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METHOD OF AND APPARATUS FOR REMOVING LUBRICANT FROM COLD ROLLED STRIP METAL

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Fig. 1

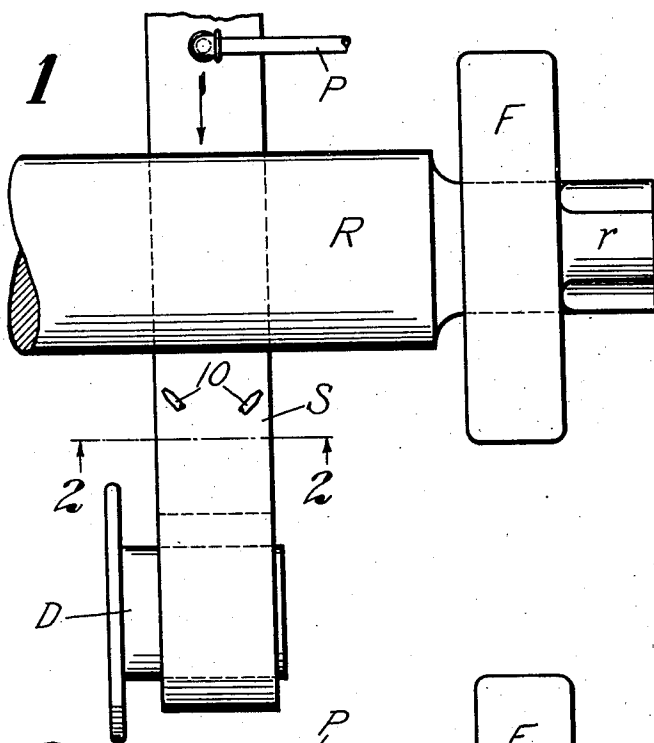


Fig. 2

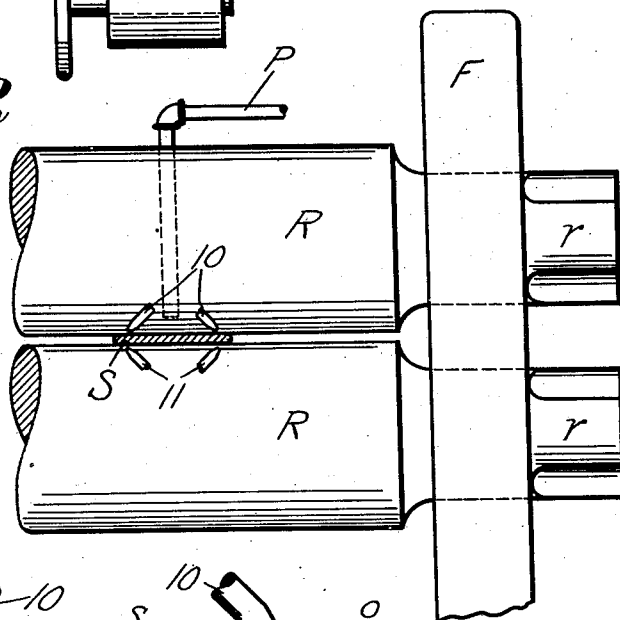
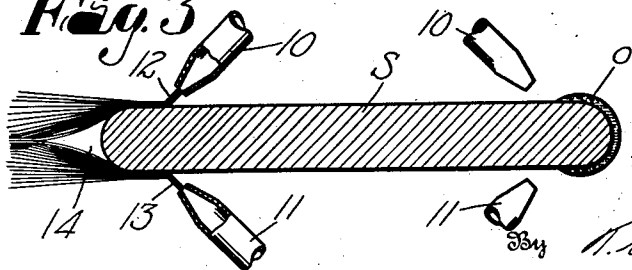


Fig. 3



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METHOD OF AND APPARATUS FOR REMOVING LUBRICANT FROM COLD ROLLED STRIP
METAL

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This invention relates generally to machines wherein metal strips are passed through or between suitable rolls to accomplish the desired operation upon the strips and has particular reference to the method of and apparatus for removing lubricant from the strips after they have been passed through the rolls. As an instance of a use to which the improvements of the present invention may be applied, reference may be had to cold rolling machines, since the invention has particular adaptability in that connection, it being understood that the present disclosure is by way of illustration only.

