S. A. DAVIS.

METHOD OF OPERATING HOT MILLS.

APPLICATION FILED APR. 4, 1911.

1,035,949.

Patented Aug. 20, 1912.

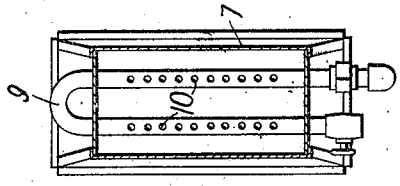

FIG. 5

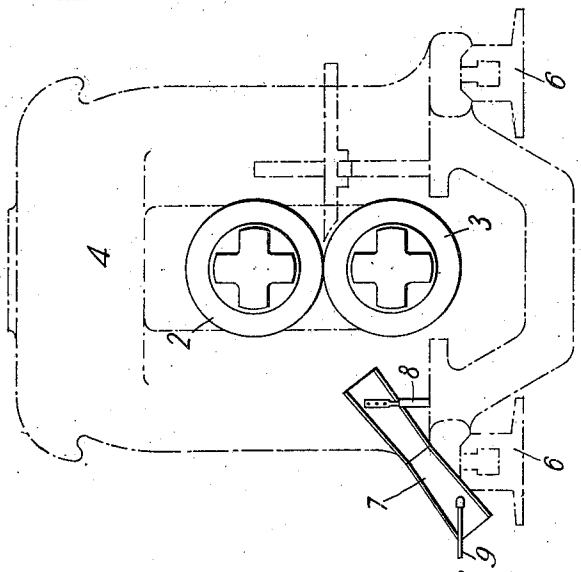

FIG. 1

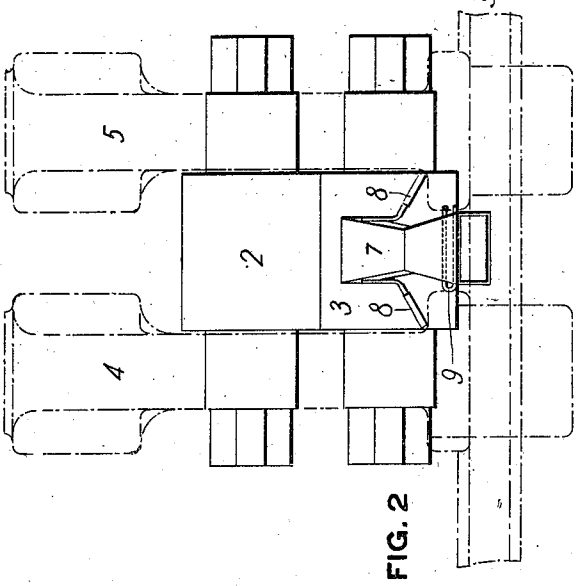

FIG. 2

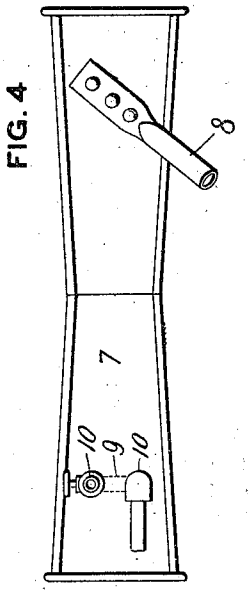

FIG. 4

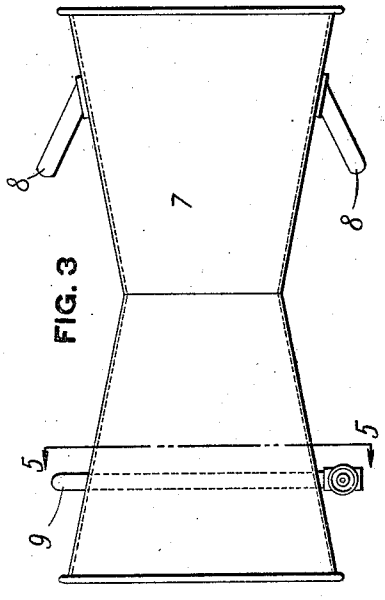

FIG. 3

WITNESSES

A. D. Little

M. P. Alexander

INVENTOR

S. A. Davis

by Leuthiemm Bell & Fuller

his Attorneys

UNITED STATES PATENT OFFICE.

