The present invention relates to a machine for forming plates preferably of metal, that are flat, into plates that have a curvature and for forming non-flat plates substantially flat.

It is well known that a curvature can be made in a flat plate by the use of a rolling machine, these heretofore known machines have generally comprised an upper roller and two lower rollers. The rollers are mounted to have their axes parallel with a lower roller spaced on each side of the upper roller. By rotating the rollers and passing a flat plate between the upper and two lower rollers, it is assumed to cause an accurate curve. In use, however, such machines have not been found completely satisfactory because of numerous deficiencies. For example, such machines have not been able to form the initial and trailing edge portions of the flat plate into a curve and thus these edge portions remain flat even though they may be desired to have them curved. In addition, when rolling or curving plates that have an exterior covering such as paint or have a particular surface, the heretofore known machines have a tendency to undesirably scratch or otherwise mutilate the surface.

It is accordingly an object of the present invention to provide a plate rolling machine which obviates the above-recited disadvantages and provides for accurately forming the whole plate, including the leading and trailing edge portions and also does not mutilate the surface of the plate.

Another object of the present invention is to provide in such a machine for permitting adjustment of the curvature imparted to a plate and to handle plates of different thickness and strength and also to cause non-flat plates to be passed through the machine to become substantially flat. A further object of the present invention is to provide a plate rolling machine which is simple in construction, durable in use and relatively inexpensive to manufacture.

In carrying out the present invention the rolling machine hereinafter disclosed includes only two rollers, an upper roller and a lower roller with the rollers being cylinders and mounted to have their axes parallel and with the diameter of the rollers being the same or different. Each roller is preferably formed of a relatively rigid material such as steel and on the periphery of at least one there is provided a covering of a relatively soft, resilient material, such as rubber. In the form of the invention hereinafter specifically described, the lower roller is larger in diameter than the upper roller and has a peripheral covering while the upper roller also has a peripheral resilient covering. The covering of the upper roller, while being resilient, is however relatively harder than the peripheral resilient covering of the lower roller. Thus, when the two rollers are rolling a plate, there is more displacement of the covering of the lower roller that engages the plate than of the upper roller.

Both rollers are mounted for rotational movement on their axes with one roller being driven and the other being rotated by frictional contact with the first. Additionally, the upper roller is mounted for movement towards the lower roller so that the distance between the axes of the two rollers may be selected with adjustment means being provided for this purpose. Thus when a plate is introduced between the rollers it will be fed through the two rollers and assume a curvature. The adjusting means by changing the distance between the axes of the two rollers enables the operator to easily change the curvature set into the plate by the machine.

It has also been found that with the present invention, plates which may not be flat but have curvatures therein, as, for example, caused by previous operations thereon such as having holes punched therein may also be passed through the rolling machine of the present invention to initially provide a continuous curve and then turning the plate over to impart a reverse curvature in the plate that straightens out the continuous curve to render the plate substantially flat.

Other features and advantages will hereinafter appear.

In the drawing:

FIGURE 1 is a side elevation of the plate rolling machine of the present invention with portions broken away to show details of construction.

FIG. 2 is a front elevation thereof, partly in section, to show constructional details.

FIG. 3 is a diagrammatic illustration of the forming of a curvature in a flat plate.

FIG. 4 is a diagrammatic representation of forming a plate substantially flat that initially had curvatures.

FIG. 5 is an enlarged section of adjacent peripheral portions of the rollers with a portion of a plate therebetween.

Referring to the drawing, the plate rolling machine of the present invention is generally indicated by the reference numeral 10 and includes a frame 11 composed of a base 12 and a top 13 with four vertical spacers 14 secured theretofore to maintain the base 12 and top 13 in aligned, spaced apart relation. Extending from opposite side edges of the base 12 are a pair of bearing supports 15 each having an aperture 16 in which is rotatably supported an end of a shaft 17 of a lower roller 18. Mounted on the spacers 14 for vertical movement along the axes of the spacers are two cross members 19 and 20. Each member 19 and 20 is provided with a threaded aperture 21 and 22 into which are threaded bolts 23 and 24 respectively. The bolts 23 and 24 are secured in the top 13 for rotational movement therein and it will be appreciated that rotational movement of the two bolts simultaneously will effect the relatively vertical position of the members 19 and 20 in the frame.

