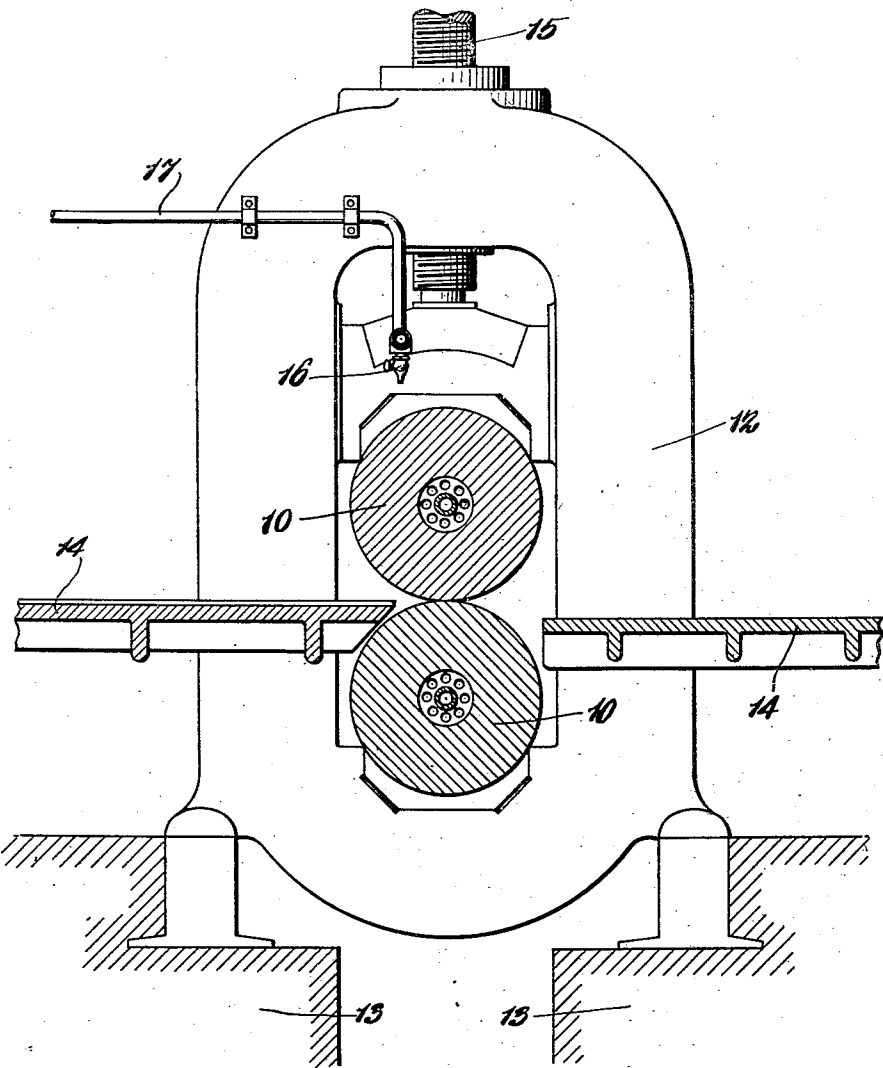


Nov. 28, 1933.

L. R. CLAPP ET AL

1,936,583

METHOD OF COLD ROLLING METALS
Original Filed April 4, 1929



INVENTORS
Lawrence R. Clapp
George W. James
BY *Albert M. Austin*
ATTORNEY

UNITED STATES PATENT OFFICE

1,936,583

METHOD OF COLD ROLLING METALS

Lawrence R. Clapp, Woodbury, and George
Walter James, Oxford, Conn., assignors, by
mesne assignments, to Rolling Process, Inc.,
New York, N. Y., a corporation of Delaware

Application April 4, 1929, Serial No. 352,599
Renewed September 23, 1932

6 Claims. (Cl. 29—18)

This invention relates to the process of cold rolling sheet metals to effect a reduction in thickness therein, and more particularly, to a process in which wide sheets of ductile metal, such as copper, are passed between rolls to which pressure is applied for depressing and deforming the sheet.

In rolling ductile metals a considerable amount of energy is expended in producing the desired deformation which is converted into heat at the rolling surfaces. This heat is absorbed by the rolls and must be removed by suitable cooling means to prevent the rolls from becoming excessively hot. Furthermore, the heat may cause an uneven expansion of the rolls which would tend to deform the line of contact between the rolls and sheet metal.

