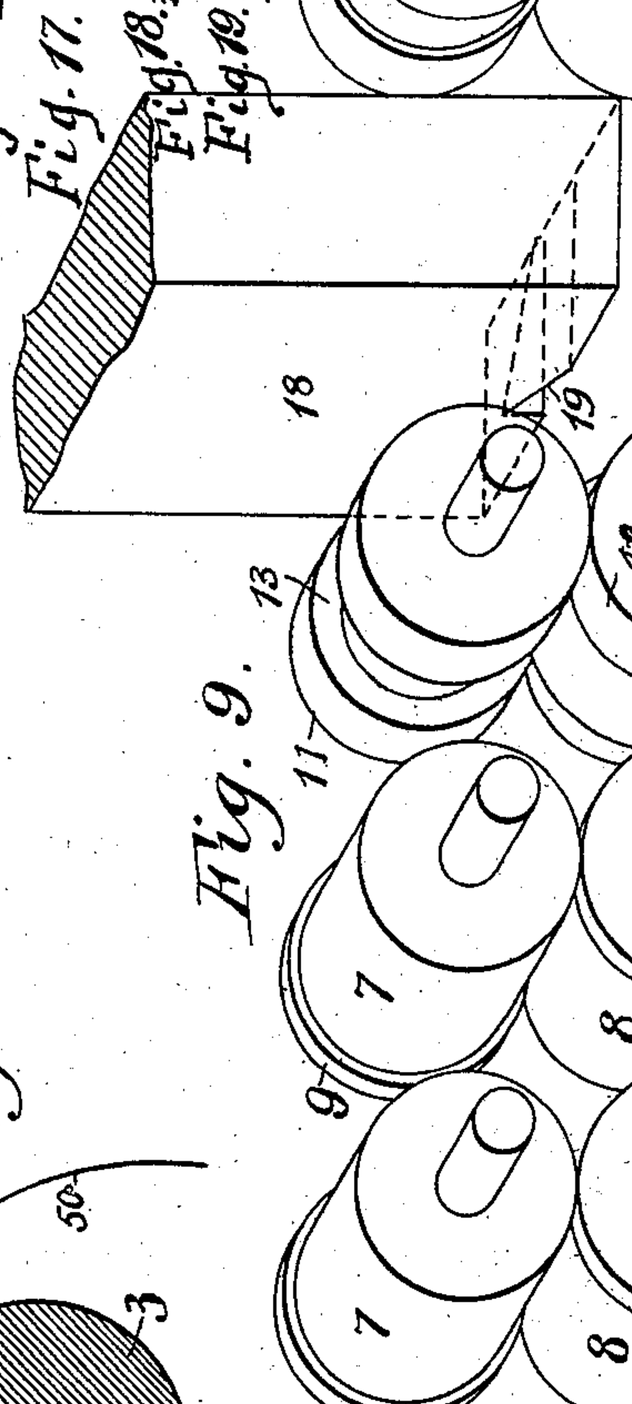




Fig. 14.

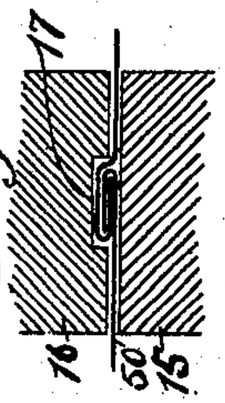



Fig. 13.