STEWART A. DAVIS, OF PITTSBURGH, PENNSYLVANIA, ASSIGNOR TO THE AMERICAN SHEET & TIN PLATE COMPANY, OF PITTSBURGH, PENNSYLVANIA, A CORPORATION OF NEW JERSEY.

METHOD OF OPERATING HOT-MILLS.

1,035,949. Specification of Letters Patent. Patented Aug. 20, 1912.

Application filed April 4, 1911. Serial No. 618,960.

To all whom it may concern:

Be it known that I, STEWART A. DAVIS, of Pittsburgh, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Method of Operating Hot-Mills, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming part of this specification.

My invention relates to the hot rolling of steel and iron or other metals into sheets or plates, and more particularly relates to the operation of hot mills used in rolling such sheets and plates.

In the operation of hot mills, heat is imparted to the rolls by contact with the bars or pieces of highly heated metal passed between them in the rolling operations, and it is customary in beginning the operation to roll comparatively short, narrow and heavy pieces of metal until the preliminary heating of the rolls is effected. When this heating has progressed until the surface of the rolls attains a practically solid blue black color, which corresponds to a temperature of approximately 800 to 900 degrees F. it has heretofore been considered that the proper rolling temperature for rolling light sheets to gage had been attained. This color indication is manifest over the entire surface of the roll and is due to a complete oxidation over the entire surface of the roll corresponding to this degree of heat. As the middle of the length of the barrel or body of the rolls becomes more highly heated than the ends when expanded by heat transmitted to them during the rolling operations, the center of the length of the rolls becomes "puffed up" or expanded more than the end portions. To overcome this difficulty and obtain the desired contour on the rolling surfaces of the rolls the body of one or both of the rolls is made slightly concave. Starting with this temperature, continued rolling operations would naturally carry the temperature beyond the degree indicated and the temperature of the rolls would increase until the color of the roll would change to a perceptible red. When the temperature is increased at the center of its length to a degree indicated by this color and which approximates 950 to 1000 degrees F., the strength of the roll has been very materially decreased and breakage of the rolls at a temperature of 950 degrees F. and above is frequent. To obviate this difficulty it has been proposed to apply a cooling medium to the surface of the rolls whereby to prevent reaching a temperature at which breakage is excessive, but so far as I am aware, this cooling has never been practised, except for the purpose of keeping the roll temperature within the breaking limit and practically at a temperature corresponding to a solid blue black color of the rolls over the entire surface of the rolls; or, stated in other words, the heretofore generally accepted rolling temperature has been approximately from 800 to 900 degrees F. With wide sheets and plates and with the lighter gages of such materials it has been considered absolutely necessary for the rolls to be heated to a temperature of at least 800 degrees F.

The maximum strength of a chilled cast iron roll, (which is the material used in making such rolls) is reached at approximately 600 to 700 degrees F., and at a temperature of 900 degrees F. the structure of the metal in a chilled cast iron roll changes to such extent that the strength of the roll at this temperature is greatly lessened, while any further increase in temperature causes a much more rapid loss of strength. As a result heretofore, the aim has always been to maintain the rolls of such mills at a temperature between 800 and 900 degrees F., and as closely as possible to 800 degrees F.

Owing to the generally accepted belief that in order to obtain operative rolling conditions the rolls of hot mills must be heated to not less than 800 degrees F., such rolls have always been so heated at a great sacrifice in strength, while the much greater rapidity with which the rolls lose strength when heated above 900 degrees F. requires the maintenance of the rolls below a maximum temperature of 1000 degrees F. This narrow range in temperature has been maintained at the very great expense and loss of time in operating such mills necessarily occasioned by the frequent delays in the operation of making sheets or plates found necessary in order to prevent over-heating of the rolls and the prohibitive losses occasioned otherwise by reason of the resulting large number of broken rolls caused by such overheating. In actual practice it has been customary in order to maintain the temperature within safe limits, to interrupt the passage of the metal between the rolls, either par-

tially or entirely, at frequent intervals, but whether the one method or the other of maintaining the temperature of the rolls has been employed, this temperature has never heretofore been carried below what has been considered as the normal working temperature indicated by a solid blue black color of the roll over its entire surface and corresponding to a temperature of approximately 800 to 900 degrees F.

