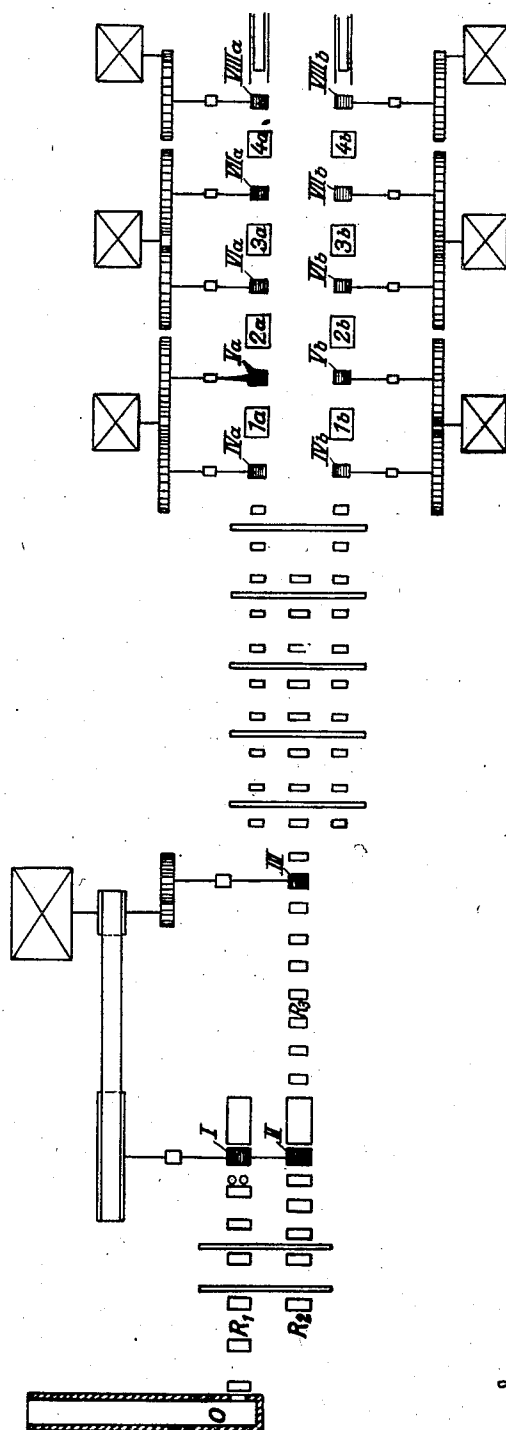


May 1, 1934.

L. E. BROEMEL
PROCESS OF ROLLING METALLIC STRIPS AND SHEETS
OF THIN SECTIONS OF ANY DESIRED LENGTH
Filed Nov. 5, 1930 4 She