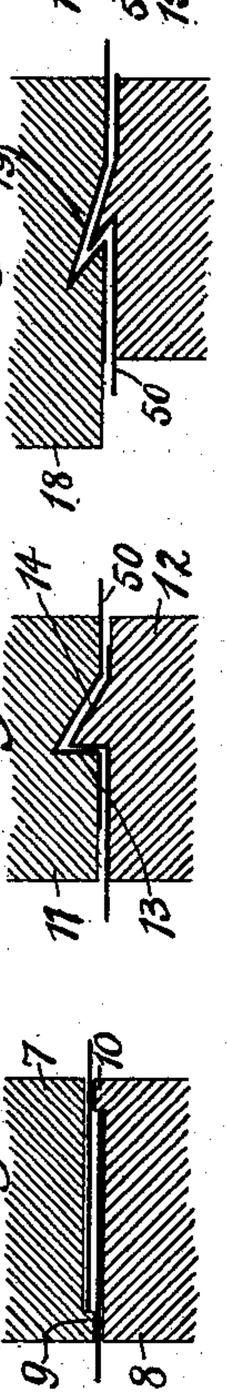


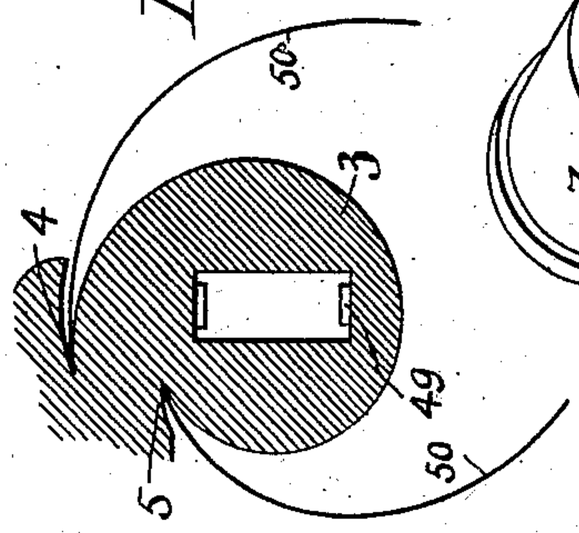

Fig. 12.




Fig. 11.




Fig. 8.

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Vito Livio Carbone

BY

Thomas Drew Stetson

ATTORNEY

# UNITED STATES PATENT OFFICE.

TITO LIVIO CARBONE, OF BERLIN, GERMANY.

## MACHINE FOR THE PRODUCTION OF FOLDED JOINTS OF SHEET METAL.

SPECIFICATION forming part of Letters Patent No. 702,043, dated June 10, 1902.

Application filed July 10, 1900. Serial No. 23,110. (No model.)

*To all whom it may concern:*

Be it known that I, TITO LIVIO CARBONE, a citizen of Italy, residing at Berlin, in the Kingdom of Prussia, German Empire, have invented certain new and useful Improvements in Machines for the Production of Folded Joints of Sheet Metal, of which the following is a specification.

This invention relates to a machine for effectually and strongly uniting sheet metal by means of folded joints, the machine producing such joints automatically. It may be used either for uniting two otherwise separate sheets of metal or for uniting the opposite edges of one and the same sheet for the purpose of producing tubes or tubular articles therefrom. The machine is mainly intended for the production of such tubes and will be described as thus applied. The tubes can be produced from sheets of any desired length. Thus if, for example, sheets of metal of two meters' length are available tubes with folded joints can be produced therefrom two meters in length, and the long tube can subsequently be cut up into short lengths for making sheet-metal cases—such as cans for preserves, &c.—therefrom. The said tubes may be produced either of a circular or any other required sectional form. I will describe them as of circular section. In all cases, however, the securing together of the metal edges, the formation of the folded joint, and, if desired, the soldering of the completed joint are effected automatically, so that no further manipulation is required beyond introducing the end of the previously-bent sheet into the machine, which then completes all the other operations, including the soldering when required, in an automatic manner.

In order to make my invention more clear, I refer to the accompanying drawings, in which similar marks of reference denote similar parts throughout the several views, and in which—