The members 19 and 20 carry an upper roller 25 by rotatably supporting the ends of a shaft 26 of the roller in bearing apertures 27 and 28 fast on the members 19 and 20 respectively. It will be noted that rotating the bolts 23 and 24, that the members 19 and 20 are caused to be moved vertically along the spacers and hence the distance between the axis of the upper roller and the axis of the lower roller may be adjusted with the bolts maintaining the distance selected. While two bolts have been shown, each being separately manipulable, it is of course, within the skill of the worker in the art to have these connected to be operable simultaneously in order to prevent misalignment or to employ other well-known adjusting means that permit changing and maintaining of the distance between the axes of the two rollers.

Further mounted on the spacers and secured thereeto are flat work supports 29 and 30, one being on each side of the center line of the axes of the rollers so that plates may be supported thereon for being guided between the rollers. The supports are preferably mounted for vertical adjustment in order to prevent interference with plates being introduced and ejected from the rollers with dotted lines 29a and 30a showing another position to which the supports may be adjusted.

In carrying out the present invention, the lower roller 18 consists of a rigid, substantially unyielding hub portion 31 which is preferably of metal such as cast iron and has a diameter just somewhat smaller than the peripheral or exterior diameter of the lower roller. The shaft 17 of the
lower roller is made fast to the hub portion 31. Secured on the periphery of the hub portion 31 is a peripheral covering 32 of relatively substantial thickness that completely encircles the working periphery of the lower roller. The covering 32 is formed of resilient, relatively soft material, such as rubber and may include either natural or synthetic types and is of sufficient thickness to accept displacement by compression without becoming free of the hub portion and also without becoming permanently deformed.

While it has been found that a plate rolling machine, as herein disclosed, having just one roller formed with a peripheral covering that is relatively soft and displacable and could be used with another roller such as a metal roller, that has a rigid, unyielding surface, the present invention includes additionally forming the upper roller to have a rigid hub portion 33 secured to the shaft 26 and to be made metal, such as steel, to be unyielding, and completely covering the working periphery of the cylindrical hub portion 33 with resilient material 34 such as rubber which again may be either natural or synthetic. The covering 34 is also of a substantially flatness compared to the diameter of the upper roller 25.

When in operation the rolling machine of the present invention has the bolts rotated to adjust the cross members 19 and 20 and hence the upper roller with respect to the lower roller so that in some instances as with a double plate, the distance between the axes of the two rollers may be less than the sum of their radii and hence in effect the upper roller is forced into the periphery of the lower roller. With the two rollers so adjusted, a motor 35 is actuated to drive a belt 35A which is connected to a pulley 36 secured to the shaft 16 of the lower roller 18 to thereby rotate it. The lower roller by friction causes the upper roller to also be rotated. Upon a flat plate 37 being forced between the contacting surfaces of the two rollers, it will be appreciated that the rollers will grasp the leading edge of the plate, pulling it through the contacting surfaces and causing it to assume a curvature, as diagrammatically shown in FIG. 3 and also indicated by the reference numeral 37. If, however, a plate 38, as shown in FIG. 4, which already has a curvature is inserted between the two rollers and the proper distance between the axes of the rollers has to be selected, said plate will be rendered substantially flat by the rolling machine of the present invention putting in a reverse curvature in a plate to thereby eliminate the initial curved set which the plate had.