1,957,009

4 Sheets-Sheet 1



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4 Sheets-Sheet 2

Fig. 2

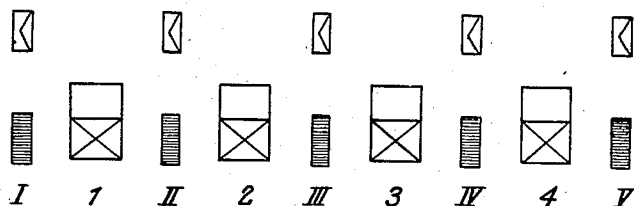


Fig. 3

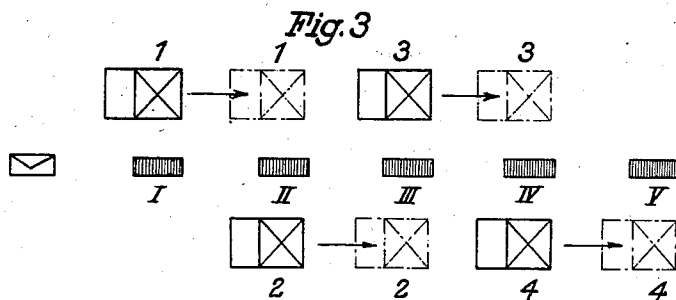


Fig. 5

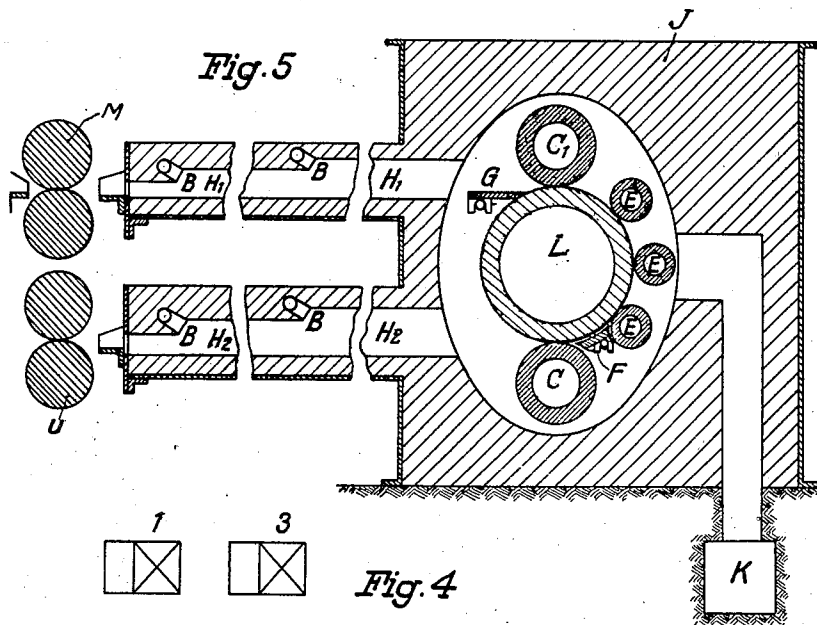
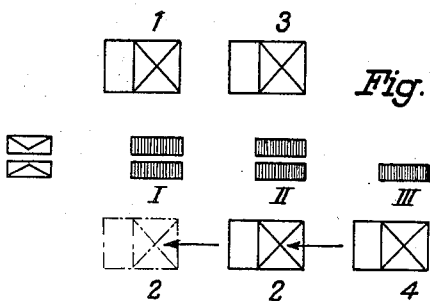


Fig. 4



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Fig. 6A

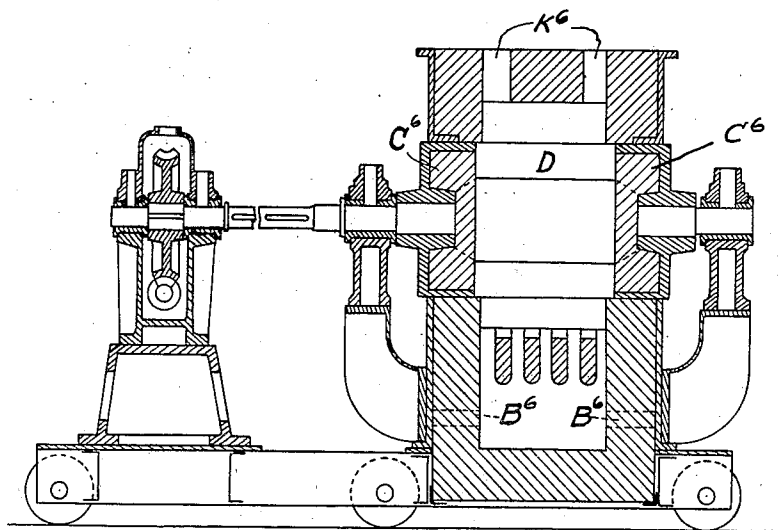
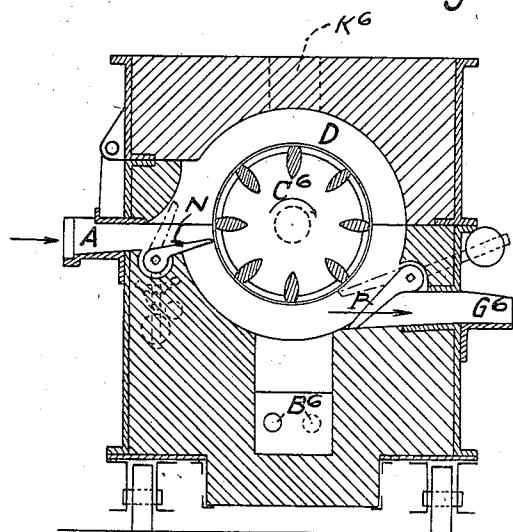


Fig. 6



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4 Sheets-Sheet 4

Fig. 8.

