Nov. 15, 1927. 1,649,704

G. L. KELLEY ET AL

METAL WORKING MACHINE

Filed Jan. 5, 1924 2 Sheets-Sheet 1

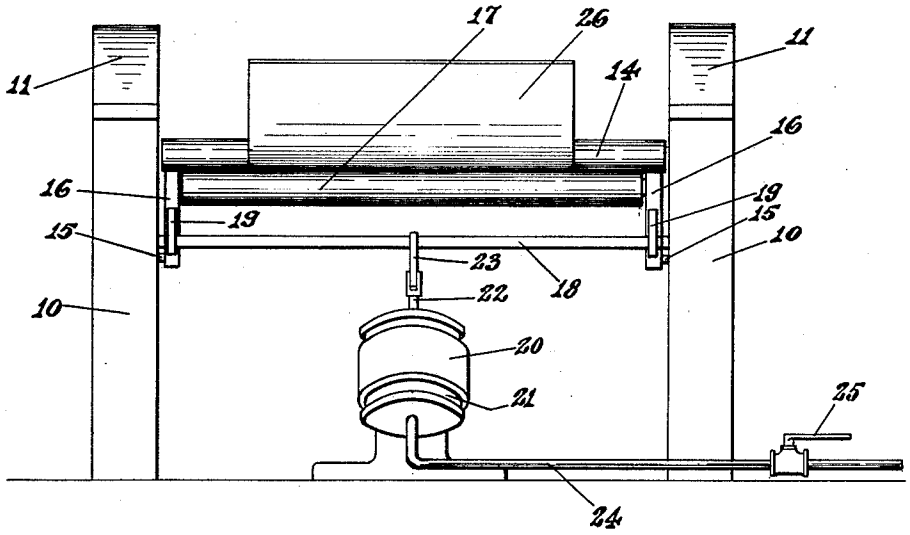


FIG 1

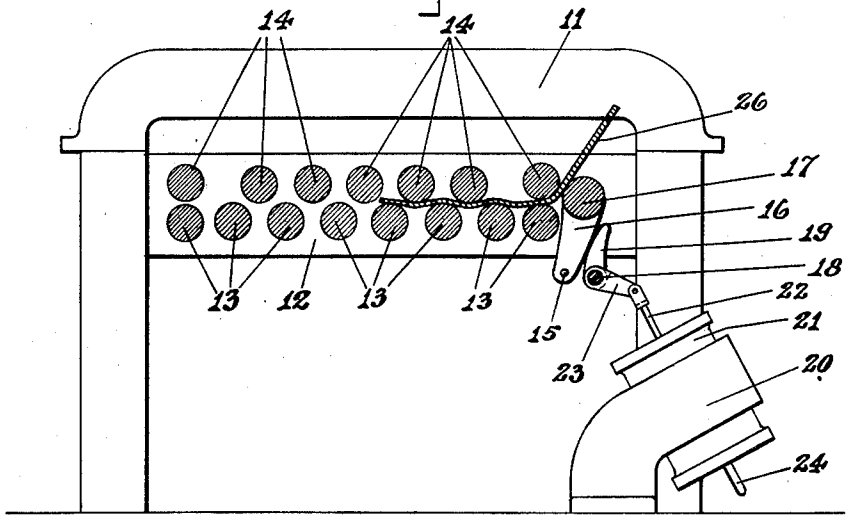


FIG 3

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BY John P. Barbour ATTORNEY.