I have discovered that sheets and plates may be rolled at a roll temperature very materially less than that which has heretofore been considered necessary; that is to say, I have discovered that the rolling of sheets and plates may be more advantageously carried on at a roll temperature indicated by a color changing from a light blue to a bronze along that portion of the roll approximating the width of the metal passing through and corresponding to temperatures ranging from 600 to 700 degrees F. In further explanation of the color indications, I may say that the center of the length of the roll will change from a light blue color to a bronze during the passage of the metal and when free of the metal will change back to a light blue, the end portions of the surface of the rolls remaining constantly of a light yellow or straw color corresponding to a temperature of about 400 degrees F. By this discovery a number of important practical results are attained: 1st. I enormously increase the out-put of the mill for the reason that the time interval between the passage of the metal through the rolls is limited only by the speed of rotation of the roll train and the ability to get the metal to the rolls and take it away. 2nd. By working at these temperatures I am enabled to maintain a better surface on the rolls themselves with a consequent improved surface on the finished materials. 3rd. This method of working also facilitates the opening of the sheets when rolled in packs, and the cost of lubricating the roll bearings is materially decreased.

In the operation of my improved method, I have found that it is unnecessary to initially raise the temperature of the rolls beyond the degrees above indicated and that this temperature may be maintained in a practical manner by the application of a cooling medium to the surface of the rolls at the middle of their length. The particular cooling medium and its method of application may be considerably varied but I have found in practice that it may be accomplished by known means, such as the employments of a blast of air, steam, or air and steam commingled, preferably the latter.

Referring to the drawings, Figure 1 is an end elevation of a hot mill as arranged to carry out my improved method and showing the preferred means employed in maintaining the rolls within the temperatures required in carrying out my improved method. Fig. 2 is a side elevation of the mill shown in Fig. 1. Fig. 3 is a plan on a larger scale showing one form of apparatus adapted for use in maintaining the rolls at the temperature required in carrying out my improved method. Fig. 4 is a longitudinal side elevation and Fig. 5 is a sectional end elevation of the apparatus shown in Fig. 3 the section being taken on the line 5—5 of Fig. 3.

In the accompanying drawings, 2 and 3 designate the top and bottom rolls of a hot mill of the usual construction, the rolls being secured in the usual bearings mounted in the windows of the housings 4 and 5, and the housings being mounted on the usual housing shoes 6.

On the catcher side of the mill is a blower by means of which air, steam or a mixture of steam and air is directed against the surfaces of the rolls. As shown, this blower consists of a box 7 rectangular in cross section, with its sides tapering inwardly from its ends toward the middle of its length. The box is supported by means of arms 8 secured to its upper or inner end, the arms 8 resting on the feet of the housing so as to hold the blower in position. Adjacent to the lower or outer end of the blower which is inclined inwardly and upwardly when in position between the roll housings, is a pipe 9 which is bent into the form of a U, and which extends transversely across the width of the box 7. The bent pipe 9 is provided with perforations 10 through which steam or air is emitted when the blower is in operation. One end of the pipe 9 is connected with a supply of steam or other gaseous fluid and a valve is provided in a suitable location on the supply pipe by which the supply of steam or other gaseous fluid is regulated and controlled.