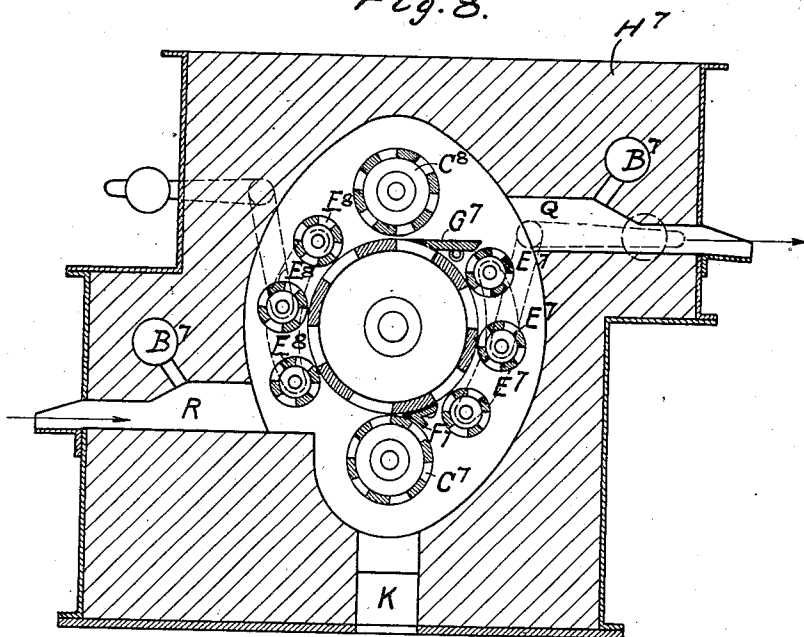
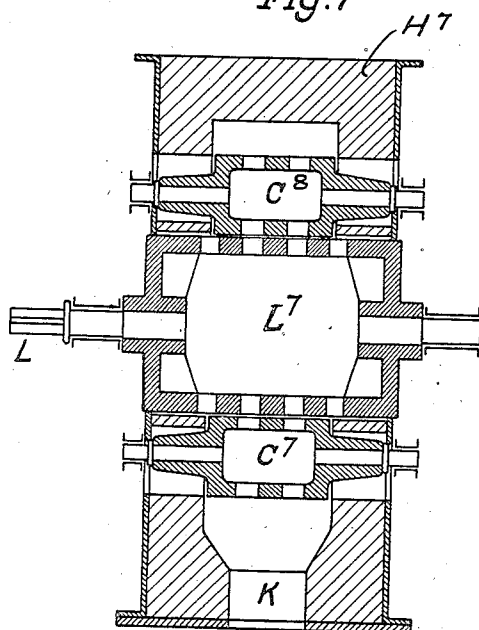


Fig. 7



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UNITED STATES PATENT OFFICE

1,957,009

PROCESS OF ROLLING METALLIC STRIPS
AND SHEETS OF THIN SECTIONS OF ANY
DESIRED LENGTH

Louis Emil Broemel, Volklingen, Saar, Germany

Application November 5, 1930, Serial No. 493,612
In Germany November 27, 1929

4 Claims. (Cl. 80—32)

The production of strips or bands of iron, steel and other metal alloys by warm process is today possible only to a minimum thickness of approximately one hundredth part of the width of the strips to be rolled and only up to a width of 500 mm. To roll wider strips on the so-called warm strip-rolling-mill is connected with considerable difficulties and, as a matter of fact, the least thickness obtainable depends on the hardness of the metal and its cooling properties.

In these producible thicknesses, the metal strip does not offer a product freely salable to the iron and steel industry. In consequence, the expensive cold rolling processes used today consist therein that the warm rolled strips are, after preceding descaling, pickling, neutralizing and drying, on separate rolling mills cold-rolled down to the desired thickness. In this process, highest permissible reduction in thickness and speed of the rolling mill are very slight and the rolling mill pressure is very high, so that rolling mills of that type become extremely heavy compared to the cross section to be rolled and the output obtained.