Figure 1 shows a separate sectional view of the parts where the metal sheet, partly prepared by bending around, is introduced. It is a section on the line 1 1 in Fig. 2 seen from the left. Fig. 2 is a front view. It shows particularly the parts carried by the top of the pedestal and capable of moving up and down therein. This figure shows also in section certain further parts employed in soldering. Fig. 3 is a plan view without the soldering attachment. Fig. 4 is an end view seen from the right with the soldering attachment restored. This is the end at which the finished jointed tubes issue. Fig. 5 gives detached views of the several revolving folding devices employed for carrying out the invention. Fig. 6 is a cross-section on line 6 6 in Fig. 2 on a larger scale. Fig. 7 is a longitudinal section through a portion of the machine on the line 7 7 in Fig. 4. Fig. 8 is a transverse section of a portion on the line 8 8 in Fig. 2. Fig. 9 is a perspective view showing the relations to each other of the several rollers and the fixed piece. Fig. 10 is a vertical section, on a large scale, at the base of the solder vessel. The two succeeding figures are cross-sections of portions of the mechanism at and near the joining lines of certain pairs of rolls, as follows: Fig. 11 shows the junction of one of the pairs of rolls, that on the extreme left (see Fig. 9) with the overlapping edges of the sheet metal lying between. The next pair of rolls are similar to these. Fig. 12 correspondingly shows the junction of the third pair of rolls with the edges of the sheet metal not only overlapping, but ridged upward near the mid-width of the rolls. Fig. 13 shows the partially-crushed-down condition of the ridges attained at about the middle of their passage through a peculiarly-formed notch in a fixed piece. Fig. 14 shows the junction of the fourth pair of rolls with the sheet metal not only overlapping and ridging upward, but nearly crushed down, flattened. The five succeeding figures show cross-sections of the notch in the base of the fixed piece at successive small distances from the left side, as follows: Fig. 15 shows the form of groove on the left side, that at which the partially-formed joint in the sheet metal enters. Fig. 16 shows the condition a little farther to the right. Fig. 17 shows the condition still farther to the right. This substantially coincides with Fig. 13. Fig. 18 shows the condition still farther to the right, and Fig. 19 shows the form of the notch where the now completely-folded joint emerges from the fixed piece. Fig. 20 is a vertical section at and near the junction of the last pair of rolls, where the soldering is effected.

Similar reference characters indicate corresponding parts in all the figures where they appear.

The head 1 of the column 2 carries at its front end a "former" 3, cast integral therewith and which performs important functions. It is hollow and incloses a pitch-chain which may operate the lower rollers of each pair. Its right side has an inclined groove 4, constituting a guide-surface for one edge of the metal sheet to bear upon, and at its opposite, the left or rear side, it has a horizontal guide-groove 5 for the other edge of the sheet. Against the under sides of those guides bear the edges of the metal sheet, which has been previously bent by hand or otherwise into an approximately tubular form, as shown at Fig. 1, and it will be seen that the guide-surfaces are so arranged that the two edges of the sheet are at starting practically situated vertically one above the other and a sufficient distance apart to allow a strong support of the former. Adjacent to these two guide-grooves extends horizontally a rounded tapering fixed portion, Figs. 1, 2, and 4, which I term the "former," around which loosely extends the metal sheet to be treated, as shown in Fig. 1, where 50 indicates the partly-bent sheet with its edges applied to the guide-surfaces in entering the machine. The rounded former 3 also serves at the right-hand side of the machine as support and guide for the bent metal while subjected to the folding devices, as will be presently described.

As will be seen at Fig. 2, the guide-surfaces 4 and 5 converge toward the right-hand end, the surface 4 being made to descend toward 5 until both unite in one and the same line. From the dotted lines shown in the lower part of Fig. 3 it will also be seen that the guide-surface 4 not only descends, but also recedes somewhat, so that while the two edges of the metal sheet move along the guide-surfaces the upper one not only approaches the lower one in a vertical direction, but also overlaps the same in the horizontal direction, so that at the place where the two guide-surfaces merge into one another the necessary overlapping of the sheet-metal edges is effected. As soon as the said edges have passed beyond this point they come under the action of the revolving folding devices. (Shown separately at Fig. 5 and which will be presently described.)

I use the terms "bend" and "indent" interchangeably to indicate the distorted condition produced in the thin metal by the action of the parts in forming the seam.

A strong pitch-chain 53 receives motion from a sprocket-wheel 54, revolved by the pulley 29, and running back and forth horizontally gives motion through corresponding sprocket-wheels to the short shafts 28. The motion is derived from any convenient motor through a belt (not shown) running on the pulley 29.