WITNESS:-

Walter M. Trout

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2 Sheets-Sheet 2

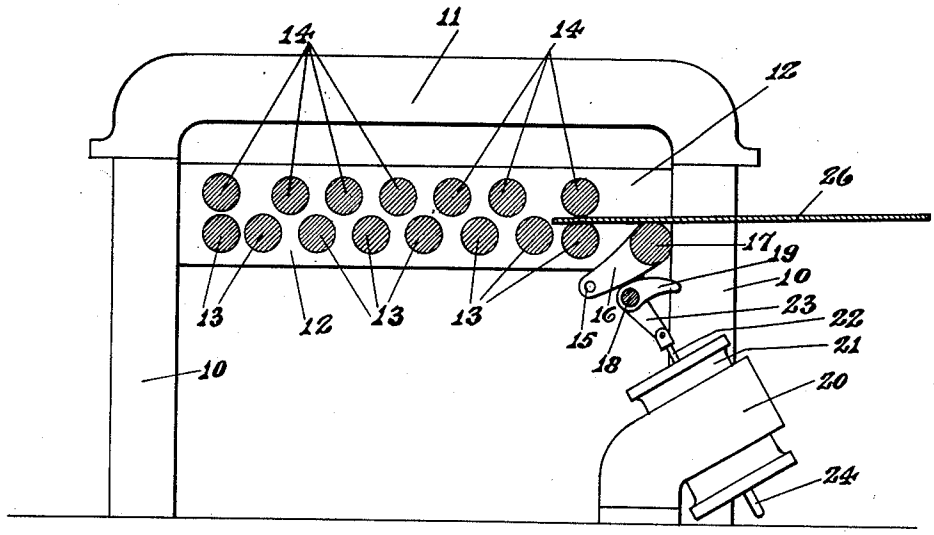


Fig 2

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Patented Nov. 15, 1927. 1,649,704

UNITED STATES PATENT OFFICE.

GEORGE L. KELLEY AND JOSEPH WINLOCK, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNORS TO EDWARD G. BUDD MANUFACTURING COMPANY, OF PHILADELPHIA, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

METAL-WORKING MACHINE.

Application filed January 5, 1924. Serial No. 684,480.

Our invention relates to improvements in metal working machines.

The object of our invention is to provide a simple and efficient machine by means of which metal sheets may be given a preparatory treatment or working such that "strecher strains" or "wormy metal" will not develop during subsequent forming operations upon such sheets.

A further object of our invention is to provide a machine of such a character that it is effective in treating or working steel or metal sheets having widely varying physical characteristics in order to prevent the development of "stretcher strains" or "wormy metal" during subsequent forming operations on the sheets.

Further objects, and objects relating to details and economies of construction and operation, will definitely appear from the detailed description to follow. In one instance, we accomplish the objects of our invention by the devices and means described in the following specification. Our invention is clearly defined and pointed out in the appended claims. A machine forming a preferred embodiment of our invention is illustrated in the accompanying drawings, forming a part of this specification, in which—

Figure 1 is a view of our improved machine in end elevation.

Fig. 2 is a longitudinal, sectional view of the machine, showing a sheet of metal as it is being introduced into the machine.

Fig. 3 is a similar, longitudinal, sectional view of the machine, showing the position of the sheet of metal as it progresses through the machine, and the bending roll has been elevated to its normal position.

In the drawings, the same reference numerals refer to the same parts throughout the several views.

In the working of sheet metal it frequently happens that irregularities occur in the surface of the metal, particularly after the metal sheet has been subjected to a forming or die pressing operation, in which a slight stretching of the metal takes place. These irregularities are known in the trade as "stretcher strains" or "stretching strains", and they are also sometimes called "wormy metal". These surface irregularities and blemishes are exceedingly objectionable, especially where the metal sheet, or the surface thereof, is to receive a finish, polish or enamel, and a large amount of expensive hand work such as filing, grinding, hammering and polishing is required to remove them and to put the surface into desirable condition for the use, finish or polish of the sheet.