In addition, the consumption of power per ton is very high for the reason that the same material when cold has on the average 8 times the solidity than when warm. The process requires repeated rolling and intermediate annealing in highly expensive annealing furnaces and under certain circumstances, after each annealing, repeated pickling. For instance, alloyed hard steel qualities of 5 to 6 mm. initial thickness require up to 100 rolling operations with a great number of intermediate annealing operations. This method of operation exerts in addition a detrimental influence on the quality of the material.

Fine sheets and similar products are on the heretofore used rolling mills in general rolled to a thickness of 0.25 mm., but only in very short lengths and, according to the thickness, up to maximum length of 5 to 8 m. The customary methods are cumbersome and expensive and require a great deal of hand work. Coal and current consumption per ton produced and the cost of the rolling are very high by reason of the extensive manual labor. The yield in useful goods is very slight. The production of this article is made from plates of slight weight which by pre-rolling and subsequent repeated heating and doubling are brought to the desired thickness. The surface of the double sheets is not always clean and requires after-treatment. By reason of their slight thickness, the sheets become very cold during rolling and must be brought to red

heat. Since the production is effected only in very small plates, the descaling of the sheets is cumbersome and expensive. These disadvantages are removed by the process described below in which the cold rolling is omitted in all widths and in all metals and metal alloys.

The invention is illustrated in the accompanying drawings wherein:

Figures 1, 2, 3 and 4 are diagrammatic plan views of the invention;

Figure 5 shows a vertical section of a furnace suitable for carrying out the process;

Figure 6 is a vertical transverse section of a modified form of furnace;

Figure 6a is a vertical longitudinal section taken along the axis of the revolving drum in Fig. 6;

Figure 7 a view similar to Fig. 6a of a modification, being a vertical, axial section of Fig. 8; and

Figure 8 is a vertical, transverse section of Fig. 7.

The rolling of these strips is made, according to the present invention:

First: In continuous arrangement of the rolling mills and furnaces, shown in Fig. 1 and Fig. 2.

The blooms or flat pieces heated in furnace O travel over the rollers R1 to mill I and from there, by means of tractor over roller train R2 to mill II and over roller train R3 to mill III. In these three mills, the blooms are rolled down to strips of a thickness allowing, after further passage through mills IVa or IVb, of winding the strip during the rolling in the furnaces 1a and 1b arranged directly behind mills IVa and IVb and kept at rolling temperature. When the direction of rotation in the furnaces 1a and 1b is reversed, the strip is delivered to the next mill, again wound during the rolling operation in furnaces 2a and 2b and delivered to the adjacent housings until the desired thickness is obtained. The reversal of the direction of rotation causes the strip to turn so that the lower of the preceding rolling operation becomes the upper side during the subsequent course. A strip runs alternately on mill IVa and b to VIIa and b of the train so that a high production is obtained. In this arrangement of the mills, the furnaces are stationary and connected to a common chimney or flue.

Fig. 1 represents a rolling mill of the preferred form of construction and shows the operation of the continuous arrangement of the present process with a standard rolling mill.

In Fig. 2, the mills I to V are placed in alternating positions with the furnaces 1 to 4.

Second: The process can also be carried out in open arrangement of twin, triple or double-twin mills (Figs. 3 and 4). In this arrangement the furnaces are portable and the course of operation is as follows:

The strip coming from mill III of the plant illustrated in Fig. 1 is introduced in mill I of Fig. 3 and is during passage unrolled in furnace 1 which has rolling temperature. After the passage through mill I, furnace 1 is moved to the rear of mill II and by the reversal of the direction of rotation the strip therein is through mill II unrolled in furnace 2 which is positioned in front of mill II and by removal of the furnace to the front of mill III, it is introduced in mill III and so forth. In the meantime, furnace 1 has again been moved back to the rear of mill I and is ready to receive a new strip and the course of operations is repeated. This method assures of continuous operation.

In carrying out the process in a double-twin train according to Figure 4, the two furnaces 1 and 3 arranged in the rear of the train are stationary and only the two front furnaces 2 and 4 are portable. The strip coming from mill IIIa (Fig. 1) is introduced in housing I (Fig. 4), is unrolled during its passage through heated furnace 1 and after unrolling through the reversal of the direction of rotation rerolled through the same frame, being unrolled during the drawing operation in furnace 2 placed in front of mill I, brought in front of mill II and introduced in the latter, whereupon the operation is repeated.