At the right-hand side of the pedestal-head 1 there is a vertically-movable slide 6, (Figs. 2 and 3,) the lower part of which projects some distance to the right, where it carries the upper series of the said folding devices. Before the said sheet-metal edges, which have been held one above the other by the guide-surfaces 4 and 5, come under the action of the roller-like folding devices they are placed parallel to each other by means of two pairs of feeding-rollers arranged one behind the other and serving also as guide-rollers for guiding the edges accurately, so that the superposed parts thereof may always be of the same width during the entire folding operation. These feeding-in and guiding rollers are also shown detached in Fig. 5. The rollers 7 and 8, which are here shown side by side, are in reality one over the other, as will be seen from Fig. 2, which figure also shows the two pairs of these rollers one behind the other.

The enlarged end 10 of the roller 8 (see Fig. 9) runs upon the smaller end of roller 7, whose enlarged end 9 runs upon the smaller end of 8, so that a narrow space is formed between the two enlarged ends 9 and 10, in which space the superposed edges of the sheet metal are free above and below. The superposed metal edges after being guided by the said rollers pass between rollers 11 and 12, of which in the form of the invention here shown 11 has a peripheral groove 13 and 12 an annular projection or collar 14. One arrangement of these parts is shown in Figs. 2 and 3, the roller 12 having the collar 14 shaped so as to fit into the groove 13, being above. As thus shown, the metal will be depressed by the ridge 14, and the resulting joint will be produced with a smooth and continuous surface on the outer face of the can, and the excess of thickness due to the folds of the metal at the joint will be on the inside of the can. Such arrangement has advantages; but it is preferable for some reasons to make the joint protrude on the outside. This can be attained by putting the roller 12, which carries the ridge 14, below instead of above the roller 11, which carries the groove 13. Such arrangement is assumed in the remaining figures, and I will describe the invention as thus applied. It gives the advantage, among others, that the degree of perfection attained by the folding and crushing down to produce the joint can be better inspected, and if the joint is wrinkled or in any manner deformed it can be seen and remedied better if it is on the outside. If the fault is irremediable, it is easily detected, and the work having such defect can be thrown aside. From the rollers 11 and 12 the metal edges pass to the rollers 15 and 16; but before the metal edges, indented or grooved, as described, by the rollers 11 and 12, are acted upon by 15 and 16 they come under the action of a fixed piece 18, projecting laterally into the space between these contiguous rollers, Figs. 2 and 3, and

which has a groove 19, that lies in the path of the bent metal edges. The form of this groove at the end lying toward the rollers 11 and 12 corresponds with the form of the parts 13 and 14 thereof, (see Figs. 9 and 12,) so that the ridged part of the metal edges readily enters this groove 19. From this point the groove is gradually narrowed and inclined toward the other end (see Figs. 15 to 19, inclusive) in such manner that the grooved or partially-bent part of the edges has its sides completely bent or folded together and bent down against the flat part of the sheet metal, so that the folded joint is by this means completely formed, though without being closed tightly together. The sheet-metal edges thus folded together now pass between the rollers 15 and 16, of which 16, being below, is within the closed sheet metal 50, which now forms a tube, while 15 is above outside the tube. The roller 16 has a groove 17, into which the folded edges approximately fit, and as these parts pass under the action of the rollers 16 they are pressed firmly together, so that by this means the finished folded joint is produced, but without the soldering. Before describing the latter operation the following must be stated: The two pairs of rollers 7 and 8, which, as above stated, serve both for the forward feed and the guidance of the sheet-metal edges, require to exercise forcible adjusting action upon the metal edges. On this account it is necessary that the rollers 7, mounted in the slide 6, shall on the lowering of this slide come sooner in contact with the rollers 8 than is the case with other upper rollers mounted on the slide in respect of their lower rollers, which are independent of the slide. When the metal edges have advanced so far along the guiding-surfaces 4 and 5 that they enter between the pairs of rollers 7 and 8, (the slide being raised,) then on the lowering of the slide the metal edges are first gripped between the rollers 7 and 8, such grip having to be of greater force than that exercised between the other rollers. For this purpose the bearings of the rollers 7 are vertically movable in the slide, each bearing being itself formed as a slide $6^a$, (see Fig. 2,) which is subjected to the action of a loaded lever 20, Figs. 3 and 4. Each of these levers is pivoted at 21, Fig. 4, and carries a weight 22 at its free end, thereby forcing the bearing of roller 7 down with considerable force, as shown by the proportion of leverage shown at Fig. 4. Thus on lowering the slide 6 the rollers 7 are first brought in contact with the rollers 8 and are then forced against these with considerable pressure, due to the weighted levers. The upper rollers 7 7, 12, and 16 (as also the upper roller of the pair 23, to be presently described) are driven by a suitable gear and a pitch-chain 53 directly from the driving-shaft of the machine, as above described. (See Fig. 7.) If thick sheet metal is operated upon, the lower rollers 8, 11, and 15, Fig. 2, (as also the lower roller 23,) are also rotated by the machine, while with thinner sheet metal the rotation of the lower rollers may be more simply effected by frictional contact with the metal edges the forward feed of which is effected by the upper rollers.

