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J. B. TYTUS

ROLLING SHEET METAL

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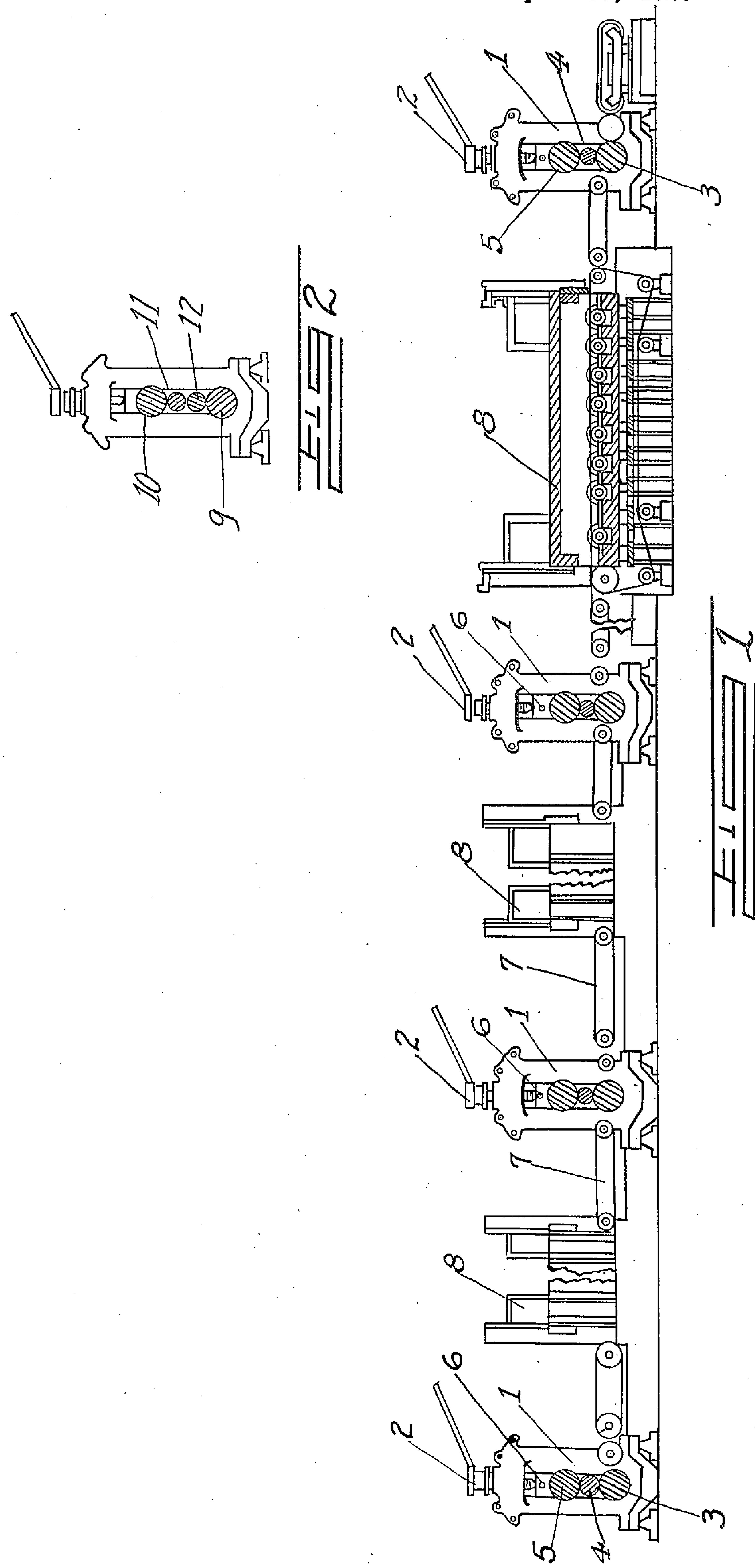

INVENTOR.

John B. Tytus

by Allen & Allen

ATTORNEYS

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UNITED STATES PATENT OFFICE.

JOHN B. TYTUS, OF MIDDLETOWN, OHIO, ASSIGNOR TO THE AMERICAN ROLLING MILL COMPANY, OF MIDDLETOWN, OHIO, A CORPORATION OF OHIO.

ROLLING SHEET METAL.

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My invention relates to the method of rolling sheet metal in packs in order to get fine reduction, by successive roll reduction in a series of stands of rolls, each acting on the pack but once.

I have hitherto discovered that in rolling thin wide metal pieces such as the customary sizes of steel and iron sheets in the industry at the present time, that the difficulty in attempting a continuous process is that the active pass, in each stand of rolls must be particularly controlled in order to successfully keep the piece flat, and feed it accurately through the stand.

It has been assumed in the past that the desirable way to roll sheet metal in successive stands of rolls was to keep each pass as flat or truly rectangular in contour as possible; whereas my process calls for the formation of a contour of pieces that is thicker along the median line than at the edges, and in each stand of rolls attenuating the median thickness more than the edges of the piece are attenuated.