In the operation of cold rolling strip metal, it is the usual practice to use lubricant in order to reduce friction and the heat generated thereby, to lessen the power required in driving the rolls, and also to produce a superior finish on the strip. The lubricant (such as oil or other fluid, the term "lubricant" here being used in its generic sense) may be applied to surfaces of the rolls, or it may be applied to the strip before it enters the rolls, as by dripping the lubricant onto the strip or immersing the strip in the lubricant.

As the strip passes through the rolls of the rolling mill, the rolls have a wringer action which causes the oil or lubricant to back up and collect in the entrance angles between the rolls and the strip. This lubricant, in part, will also flow towards and onto the side edges of the strip and onto the rolls, with the result that, as the strip leaves the rolls, it carries on each edge a certain amount of lubricant together with more or less foreign solids. It will also crawl back onto the marginal edge of the surface of the strip. In the event that the strip is wound into a coil or if the strip is cut into lengths and subsequently stacked, this lubricant will spread over the surfaces of the strip due to contact and pressure. Beyond this, the residual heat in the metal, resulting from the rolling operation, causes an increase in the fluidity of the lubricant, allowing it to flow more readily over the surfaces when the coils are piled on edge or the lengths

piled in a stack. The strip will therefore be quite well coated with a film of lubricant, the presence of which is objectionable during the annealing operation.

In some plants, it is the practice to remove the lubricant prior to the annealing operation by wiping the strip with rags or felt. This practice is open to many objections in that the wiping materials soon become saturated, resulting in the spreading of the lubricant over the surfaces of the strip. To offset this, it is necessary to frequently renew the wiping materials, at an expense of both labor and materials. In spite of frequent renewals of the wiping materials, when strip wiped in this manner is annealed, the surface has a streaked or lined appearance, due to the presence of dust and foreign matter which has gotten into the lubricant, which is objectionable. Frequently, slivers of metal or hard, foreign particles imbed themselves in the wipers and cause scratching of the surface. Also, this practice does not lend itself to continuous operation as the wipers must be readjusted at the start of each new strip. There is also a serious physical hazard, as the adjustments are made to the wipers while the strip is in motion, and it is a matter of record that this practice has been responsible for the loss of limbs by the operators.

Furthermore, attempts have been made to remove the lubricant with alkaline cleaning solutions or organic solvents, but these processes incur separate operations and extra expense for equipment.

After the metal strip has been rolled, it is customary to anneal it, and it is a common practice to carry out the annealing process in such a manner that the surfaces of the strip are protected from oxidation by the use of suitable covers, sometimes with and sometimes without protective layers of cast iron borings and sometimes in an atmosphere of a non-oxidizing or reducing gas. During the annealing operation, it is desirable to have the strips, which may be in the form of coils or lengths, as free as possible from lubricant for the reason that, during this operation, the strip is elevated to

a temperature which produces first a vaporization of the oil and a subsequent cracking of this vapor into both a carbon deposit and a highly reducing gas of high carbon content, both of which have a tendency to result in discolored surfaces. In some cases, the carbon is deposited in a somewhat non-adherent film which is easily removed, but in other cases, it adheres very tightly to the strip and forms a scale and stain thereon. In any event, however, the presence of any material amount of lubricant during the annealing process results in discoloration of the strip, which is very difficult, and sometimes impractical, to remove. Furthermore, the cleaning of the strip represents a costly operation.

Therefore, the main object of the present invention is to provide an improved method whereby the lubricant, which has been applied to the strip, is very effectively removed in a very economical and simple manner and without in any way interfering with or retarding operation upon the strip.

A further aim of the invention is to provide an improved apparatus by means of which the method of the present invention may be carried out, the apparatus being characterized by its simplicity and economy in structure and installation and by its effectiveness in operation.