As shown at Figs. 3, 4, and 7, the five shafts of the upper rollers 7 7, 12, 16, and 23 are connected by universal joints 24, rods 25, sockets 26, and universal joints 27 with the short shafts 28, which are connected together and driven by a pitch-chain 53, which is strongly impelled by the sprocket-wheel 54. In a similar manner motion is imparted by the same chain 53 through a sprocket-wheel and gears and a sleeve or socket 26 with proper universal joints to a toothed wheel 45, situated at the front end of the former and between the guiding-surfaces 4 and 5, which wheel drives a second one below, 46. (See Fig. 1.) On the axis of this lower toothed wheel is mounted a chain-wheel 47, from which a pitch-chain 49 passes through the hollow interior of the former 3 to the chain-wheels 48. (See Fig. 4.) Each of the lower rollers is provided with a chain-wheel 48. All are engaged by the chain 49, so that in this manner all the lower rollers can be driven by the machine if thick sheet metal has to be treated.

When thin sheet metal is to be treated, the pitch-chain 49 and chain-wheels 48 can be removed, so that, as above stated, the lower rollers are only rotated by frictional contact.

For forcing the slide 6 down in its guides it is connected at the top to a lever 38, which is pivoted at 39 to the pedestal-head. This lever is loaded with a weight 40 and engages by a beak 41 under a transverse pin provided in a vertical slot of the slide 6. The lever-arm 38, which is loaded by the weight, presses upon this pin, and thereby forces the entire slide, with its revolving rollers, downward as far as the lower rollers permit. The lever 38 has a tail 42, Fig. 2, carrying a pin 43, on which is pivoted a rod 44, extending downward and connected at the bottom to a pedal. (Not shown.) So long as the machine is making a folded joint the pedal is not acted upon; but when the folding operation is completed the lever 38 should be turned by the depression of the pedal, so that the beak 41 raises the slide 6, and with it the upper rollers, the slide being, if necessary, retained in that position by any suitable holding device. The slide is only lowered again when the next sheet of metal after having been slid with its edges along the guiding-surfaces 4 and 5 has the front ends thereof brought between the feed and guide rollers 7 and 8, whereupon the slide is lowered again.

If the folded joint is also to be soldered, the following arrangement is put in action: As shown in Figs. 2, 4, and 10, the two rollers 23 are made of bobbin shape and into the deep groove of the upper one of these rollers enters a flame-spout 51 to be presently

described. The lower end of the funnel-shaped receptacle 30, Figs. 2 and 4, is surrounded by a similarly-formed receptacle 31. The latter receives air and a slight stream of combustible matter through the gas-pipe 52, Fig. 4, by the combustion of which the solder or suitable soldering compound contained in the inner vessel is maintained in a molten condition. The receptacle 31 acts as guide for a heating-flame passing up between the two vessels and produced in a suitable combustion apparatus connected to the lower part of the vessel 31. Any of the well-known devices for producing a flame of some length may be employed for the purpose, the flame being preferably made to enter the vessel 31 in a tangential direction, so as to be made to sweep around in the space between the outer and inner vessel in a helical direction.