In other words, by my process the active pass, or shape of the space between the rolls when the metal being rolled is embraced between them, must be less convex as compared to a horizontal plane, in each successive stand, with the final convexity such as will not diverge sufficiently from commercial allowance in the judging of flat metal sheets.

I have also discovered that where the proper convexities of active pass are maintained, it is possible to roll hot metal packs, between rolls which are kept cold. By cold in the hot metal rolling mill is meant a temperature that will maintain a film during rolling on the surface of the rolls. Rolls are kept cold in hot rolling by spraying with water.

There is a decided advantage in keeping the rolls cold, in my process, because this eliminates one of the variable factors going to make up the active pass. Thus if the rolls are unevenly heated or vary in heat at one time from another, their diameters or shape will change due to the hotter metal expanding more than the cooler. By eliminating this factor it is easier to maintain an active pass of desired contour.

I have also discovered that it is necessary in rolling packs by a continuous process such as I have noted above, to prevent the pieces making up the pack from sticking together in some places and not in others. To the end of avoiding this it is my practice to require that the packs be kept within manipulating range of workers, who will strip apart the separate sheets making up the packs, between roll passes, where this is necessary.

Finally in the use of rolls which are kept cold, and packs which are rollable because hot, the degree of heat in the packs is factor of the active pass in each stand of rolls, so that it is my practice to provide temperature controlling means for the metal packs between stands of rolls.

It is the object of my invention to provide a process of pack rolling, in which one or two small diameter rolls are applied to the piece, in which these rolls are kept cold, in which the temperature control of the packs is provided for, and in which the progressive convexity reduction from pass to pass is provided for by the nature of the rolls, and prearranged settings of the pressure applying screws thereon for packs of a prearranged contour to begin with.

The advantage resulting from the use of small diameter rolls in connection with the rolling process arises from a series of factors, some heretofore recognized, and some not.

If a piece of relatively thin metal, such as a pack for example, is passed between standard sized rolls, the area of the pack under compression between the rolls at any given instant is much greater than if one or both of the rolls were of small diameter. Keeping in mind that in rolling the power is applied as torque and not as pressure, and that the adjustment of the screw holds the journals of the rolls against separation, rather than forcing them about the piece, still the result of the action in the mill is to spring the rolls, apply compressive strain to the pack, and spring the housings of the mill as well. By cutting down the size of one or both the rolls and backing them with large diameter rolls for stiffness, I can get the same amount of reduction of a pack with (1) less friction at the necks and hence expenditure of power and creation of heat which distorts the shape of the rolls, (2) less spring of the rolls, because less compressive strain is applied, resulting in less pressure on the pack as well, thus avoiding the danger of sticking the parts thereof together, (3) less difficulty due to elasticity of the housings in which the rolls are supported, thus making the screw settings more positive in their results.

It is evident that with the added availability of the several features above outlined, I am enabled to produce very thin gauge metal sheets in packs with a minimum of labor, economy of replacement in case of roll breakage in the small rolls, and with simplicity of control of active pass.

I have illustrated in the drawing a typical installation of sheet mill for accomplishing my process, and will proceed to describe my process in connection therewith, and point out the novelty inherent therein in the claims that follow.

In the drawing:

Figure 1 is a sectional diagram of a mill of four stands, designed for the accomplishment of my invention.

Figure 2 is a sectional diagram of a four high stand.

I have indicated a series of roll stand housings 1, which are preferably of a rigid type, with screws controlled at 2 for adjusting the spacing of the rolls from each other. In each stand are three rolls, a large bottom roll 3, a central idle roll 4 of small diameter, and a large upper roll 5, the upper roll being the one to which the screw is applied.

I have indicated shower pipes 6, by means of which water can be sprayed on the rolls, thus keeping thereon a film of water, the rolls being then termed "cold" in the rolling mill industry.

I have shown tables 7 between the stands of rolls by means of which the packs are fed and I have shown furnaces 8, through which the packs are fed between stands. The furnaces have been broken away, except for the one to the right, and the feed table beyond the furnace to the right has been broken away, all for the purpose of compressing the length of the diagram. It should be understood that the space from each furnace to the stand of rolls either in front or behind it, must be sufficient for an operator to strip the sheets forming up a pack from each other, if they have points of partial adherence. A full adherence without spots of looseness is perhaps practical, and a complete freedom of the sheets from the others in the pack is preferable, but a partial adherence and a partial looseness is absolutely to be prevented, and hence the space must be given, and time factor be sufficient for an inspection and stripping should this be required.

The small inner roll may be held freely in the housings so as to be removable, and in controlling roll contours, the small inner roll need not be other than cylindrical, since it will take the shape of the larger upper roll against which it bears. The breakage of the small diameter roll will thus be easy to repair by quick insertion of a new one.

Instead of having one small diameter roll there may be two, as indicated in Figure 2, where there are large rolls 9 and 10 and smaller inner idler rolls 11 and 12.

In the process a pack is provided which has a known cross sectional shape, which has been termed contour. It is heated to the proper degree for rolling, and preferably rolled so that the pieces making up the pack will not adhere to each other. Each stand of rolls is kept cold with a film of water, and preferably each furnace will be kept at a temperature sufficient to maintain the pack at somewhat higher temperature than is normally practiced in rolling by repassing through a single stand, as in the Welsh process.