In general, we accomplish the objects of our invention by providing a machine in which a sheet of metal is subjected to a comparatively pronounced initial bending and is subsequently flexed in alternate directions, and straightened so as to leave the machine as a flat or level sheet. To secure the best results, the sheet, after having been subjected to the initial bending and the subsequent flexing and straightening operations, should be subjected to the operation in which such "wormy metal" would be likely to develop before the metal of the sheet regains its original condition. In carrying out our invention, we propose to provide an auxiliary bending roll at the entrance end of a roller leveler, so that the bending roll cooperates with the entrance or pinch rolls of the roller leveler to impart a pronounced initial bending to the sheet and the subsequent rolls of the roller leveler act to flex the sheet back and forth to a less degree and to straighten it so that it leaves the machine flat and straight. We propose to mount the bending roll so that it may be moved from its normal working position in order to permit the insertion of a sheet of metal between the entrance rolls of the machine.

Referring to the numbered parts of the accompanying drawing, in which we have illustrated a machine constructed in accordance with and forming one embodiment of our invention, the standards, 10, carry the longitudinal members, 11, tying the standards together and forming the framework of the machine. The upper ends of the standards, 10, are also connected by the longitudinal members, 12, in which the ends of the rolls, 13 and 14, are journaled. There are two sets of these rolls, the lower rolls being numbered, 13, and the upper rolls, 14. The first pair of rolls, 13 and 14, at the entrance end of the machine, are in vertical alignment with each other and the last pair of rolls, 13 and 14, at the discharge end of the machine, are similarly aligned. The intermediate rolls are staggered with respect to

each other, as clearly shown in Figs. 2 and 3. Either one or both of these sets of rolls, 13 and 14, may be driven by any suitable means in order to carry the sheet of metal through the machine. In this case, the lower rolls, 13, are driven by suitable driving mechanism (not shown). The axes of the rolls, 13 and 14, are so positioned with respect to each other as to effect a slight flexing or bending of the metal, in opposite directions, as it passes between these rolls, as illustrated in Figs. 2 and 3. The initial bending of the sheet is effected by means of a roll, 17, which is located at a point in advance of the entrance end of the machine, adjacent the feed in pinch rolls, 13 and 14, as shown in Figs. 2 and 3. The auxiliary roll, 17, in the illustrated arrangement shown, is mounted upon the rocking arms, 16, pivotally connected, as at 15, so that it may be raised and lowered to bring it from the position shown in Fig. 3 to that shown in Fig. 2. Any convenient means may be provided for raising and lowering this roll. We have shown a device which is particularly effective for this purpose and which consists of a rock shaft, 18, journaled in the frame of the machine and having arms, 19, which engage the arms, 16, in which the auxiliary bending roll, 17, is journaled. The rock shaft, 18, has an operating arm, 23, connected to the piston rod, 22, of a piston working in the cylinder, 21. The cylinder, 21, is carried by a suitable bracket, 20, and is connected by the pipe, 24, to a compressed air reservoir or a similar source of fluid pressure. The valve, 25, controls the flow of pressure medium through the pipe, 24.

In Fig. 2 the auxiliary bending roll, 17, is shown in its lower position in which it is substantially on a level with the roll, 13. In this position, the sheet of metal, 26, may be introduced in the machine so that its front edge is gripped between the first pair of pinch rolls, 13 and 14. When it has been advanced sufficiently for it to be gripped by the machine, the operator opens the valve, 25, and admits pressure medium to the cylinder, 21, thus forcing the piston rod, 22, outwardly and rocking the shaft, 18, so as to force the arms, 16, upwardly, and move the bending roll, 17, to the position shown in Fig. 3. Since this auxiliary bending roll bears against the under side of the sheet, 26, the latter will be sharply bent or stretched around the first of the rolls, 14, and, as the sheet of metal is drawn through the machine by the action of the driven rolls, the metal will be flexed back and forth by the action of the rolls, 13, 14. By manipulating the valve, 25, the piston rod, 22, may be withdrawn to its lower position, permitting the auxiliary roll, 17, to drop, so that a new sheet may be introduced between the rolls, 13 and 14.