In accordance with the present invention, it will be appreciated that the degree of curvature formed in the plate may be changed by altering the distance between the two rollers, by altering the relative diameters of the rollers, by altering the distance between the axes of the rollers to thereby change the pressure between their peripheral surfaces and also by changing the relative hardness of the peripheries of the rollers. Thus as shown in FIG. 5, in all forms of the invention there is provided at least one roller which has a relatively soft peripheral covering on a rigid cylindrical hub while the other roller has a harder peripheral surface which may be either a covering or merely the peripheral of a steel roller. Accordingly when a portion 39 of the plate is positioned between the two rollers, the adjustment being such that the distance between the two axes is less than the sum of the radii of the rollers plus the thickness of the plate, the hard surfaced roller will cause the plate to displace the softer peripheral covering of the other roller. The displaced portion of the roller having the relatively soft peripheral surface is indicated by reference numeral 40 in FIG. 5, while the dotted line 41 indicates the peripheral surface without any displacement. Such a displacement of the covering has not only been found to enable a flat plate to be curved but also a non-flat plate to be substantially straightened even when it has different degrees of curvature throughout its length. It will thus be appreciated that the amount of displacement of the covering controls the degree of curvature formed in a plate and this may be altered not only by changing the distance between the axes, but also by changing the relative hardness of the peripheral surfaces of the two rollers.

If the rolling machine has both rollers provided with a peripheral covering, then the covering of one roller is made substantially harder or less yielding than the peripheral covering of the other roller. Moreover, it has been found in the preferred embodiment of the invention disclosed herein that when two rollers are employed having different diameters that the harder peripheral covering should be on the smaller roller in order to provide the most effective use of the present invention.

One embodiment of the invention which has been found to be satisfactory includes a lower roller having a diameter of approximately twenty inches with the outer covering being about one inch thick and being formed of rubber having a hardness of 50 P and J. The upper roller is approximately six inches in diameter with the outer covering being about ¾ of an inch thick and being of rubber having a hardness of 20 P and J. In both instances, it will be clear that the covering is substantially thick compared to the diameter of its roller.

It will accordingly be appreciated that there has been disclosed a plate rolling machine which is simple in construction, utilizing only two rollers. These rollers not only are effective to produce a curvature in a flat plate passed therebetween from the leading edge to the trailing edge without any flat portions at the edge portions but also may be employed to render substantially flat, plates which by prior operations have curvatures therein. The present machine provides at least one roller with an outer covering that is sufficiently soft so that it may be resiliently displaced without becoming free or being permanently distorted while the other roller has a covering hard enough to cause said displacement. When there is peripheral covering on both rollers, it is preferred that one be relatively soft as compared to the other even though both be relatively soft as compared to the hub portions of each roller.

Variations and modifications may be made within the scope of the claims and portions of the improvements may be used without others.

I claim:

1. The method of making substantially flat a plate having an initial lengthwise curvature comprising the steps of inserting the leading edge of the curved plate between a pair of rollers with one roller having a larger diameter than the other roller having a resilient peripheral covering softer than the resilient peripheral covering of the smaller roller, the concave surface of the plate engaging the larger diameter roller, forcing the rollers radially together with sufficient force to cause more displacement of the curvature of the larger roller than the periphery of the smaller roller by the engagement of each with the opposite surfaces of the plate, and rotating at least one of the rollers until the plate has passed between the roller while maintaining the forcing of the rollers radially to thereby effect sufficient reverse lengthwise curvature in the plate to overcome the initial lengthwise curvature.

2. The method of making substantially flat a plate having curvatures comprising the steps of inserting the leading edge of the plate between a pair of rollers with one roller having a larger diameter than the other and with the larger roller having a resilient peripheral covering softer than the resilient peripheral covering of the smaller roller, forcing the rollers radially together with sufficient force to cause more displacement of the periphery of the larger roller than the periphery of the smaller roller by the engagement of each with the opposite surfaces of the plate, rotating at least one of the rollers until the plate has passed between the roller while main-
taining the forcing of the rollers radially to thereby effect a lengthwise curvature in the plate, inserting a leading edge of the lengthwise curved plate between the rollers with the concave surface of the plate engaging the larger diameter roller, forcing the rollers radially together with sufficient force to cause more displacement of the periphery of the larger roller than the periphery of the smaller roller by the engagement of the rollers with opposite surfaces of the plate, and rotating at least one of the rollers until the plate has passed between the rollers while maintaining the forcing of the rollers radially to thereby effect sufficient reverse lengthwise curvature in the plate to overcome the previously effected lengthwise curvature and render the plate substantially flat.

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