In preparing the several rolls for the stands that the piece is to pass through, the grinding or turning will be such as to give under normal operation an active pass in each stand of progressive difference, and other factors entering into the active pass will be controlled by the operator depending upon the contour of the pack with which he is provided.

Thus the grinding of the rolls is practiced so as to give a slight crown to all of the large rolls, and more of a crown to the larger rolls in the first stand. This is because the pack is thicker in the first stand, and granted a uniform extension in each stand, the tendency of the pack to spring the rolls will be less, where the pack is thinner.

The screw on the rolls is a factor in the roll contour during the moment that the pack is between them, as is the temperature of the pack, and its thickness. Where the rolls are at a uniform temperature, as when kept "cold" the factor of differential expansion of the rolls, is largely eliminated from my present process.

The necessities of the use of additional heat to keep the packs up to temperature for rolling and preferably slightly higher than in usual Welsh process rolling, arise partly from the necessity of keeping the contours of active pass correct, and the several passes in a series uniform in temperature in each pass, and partly because by my process I reduce the packs between rolls which are kept cold, which takes heat away from the packs. Due to the necessity of keeping the packs free of adherence by a manual manipulation, the passage of the packs from stand to stand cannot be fast enough to avoid re-heating.

In directing the operation of the typical mill shown, once installed, the rollers will be instructed that in each stand they should take down the center of the pack more than the edges, and that they should work out screw settings and temperature control on the packs, so that when starting with a run of packs of a given degree of convexity, the first stand should be controlled and the successive stands set with regard to the first stand so that each active pass will have less convexity of contour. In each case also the piece should be kept at a prearranged temperature for each stand. Thus each successive stand after the first must be controlled so that the spring of the rolls about the piece will be proper to reduce the median area of the piece more than the edges, the general rule being to reduce the total thickness at the middle proportionately as the length of the piece over-all is increased by the pass.

Due to the lower power expenditure secured by my method in each pass it is possible to more accurately control the contour of active pass than in a case where the control of contour might affect the amount of extension of the piece disadvantageously. Also a thinner product will result from a given number of passes.

The convexities spoken of, are naturally slight and not determinable by the eye, but in a thin piece it is necessary to control the contours by prearranged plan, so that the active pass of each stand is correct for taking the product of the preceding one. All of the furnaces need not be used, all of the time, as control of temperature may require blanking one or more of them on particular runs.

As has been stated, the fallacy of former endeavors to roll packs by a continuous process has arisen from the fact that the experimenters disregarded the spring of the rolls, or else tried to control it to give the unnatural effect of a completely parallel set of roll faces presented to the piece lying therebetween at each pass.

Not only does the failure to observe the rule of progressive lessening of convexity curve in cross section of the piece, result in failure to get an even and flat product, but it results in a piece which will not exhibit a natural tendency to feed through the center of the roll passes.

This application is directed to a final refinement of my continuous rolling process for packs and thin metal generally wherein I obtain a high degree of reduction by the added device of using a single or double small diameter rolls, backed by large diameter ones, since I employ the added features of keeping the elements thereof from partial adherence, and preserving a progressively less convex active pass from stand to stand.

I am thus able to reduce to a minimum the chances of failure to obtain commercially flat and satisfactory sheet, I can make a thinner sheet than ever before, and have eliminated very fully the chances of inadequacy of the apparatus used to produce a product of uniform length regardless of the practical range of convex contours to be met with in the heated packs with which my process starts.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent, is:—

1. A process of rolling hot packs for the production of sheets which consists in passing the packs through successive stands of rolls in a series, and in said stands engaging the packs by small diameter rolls backed by rolls of larger diameter, said rolls being maintained cold, and controlling the temperature of the packs between selected stands, and preserving an active pass in each stand which has less of a convex curve, than the convexity of the pack prior to its passage therethrough.

2. A process of rolling hot packs for the production of sheets which consists in passing the packs through successive stands of rolls in a series, and in said stands engaging the packs by small diameter rolls backed by rolls of larger diameter, said rolls being maintained cold, and controlling the temperature of the packs between stands, and preserving an active pass in each stand which has less of a convex curve, than the convexity of the pack prior to its passage therethrough, said packs being open to manipulation between stands for the purpose of preserving the pieces making up the pack from partial adherence to each other.

3. A process of rolling hot packs for the production of sheets which consists in passing the packs through successive stands of rolls in a series, and in said stands engaging the packs by small diameter rolls backed by rolls of larger diameter, said rolls being maintained cold, adding heat to the packs intermediate selected stands, and preserving an active pass in each stand which has less of a convex curve than the convexity of the pack prior to its passage therethrough, said preservation of active pass being maintained by predetermining the contour of a run of packs, maintaining the heating requirements so as to give each stand of rolls a pack of the same temperature, and to provide a metal of proper degree of softness and arranging and maintaining the pressure applied to the rolls in each stand with relation to each other stand and with relation to the packs being run.

JOHN B. TYTUS.