It has also been found that the heavy pressure which is required in rolling metals tends to deform the rolls in such manner that a crowned sheet is produced. This is compensated for by forming the rolls with an initial crown of such dimensions that the longitudinal line of contact with the sheet material will form a substantially straight line when the rolling pressure is applied.

The pressure exerted by the rolls on the material may be divided into horizontal and vertical components. The vertical component represents pure compression which tends to squeeze the sheet and reduce the cross sectional area thereof, while the horizontal component produces tension at the point of rolling which tends to stretch and pull the metal away from the point of rolling and thereby assists in the reduction. If the horizontal component is sufficiently large the sheet will become torn, particularly when thin materials are being treated.

In accordance with the present invention the horizontal component of the force applied by the rolls is controlled with respect to the vertical component in such manner that tearing of the sheet is eliminated while a substantial reduction in area is obtained. The invention also provides for cooling the rolls to prevent an uneven expansion thereof and to control the condition of the finished product.

The invention further consists in the new and novel features of operation and the new and original arrangements and combinations of steps in the process hereinafter described and more particularly set forth in the claims.

Although the novel features which are believed to be characteristic of this invention will be particularly pointed out in the claims appended hereto, the invention itself, as to its objects and advantages, the mode of its operation and the manner of its organization may be better understood

by referring to the following description in which a particular commercial embodiment thereof is disclosed. It will be understood however, that the processes and the steps thereof may be modified in various respects without departing from the broad spirit and scope of the invention.

The drawing forming a part of the present application is a side elevation, partly in section, of a rolling mill constructed in accordance with the present invention.

In the following description and in the claims the various steps in the process and the details comprising the invention will be identified by specific names for convenience but they are intended to be as generic in their application as the art will permit.

In accordance with the present invention the ratio of the horizontal to the vertical component of the force applied to the sheet is controlled by causing a predetermined slip between the roll and the surface of the sheet. As the slippage increases the horizontal component is decreased and vice versa. A single medium, may be utilized for controlling both the slippage and the heat of the rolls. It is obvious, however, that a plurality of mediums may be employed if this is found desirable in certain instances.

The slippage is controlled by applying a lubricant having the desired lubricating properties to the roll. The lubricant employed may vary in accordance with the thickness of the sheet and with the desired slippage, whereby the horizontal component of the force applied may be controlled with respect to the vertical component within the desired limits.

It is obvious that with comparatively thick sheets an oil having slight lubricating properties may be employed whereas, in treating extremely thin sheets, the lubricating properties must be correspondingly increased since the latter are more easily torn unless the horizontal component of the force is properly reduced.

In accordance with the present invention the oil which is utilized for lubricating purposes is also employed for cooling the roll. It has been found that a greater cooling effect is obtained and the speed of rolling accordingly increased if an oil capable of evaporating at the temperature of the roll is employed. The heat of evaporation materially assists in cooling the roll and provides for a comparatively rapid transfer of heat therefrom. Oils of this type will be referred to hereinafter as evaporative oils.

It is desirable to utilize an oil which completely evaporates without leaving a residue on the surface of the roll, which would tend to corrode or

tarnish the sheet. Obviously a large number of oils are suitable for these purposes. The lighter hydrocarbon distillate oils, such as kerosene and benzine, the alcohols, creosote and pine oil have been found to be particularly suitable for this purpose. These oils possess lubricating properties of varying degrees, are readily evaporated and leave no residue on the roll. The particular oil selected will, of course, depend upon the combination of properties which is required in a specific instance. In case increased cooling properties are desired additional cooling means may be employed, such as compressed air, which may be applied externally of the roll, or a fluid medium may be circulated internally thereof. The cooling may also be regulated by controlling the heat of the oil as it is applied to the rolls.

In a specific instance of rolling sheet copper it was found that kerosene was particularly suitable for the intermediate passes involving a reduction in thickness from $\frac{1}{8}$ " to .05". For later passes, however, as the sheets became thinner, for example, from .05 to .018", where an oil having greater lubricating properties was required, pine oil or creosote was found to be satisfactory. These particular oils are mentioned by way of illustration only.