In the present illustrative disclosure of the invention, the lubricant carried by the side edges and that which may have crawled onto the outer edges of the surface of the strip is removed, immediately after the strip leaves the rolls, by the combination of a pressure and vacuum action created by suitably directed currents or streams of a suitable fluid, preferably in the form of a gas, such for example, as air, the term "gas" here being used in its generic sense, it being understood that this term includes air or a vapor or any fixed gas. It is also obvious that any suitable liquid may be used which might be a solvent for, a non-solvent for, or one producing a chemical reaction with the lubricant to be removed. In the preferred embodiment of the invention, streams of suitable compressed air are directed against the opposite surfaces of the strip adjacent the marginal portions thereof and in such directions as to effect removal of the lubricant from the marginal portions of the major surfaces of the strip and also from the edges of the strip. These streams of air blow the lubricant off of the major surfaces towards the edges of the strip, and the streams as they leave the opposite sides of the strip, tend to create a vacuum at the edges of the strip, thereby removing substantially all of the lubricant from those edges.

Other objects will be in part obvious and

in part pointed out more in detail herein-after.

The invention accordingly consists in the features of construction, combination of elements and arrangement of parts which will be exemplified in the construction hereinafter set forth and the scope of the application of which will be indicated in the appended claims.

In the accompanying drawing, wherein we have shown, for illustrative purposes and more or less diagrammatically, one embodiment which the present invention may take:

Figure 1 is a front elevational view of so much of a rolling machine as is necessary to show the application of our improved apparatus;

Fig. 2 is a front view thereof, the winding drum being omitted, and the metal strip being shown in cross section along the line 2-2 of Fig. 1; and

Fig. 3 is a diagrammatic view on an enlarged scale showing the strip in cross section and the manner in which the lubricant is removed from the marginal edges thereof.

In said drawing, we have shown, more or less diagrammatically and only in part, so much of a rolling machine as is necessary to illustrate the improvements of the present invention, it being understood that this machine is shown by way of exemplification only, the particular construction thereof forming no part of the present invention. The machine is shown as having a pair of rolls R rotatably supported by a frame F only one upright of which is illustrated. The projecting ends *r* of the rolls may be suitably fashioned to receive gears (not shown) or the like whereby the rolls are driven in opposite directions. The letter S designates the strip of metal operated upon and which travels in the direction indicated by the arrow seen in Fig. 1. After the strip leaves the pair of rolls R of the rolling machine, it may be coiled as, for example, on a coiler or drum D which is more or less conventionally illustrated. A suitable lubricant may be supplied to the strip (before it enters between the two rolls) by any suitable means, such means being conventionally shown in the drawing, for illustrative purposes, as including a pipe P from which the lubricant may drip onto the strip.

As previously stated, as the strip passes between the rolls, the strip is squeezed and the lubricant is caused to back up in the entrance angles between the strip and the rolls, and a portion of this lubricant will flow onto and collect on the side edges of the strip which, of course, are not in contact with the rolls. As soon as the strip leaves the rolls, the film of lubricant which has gathered on the edges of the strip will tend to flow back onto the upper and lower surfaces of the strip, as indicated more or less generally

and diagrammatically at the right hand side of Fig. 3. The lubricant in that figure is designated generally by the letter O.

Referring now to the improvements of the present invention, there are provided, immediately following the rolls, nozzles so disposed as to direct preferably currents of air, against the strip in such directions as to force any lubricant which may have spread onto the marginal portions of the major surfaces of the strip towards and off the edges of the strip, and the upper and lower streams of air tend to cooperate and create vacuums at the edges of the strip, so as to suck the lubricant outwardly from and off of those edges. In the particular embodiment illustrated in the drawing, there is shown, adjacent each side edge of the strip, a pair of nozzles, one 10 located above the strip, and the other 11 located below the strip, and these nozzles are so located as to cause the streams of air issuing therefrom to strike the strip at a slight distance inwardly of the edge of the strip and flow outwardly towards the edge of the strip, as indicated diagrammatically at the left hand side of Fig. 3. The stream 12 of air, striking the upper surface of the strip, is in the same vertical plane as the stream 13 striking the under side of the strip so that these streams will tend to cooperate with each other beyond the edge of the strip, thus tending to create an area of lower pressure or partial vacuum immediately adjacent the edge of the strip, the vacuum space or zone being designated by the numeral 14. It is understood, of course, that the streams and vacuum zone are more or less diagrammatically shown in Fig. 3 so as to only generally exemplify what takes place, and these streams and the zone may have shapes and sizes other than those illustrated, the main consideration being that, with the nozzles disposed as described, the streams of air remove substantially all of the lubricant from the strip. By preference, the nozzles are disposed at an angle to the planes of the surfaces against which the streams impinge and are directed rearwardly towards the mill rolls at an angle to the side edges of the strip, it being found that, with this arrangement, a very effective lubricant removing action is obtained. Obviously, the nozzles may take various forms and may be supported in any suitable manner.