In operating hot mills by my improved method, the mill is first used in rolling bars as singles, and during such rolling operations the rolls gradually absorb heat by contact with the heated metal being rolled. When the mill is first started in operation, steam or air, or a mixture of steam and air, is turned on in the pipe 9 and upon emerging through the openings or holes 10 in this pipe is directed against the faces of the rolls by means of the box 7 forming part of the blower. By the blower construction shown in the drawings, an aspirating effect is obtained and, when steam is used, the steam will temper the cold air drawn into the box by the aspirating effect of the blower. When operated in accordance with my improved method the rolls are preferably maintained at a temperature of about 600 to 650 degrees F., although the temperature may be permitted to increase until the center of the length of the rolls becomes

heated to as much as 800 degrees F., this range of temperature being very easily determined by the color of the rolls, which will be clearly indicated by bands of a light yellow color, which corresponds to about 400 degrees F. on the ends of the rolls and a changing color ranging from a light blue to bronze, (600 to 650 degrees F.) on the intermediate body portion of the rolls between the yellow bands on the end portions of the rolls. A temperature of from 400 to 650 degrees F. is very readily known by the color of the rolls which ranges from a pale yellow (400 degrees) to a light blue color (650 degrees), while a temperature of 800 degrees F. will show a blue black color on the roll body which extends solidly from one end to the other of the roll body, and above 900 degrees F. the roll will be maintained at and show a practically solid black color across its entire length, so that the temperatures can be gaged very accurately by sight. The blast of air, or a mixture of steam and air, or steam, when applied to the rolls will be regulated to suit conditions in rolling the singles, and later the pairs, and doubles, and by regulating the gaseous fluid directed against the rolls, the rolls will at all times be maintained below a temperature of 800 degrees F. and preferably, between 600 and 650 degrees F. It will be readily understood that while the maximum results are obtained by maintaining the rolls at the middle of their length at a temperature of about 600 degrees F., these results to a lesser degree will be obtained at all temperatures between 600 and 800 degrees F.

The advantages of my invention will be apparent to those skilled in the art. By operating hot mills at a working temperature of below 800 degrees F. the mill can be kept in operation continuously, at a maximum rate of production, and by operating such hot mills at a working temperature of from 600 to 650 degrees F. a product having a better finish is obtained, and the mill can be operated continuously in actually reducing the metal, and without frequent stoppages and delays to reduce the temperature of the rolls below the temperature at which the loss of strength causes great liability of breaking the rolls.

Modifications in the construction and arrangement of the apparatus employed and the method of applying the cooling medium to the rolls may be made without departing from my invention, as hereinafter claimed.

I claim:—

1. The method of operating hot mills in rolling sheets and plates, which consists in maintaining the roll surfaces contacting with the metal during the rolling operations at a temperature indicated upon said roll surfaces by a color change from light blue during the intervals between the successive passes to bronze as the metal disengages from the rolls in the successive passes.

2. The method of operating hot rolls in rolling sheets and plates, which consists in maintaining the roll surfaces contacting with the metal during the rolling operations at a temperature indicated upon said roll surfaces by a color change from light blue during the intervals between the successive passes to bronze as the metal disengages from the rolls in the successive passes and indicated on the surfaces at the ends of the rolls by a sustained uniform light yellow or straw color.

3. The method of operating hot mills in rolling sheets and plates which consists in maintaining the roll surfaces contacting with the metal during sustained rolling operations at a temperature indicated upon said roll surfaces between successive rolling operations by a color change from bronze to light blue.

4. The method of operating hot mills in rolling sheets and plates which consists in maintaining the roll surfaces contacting with the metal during sustained rolling operations at a temperature indicated by a color change from bronze to light blue upon said roll surfaces between successive rolling operations and upon the surfaces at the ends of the rolls by a uniform light yellow or straw color.

In testimony whereof, I have hereunto set my hand.

STEWART A. DAVIS.

Witnesses:
C. W. BENNETT,
W. A. IRWIN.

Corrections in Letters Patent No. 1,035,949.

It is hereby certified that in Letters Patent No. 1,035,949, granted August 20, 1912, upon the application of Stewart A. Davis, of Pittsburgh, Pennsylvania, for an improvement in "Methods of Operating Hot-Mills," errors appear in the printed specification requiring correction as follows: Page 2, lines 59–60, for the word "employments" read *employment;* page 3, line 68, for the word "rolls" read *mills;* and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 22d day of October, A. D., 1912.

[SEAL.]

C. C. BILLINGS,

Acting Commissioner of Patents.