For preventing any oxidation of the solder the inner surface of the vessel 30 is coated with platinum. The outer vessel 31 is constructed of copper and has part of its lower end situated behind the rollers 23 formed into a kind of soldering-iron 32, which is kept hot by the combustion taking place within the vessel 31. In front of this part 32 the vessel 31 has the curved spout 51 entering the hollow of the upper roller 23 and extending down to near the point where the two rollers 23 are in contact, so that the heat or flame can also issue from 31 through this spout and heat the folded sheet-metal joint at that point sufficiently to effect a proper soldering thereof. The bottom of the inner vessel 30 also has a passage 55 extending down, and the upper end of such passage is closed by a conical valve 36, carried by a spindle 33, working through a guide 34 on the cover of the receptacle and carrying at its upper end a weight 35.

In the idle position of the parts—that is, when the valve 36 closes the discharge-spout of vessel 30—the valve-spindle below the valve projects down slightly into the path of the horizontally-traveling folded metal joint, so that as the front end of such joint advances it will bear against and slightly raise the spindle 33 and valve 36, so that a certain quantity of the molten solder will flow down through the remaining space in the passage 55 and flow on to the heated part of the folded joint and will then pass, together with the latter, at once underneath the soldering-iron 32, which thus completes the soldering operation. Thus the sheet-metal tube will issue from under the soldering-iron 32 with its folded joint in a perfectly-clean and strongly-soldered condition, thus completing the process.

It is to be here remarked that the machine can also produce an ordinary lap-soldered joint without folding, if this should be required. It is in that case only necessary to replace the roller 12 by a roller similar to 16, so that no indenting of a groove in the superposed metal edges is effected. In that case of course the fixed grooved die 18 must also be removed, which can readily be done. Also it is to be observed that the rollers 11, 12, 15, and 16 need not necessarily be of cylindrical form. Thus the lower rollers may have a convexly-curved surface and the upper rollers a concavely-curved surface, so as to more or less correspond to the circular curvature of the tube that is being formed. Such rollers could of course serve best in the manufacture of tubes of a certain diameter. Such are shown in Fig. 6.

Besides the driving-belt pulley 29 there is also provided a larger belt-pulley 37, (see Fig. 4,) which is employed for driving the machine when this has not only to produce the folded joint, but also to solder it, because in the latter case, on the one hand, more power is required and, on the other hand, the sheet metal has to travel at a somewhat slower speed through the machine.

I do not in this patent claim the peculiarities of the soldering apparatus, as such form the subject-matter of a separate application for patent.

Having now described my invention, what I desire to secure by Letters Patent of the United States is—

1. In a machine for the manufacture of sheet-metal cans and analogous cylindrical articles of sheet metal, the "former" 3 of a little less diameter, supported by the framing of the machine at one end only, grooves 4 and 5 at the supported end of such former, adapted to receive the sheet metal with its edges in such grooves and to so present it as to loosely embrace the former, feeding and guiding rolls arranged to seize and move forward the sheet metal, and folding-rolls arranged to act in pairs on the overlapped edges and induce coinciding partial folds therein while in the overlapped position, all combined and arranged to serve substantially as herein specified.

2. In a machine for the production of folded joints for sheet-metal cans, the combination with a lower set of guiding and bending rollers arranged within a "former," of an upper set of rollers, means for independently rotating each set and means for strongly and yieldingly pressing them together, substantially as herein specified.

3. In a machine for the manufacture of sheet-metal cans and analogous cylindrical articles of sheet metal, having the "former" 3 of somewhat smaller diameter firmly supported by the framing of the machine at one end only, and grooves 4 and 5 at the supported end of the former, rolls arranged to seize and move forward the sheet metal so presented as to loosely embrace the former with its edges in such grooves, the first pair, 7, 8, of such rolls flanged and arranged reversely to serve the double function of feeding-rollers and as guides for the entering sheet metal, and folding-rolls arranged to act

in pairs on the overlapped edges, all combined and arranged to serve substantially as herein specified.