It will be seen from the foregoing description, taken in connection with the accompanying drawing, that, with our improved arrangement, the lubricant is removed from the marginal portions of the major surfaces of the strip and from the edges of the strip immediately after the strip leaves the rolls and before the lubricant, which has gathered on the edges during the rolling operation, has a chance to

spread to any appreciable extent over the major surface of the strip. The nozzles may be installed at a relatively low cost and, after the arrangement is in operation, it requires practically no attention. The lubricant is not only very effectively removed from the strip, but this is done at an almost negligible cost, the only expense being that of the energy used in compressing the fluid delivered to the nozzles. Another important advantage is that with our method there is no physical contact with the strip and hence no chance to mar the surface of the strip or any of the disadvantages mentioned in connection with the present method.

As many changes could be made in the above construction and many apparently widely different embodiments of this invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the language used in the following claims is intended to cover all of the generic and specific features of the invention herein described and all statement of the scope of the invention which, as a matter of language, might be said to fall therebetween.

We claim as our invention:

1. The process of removing lubricant from the surfaces of a metal strip which consists in passing the strip in lubricated condition between rolls and directing streams of fluid under pressure against the opposite surfaces of the strip and in a direction outwardly towards the edges of the strip.

2. The process of removing lubricant from the surfaces of a metal strip which consists in passing the strip in lubricated condition between rolls and directing streams of fluid under pressure against the surfaces of the strip along lines spaced from the edges of the strip and as the strip leaves the rolls, the streams being directed outwardly towards the edges of the strip.

3. The process of removing lubricant from the surfaces of a metal strip which consists in passing the strip in lubricated condition between rolls and directing streams of fluid on opposite sides of the strip at an angle to the plane of the strip and rearwardly at an angle to the line of travel of the strip, said streams being directed outwardly towards the edges of the strip.

4. The process of removing lubricant from the surfaces of a metal strip which consists in passing the strip in lubricated condition between rolls and directing streams of fluid under pressure against opposite surfaces of the strip and outwardly towards the edges of the strip, the streams directed

against one surface of the strip cooperating with the streams directed against the other surface of the strip to effect a condition of partial vacuum at the edges of the strip.

5 5. The process of removing lubricant from the surfaces of a metal strip which consists in passing the strip in lubricated condition between rolls and directing against opposite surfaces of the strip and in the same plane streams of air at like distances from the edge of the strip and outwardly towards said edge whereby the lubricant on the marginal portions of said surfaces is forced towards the edge of the strip and an outward suction action is created between the streams at the edge of the strip.

10 6. The process of removing lubricant from the surfaces of a metal strip which consists in passing the strip in lubricated condition between rolls, applying lubricant to the strip before it passes thru the rolls or on the rolls themselves, and removing from the marginal portions of the major surfaces of the strip and from the side edges of the strip immediately after the strip passes thru the rolls the lubricant thereon by directing streams of liquid under pressure against the surfaces of the strip within said marginal portions and outwardly towards the edges of the strip.

15 7. In combination, a machine having a plurality of rolls between which a metal

strip is adapted to pass, and nozzles immediately following said rolls and arranged on opposite sides of the path of movement of the strip for directing streams of fluid under pressure against the opposite surfaces of the strip and outwardly towards the edges of the strip. 70

8. In combination, a machine having a plurality of rolls between which a metal strip is adapted to pass, and nozzles immediately following said rolls and arranged on opposite sides of the path of movement of the strip for directing streams of fluid under pressure against the opposite surfaces of the strip and outwardly towards the edges of the strip; the nozzles to one side of the strip being respectively opposed to those on the other side of the strip. 75

9. In combination, a machine having a plurality of rolls through which a metal strip is adapted to pass, and a pair of opposed nozzles adjacent each edge of the strip and immediately following said rolls, a nozzle of each pair being above the strip and the other nozzle of each pair being below the strip, each nozzle being so arranged as to direct a stream of fluid under pressure against the surface of the strip at a point spaced from the edge of the strip and towards the edge of the strip. 80

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