In applying the oil to the rolls the quantity is regulated so that a continuous film covers the sheet as it leaves the rolls, and is evaporated by the heat of the rolled sheet. This evaporation assists in cooling the sheet and leaves the surface dry and in condition for the next pass. The film should be sufficiently thin to evaporate immediately so that piling and storing of the sheets is not interfered with.

In accordance with the present invention the speed of rolling may be materially increased since the evaporative oil serves to rapidly extract heat from the roll. In certain cases the speed has been increased by 10 to 15% for this reason. By utilizing a single medium for controlling both the slippage and the heat of the roll the expense of carrying on the process is reduced to a minimum. Furthermore, the control of the slip prevents tearing of the thin sheets and reduces the loss due to damaged sheets, and at the same time increases the production of the mill.

The invention is particularly applicable to the rolling of wide sheets of copper, for example, in excess of 22" in width and provides for a reduction in area in the initial passes of as great as 40% and in the final passes as great as 15%. Heretofore, it has been impossible to obtain this percentage reduction in rolling copper sheets in excess of 22" in width due to the excessive pressures which were required. By controlling the slippage and heat of the roll as above described, however, these forces are reduced to a minimum and the above reductions are made possible.

It has been found that the presence of the oil causes the sheet to have a lustre which renders the product suitable for exposed work. The lustre is believed to be due to the polishing action of the rolls as they slip with respect to the surface of the sheet.

A suitable type of rolling mill which may be used in carrying on the present process is shown in the accompanying drawing as comprising a pair of rolls 10 which are journaled in any suitable bearings (not shown) for rotation with respect to frame 12. Said frame is supported from a base 13 in any well known manner, and carries rolls 10 and tables 14 by which material is applied to said rolls.

The pressure of the rolls can be regulated by threaded member 15 which is adapted to vary the position of the bearings. A lubricant, or cooling medium, above described, may be applied to the top roll by a drip cock 16 which is supplied from a feed pipe 17. A plurality of such drip cocks are mounted along the roll so that lubricant can be applied to the various parts thereof. It is to be understood that the lubricant which is applied to the top roll is carried thereby to the sheet which is being rolled and also to the lower roll. This particular form of apparatus, however, forms no part of the present invention and has been shown by way of example only.

Although certain novel features of the invention have been described and are pointed out in the annexed claims, it will be understood that various omissions, substitutions and changes in the several steps of the process and in its operation may be made by those skilled in the art without departing from the spirit of the invention.

We claim:

1. In the cold rolling of copper, the process which comprises passing said metals between rolls and applying kerosene to said rolls during the rolling operation.

2. The process of cold rolling a sheet of copper in excess of 22" in width to effect a reduction in thickness in excess of 40% which comprises passing said sheet between rolls and applying kerosene to said rolls, said kerosene serving to lubricate the rolling surface and increase the slippage therebetween and to extract heat from said rolls for cooling purposes.

3. In the cold rolling of ductile metals, the process which comprises passing said metals between rolls and applying thereto a lubricant capable of evaporating at the temperature of the rolls without leaving a deposit and absorbing a substantial amount of heat from said rolls due to its latent heat of evaporation and utilizing said latent heat as the main source for controlling the temperature of the rolls whereby said lubricant serves to lubricate and cool said rolls.

4. In the cold rolling of ductile metals, the process which comprises passing said metals between rolls and applying thereto an oil capable of evaporating at the temperature of the rolls without leaving a deposit and absorbing a substantial amount of heat from said rolls due to its latent heat of evaporation, and utilizing said latent heat as the main source for controlling the temperature of the rolls whereby said oil serves to lubricate and cool said rolls.

5. In the cold rolling of copper, the process which comprises passing said copper between rolls and applying thereto a small quantity of an oil capable of evaporating at the temperature of the rolls without leaving a deposit and absorbing a substantial amount of heat from said rolls due to its latent heat of evaporation and utilizing said latent heat as the main source for controlling the temperature of the rolls whereby said oil serves to lubricate and cool said rolls.

6. In the cold rolling of copper, the process which comprises passing the copper between rolls to effect a cold reduction and applying thereto a quantity of kerosene such that a substantial portion thereof is evaporated due to the heat of the rolls and utilizing the latent heat of evaporation of said kerosene as the main source for controlling the temperature of the rolls.

LAWRENCE R. CLAPP.

GEORGE WALTER JAMES.