We have found that, if a sheet of metal be passed through this machine and is then subjected to a subsequent forming operation, even one in which stretching takes place, for instance the action of a die press, no "stretching strains" or "wormy metal" will result and the minute irregularities which heretofore have been caused frequently in such cases, will not appear. The result is that much more perfect stampings or pressings may be produced from metal which has been passed through this machine prior to the pressing or forming operation than has been the case with any machine used prior to this time. We are aware that roller levelers are known and in use which consist of rolls, 13 and 14, arranged substantially as we have shown them in this application, but such roller levelers will not secure the results which are obtained by the use of this machine. Such roller levelers do not have any auxiliary or initial bending roll, 17, or anything which is the equivalent thereof. When a sheet of metal is passed through such a roller leveler, without the auxiliary bending roll, 17, or its equivalent, and then subjected to a forming operation, "stretching strains" will occur and minute irregularities or "worms" will appear in the surface of the stamping, requiring expensive work in order to repair and finish the surface. The roller levelers heretofore known are not satisfactory, therefore, to produce the results which we attain. We have found, however, that such results are achieved when the metal is passed through a machine constructed in accordance with our invention.

A characteristic curve of the relations of the stress, or loading, to the strain, or distortion, of steel or like metals, exhibits three outstanding points, the elastic limit, the yield point and the ultimate strength. The present case is concerned with the behavior of metals above the elastic limit but below the ultimate strength. If a piece of steel be stressed at a uniform rate, the above three points occur in the order named. Up to the elastic limit the strain increases at a rate substantially proportional to the rate of application of stress, and the metal is said to behave elastically, returning to its former dimensions upon release of the load. When the elastic limit is passed, the rate of increase of strain changes, and is no longer substantially proportional to the rate of increase of stress, but is greater. At the yield point a marked change in the rate of increase of strain occurs, distortion taking place even without change of load. (The yield point is so close to the elastic limit, that practically, they are often taken as coincident.) With the passing of the elastic limit, the metal no longer recovers its original dimensions upon release of the load but assumes a permanent distortion or "set". It will

also be found, upon re-application of a load, that the yield point has disappeared, the rate of increase of strain exhibiting only a gradual change upon passing beyond the elastic limit. It will also be found that the elastic limit of the metal has been increased. The behaviour of the metal, above the elastic limit is said to be "plastic" to distinguish over its former state. For several hours after stressing beyond the elastic limit, the metal will exhibit the lack of the yield point and will possess a characteristic, herein called "cold plasticity" which adapts it to drawing or forming processes without the occurrence of stretcher strains. The said period of several hours varies with the physical characteristics of the metal, the degree of working and other factors.

We are aware that the machine illustrated in the accompanying drawings is susceptible of considerable change and variation without departing from the spirit of our invention, and, therefore, we desire to claim our invention, broadly, as indicated by the appended claims.

Having thus described our invention, what we claim as new and useful and desire to secure by Letters Patent is:

1. A machine of the class described comprising two sets of cooperating rolls positioned to flex and bend repeatedly a sheet of metal passed between them, an auxiliary bending roll normally positioned in advance thereof, to give the sheet an initial bending substantially greater than that imparted to it by said sets of rolls, and means for raising and lowering the auxiliary bending roll to and from its normal position.

2. A machine of the class described comprising two sets of cooperating rolls positioned to flex and bend repeatedly a sheet of metal passed between them, an auxiliary bending roll adapted to give the sheet an initial bending substantially greater than that imparted to it by said sets of rolls, and means for moving said auxiliary bending roll from a lower position in which it permits the sheet to pass freely to the cooperating rolls to an upper position in which it imparts the initial bending to the sheet.

3. A machine of the class described comprising a frame, two sets of cooperating flexing and straightening rolls mounted in said frame, a pair of arms journaled on said frame at the sides thereof, an auxiliary bending roll journaled in the said arms, and means for swinging said arms to move the auxiliary bending roll from a lower position in which it permits the sheet of metal to pass freely between the cooperating rolls, to an upper position in which it gives said sheet an initial bending before it passes to the straightening rolls.