4. In a machine for the manufacture of sheet-metal cans and analogous cylindrical articles of sheet metal, having the "former" 3 of somewhat smaller diameter firmly supported by the framing of the machine at one end only, and grooves 4 and 5 at the supported end of the former, rolls arranged to seize and move forward the sheet metal so presented as to loosely embrace the former with its edges in such grooves, the first pair 7, 8, of such rolls flanged and arranged reversely to serve the double function of feeding-rollers and as guides for the entering sheet metal, and folding-rolls arranged to act in pairs on the overlapped edges, one member of such pairs of rollers being mounted within the former and a pitch-chain and impelling means therefor driven from the attached end of the former and engaging with gear-wheels on the several rollers within the former, all combined and arranged to serve substantially as herein specified.

5. In a machine for the production of folded joints for sheet-metal cans, the combination with a grooved "former" serving as guiding means, of a pair of revolving folding-rollers adapted to simultaneously bend both parts of the superposed metal into a grooved and ridged form, means for revolving said rollers and means for bending over the ridged portions of both the overlapped parts of the metal and causing them to lie against the body of the can, substantially as described.

6. In a machine for the production of folded joints for sheet-metal cans, the combination with guiding-grooves 4 and 5, and feeding means the rolls 7 and 8, of a revolving roller having a groove 13, and a roller having a matching ridge or collar 14, of a stationary die 18 with a suitably-formed groove 19, firmly held in the path of such coinciding bent portions of the metal, adapted to bend such portions over and cause them to lie against the body of the can and means for strongly actuating such rollers so as to carry the partially-formed fold reliably through the die, all substantially as described.

7. In a machine for the production of folded joints for sheet-metal cans, the combination with guiding-grooves 4 and 5 and feeding means the rolls 7 and 8, of a revolving roller having a groove 13, and a roller having a matching ridge or collar 14, of a stationary die 18 with a suitably-formed groove 19, firmly held in the path of such coinciding bent portions of the metal, adapted to bend such portions over and cause them to lie against the body of the can, and means for strongly actuating such rollers so as to carry the partially-formed fold reliably through the die, and a pair of rollers 15, 16, and means for revolving the same arranged to act on the seam after its passage through such die and press the joint flat, all substantially as described.

8. In a machine for the production of folded joints for sheet-metal cans, having revolving feeding and guiding rollers 7 and 8, and a "former" 3 with the grooves 4, 5, in the fixed part, the combination therewith of revolving folding-rollers adapted to bend the superposed metal into coinciding grooved forms, the slide 6 carrying the bearings of the rollers 12, 16, and the weighted lever 38 pressing down such rollers, a slide $6^a$ movable up and down in the first-named slide, carrying the bearings of the uppermost member 7 of a pair of guiding-rollers 7, 8, and a weighted lever 20 pressing on such slide, proportioned as shown so as to induce a stronger hold by the guiding than by the grooving rollers, all arranged for joint operation substantially as herein specified.

9. In a machine for the production of folded joints for sheet-metal cans, having the former 3 and grooves 4 and 5, revolving guiding and grooving rollers, a die 18 having a groove 19 for folding the coinciding grooved overlapping metal down into contact with the body of the can, and rollers 15, 16, for pressing such flat, the combination therewith of a tank with means for keeping solder melted therein, a soldering-iron, and means for moving the sheet metal slowly past these appliances, all substantially as herein specified.

10. In a machine for the production of folded joints for sheet-metal cans, having the former 3 and grooves 4 and 5, revolving guiding and grooving rollers, a die 18 having a groove 19 for folding the coinciding grooved overlapping metal down into contact with the body of the can, and rollers 15, 16 for pressing such flat, the combination therewith of a tank 30, and provisions for keeping solder melted therein, a soldering-iron, and means for moving the sheet metal slowly past these appliances, and means for warming the surfaces immediately before the presentation of the solder thereto, all substantially as herein set forth.

In witness whereof I have hereunto set my hand in presence of two witnesses.

TITO LIVIO CARBONE.

Witnesses:
HENRY HASPER,
WOLDEMAR HAUPT.