4. A machine of the class described comprising a frame, two sets of cooperating flexing and straightening rolls journaled thereon, a pair of arms journaled on said frame, an auxiliary bending roll journaled in the said arms, a rock shaft journaled in the said frame and provided with arms engaging said roll-supporting arms, and means for actuating said rock shaft to move the bending roll from a lower position in which it permits the sheet to pass freely between the cooperating rolls to an upper position in which it gives the sheet an initial bending before it passes to said straightening rolls.

5. A machine of the class described comprising a frame, two sets of cooperating flexing and straightening rolls carried by said frame, a pair of arms journaled on the frame, an auxiliary bending roll journaled in the said arms, a rock shaft journaled on the frame, arms carried by said rock shaft and engaging the roll-supporting arms, and fluid pressure means for actuating said rock shaft to move the bending roll from a lower to an upper position in which it gives the sheet an initial bending or flexing before it passes to the straightening rolls.

6. A machine of the class described comprising the combination of a roller leveler, including two sets of cooperating flexing and straightening rolls and an auxiliary bending roll located at the entrance end of said roller leveler and movable from a lower position in which it permits the sheet to pass freely into said roller leveler to an upper position in which it gives the sheet an initial marked bending before passing into said roller leveler.

7. A machine of the class described comprising two sets of cooperating rolls positioned to flex and bend repeatedly a sheet of metal passed between them, and an independently movable auxiliary bending roll positioned to give the sheet an initial bend substantially greater than that imparted to it by said sets of cooperating rolls.

8. A machine of the class described comprising a plurality of cooperating rolls positioned to flex and bend repeatedly a sheet of metal passed between them, means positioned in advance of said cooperating rolls for feeding said sheet thereto, and a roller positioned in advance of said feeding means adapted to impart an initial bend to said sheet when the latter is grasped by said feeding means.

9. A machine of the class described comprising a plurality of cooperating flexing and straightening rolls, an auxiliary roll positioned in advance of said cooperating rolls, said auxiliary roll being oscillatably mounted for movement from a position substantially below the working plane of the work to be operated upon to a position substantially above said plane.

10. A machine of the class described comprising a plurality of cooperating rolls positioned to flex and bend repeatedly a sheet

of metal passed through them, a pair of feeding rolls mounted in advance of said cooperating rolls for feeding said sheet thereto, and an auxiliary bending roll cooperating with one of said feeding rolls whereby to give the sheet an initial bend greater than that imparted to it by said plurality of rolls.

11. A machine of the class described comprising a plurality of staggered cooperating rolls positioned to flex and bend repeatedly a sheet of metal passed between them, a pair of vertically aligned rolls adapted to grasp and feed said sheet of metal to said cooperating rolls, a swingably mounted auxiliary roll normally positioned to one side of the plane of contact of said feeding rolls with said sheet, and means for moving said auxiliary roll beyond said plane of contact whereby to impart a substantial bend to said sheet of metal.

12. A machine of the class described comprising a plurality of cooperating rolls positioned to flex and bend a sheet of metal passed between them, and an independently operable roll adapted to be moved from its normal position on one side of the working plane to a position intersecting said working plane whereby to give the sheet of metal an initial bending greater than that imparted to it by said cooperating rolls prior to being operated upon by the latter.

13. A machine of the class described comprising a plurality of cooperating rolls positioned to flex and bend repeatedly a sheet of metal passed between them, means positioned in advance of said cooperating rolls for feeding said sheet thereto, and an auxiliary roller positioned in advance of said feeding means adapted to impart a pronounced initial bend to said sheet, said roller being disposed in such manner as to permit initial projection of said sheet a determinate distance straight into the machine before said roller operates to initially bend the sheet.

In testimony whereof, we affix our signatures.

GEORGE L. KELLEY.
JOSEPH WINLOCK.