Third: Provision is also made that in the latter case in double-twin train the strip is not unrolled in the stationary furnaces 1 and 3 but only transferred. This transfer can be effected to superimposed pair of rolls as well as the pair of rolls positioned sideways to the former. In this case the furnaces are constructed in accordance with Fig. 5 and are provided with forehearth, the length of which depends on the length of the material to be rolled. The strip coming from mill *u* passes through the forehearth H2 heated by burners B and is received by the return device, turned and returned through the other forehearth H1 either to the same or an adjacent pair of rolls, in the rear of which it is unrolled by a furnace in accordance with the method of operation of Fig. 4 and then delivered to the next housing.

Possible forms of construction of the furnaces necessary to carry out the process is illustrated in Figs. 5, 6, 6a, 7 and 8. The furnace according to Fig. 5 comprises the two forehearths H1 and H2 in which the burners B are installed and the return device arranged within furnace J. The return device comprises the driven, revolving drum L, the two pressure rolls C and C1, which likewise revolve, guide F and stripper G. The strip entering between the lower pair of rolls *u* passes over the hearth H2 in the return device, is gripped by drum L and pressure roll C, bent over guide F, then bent 180° that is turned upside-down by means of guide rolls E and the upper pressure roll C1 and carried by the stripper G into hearth H1 over which the strip is conveyed into the upper or an adjacent pair of rolls M with opposed direction of rotation to rolls *u*.

The furnace of Figs. 6 and 6a comprises a revolving open drum, consisting of the two heads C6, C6 and tie members D by means of which the heads are rigidly connected. The furnace has an opening on both its front and rear; the opening A being used as inlet and outlet. Opening G6 is

only to be used as outlet. Within the furnace are provided guides N and P by means of which the respective openings may be closed as required. Heating is effected by means of burners B6. The furnace may be made stationary or portable according to requirements and is provided with the usual heat flues K6.

The strip coming from the roll enters the furnace through aperture A and travels through two adjacent tie members D of the drum into the furnace, the drum being given rotation. In this stage of operation, guide N is in horizontal position and guide P closes the aperture G6. After completion of the winding of the strip, the direction of rotation is reversed and the strip passes out of the strip mill, either through aperture A or G6, as desired, the position of the guides being correspondingly changed. When the exit is made through aperture A, guide N remains in horizontal position and guide P closes aperture G6. When passing out through opening G6, guides N and P are brought into the position indicated by the dotted lines.

The furnace H7 of Figs. 7 and 8 comprises two forehearths R and Q similar to H1 and H2 of any desired length made to fit the respective requirements, and the unrolling device proper. In the two forehearths burners B7 are positioned. The heat flues pass through the unrolling device to flue K which latter may be arranged below as well as above the winding device. The latter consists of the perforated drum L7, the two pressure rolls C7 and C8 and a plurality of guide rolls arranged on swinging arcs both sides E7, E7 and E8, E8 which may be of varying diameters and either driven or idle running but pressed inwardly by counterweights, and also a guide F7 and stripper G7. Stripper G7 is so constructed that it allows free passage to the first two turns without support.

The strip coming from the strip mill enters the winding device in the direction of the arrow through the aperture R across furnace H7 and is gripped by the revolving drum L7 and pressure roll C7, bent over slide F7 and coiled by guide rolls E7 and E8, E8 arranged on both sides and by pressure roll C8 into a tight ring while guide rolls, pressure rolls and slide are rising in accordance with the thickness of the coiled ring. By reversal of the direction of rotation after completion of the coiling, the strip can pass either through aperture at R or Q according to the requirement of the method of operation. When it leaves through the aperture of the foreheater R, stripper G7 may be omitted.

When the strip leaves the furnace H7 through the aperture at Q, that is on the opposite side to where it entered, the strip has become turned upside down, upon the reversal of the turning motion of the drum L7. This will be understood if it is considered that the top surface of the strip entering at R will lie nearest the drum surface and consequently become the bottom surface of the strip above the drum L7. Therefore when the end of the strip which entered last through the aperture at R leaves first through the aperture at Q, after the reversal of the rotation of drum L7, the strip has actually been turned upside down.

Heating of the described types of furnaces can be effected by oil, gas, coal or electric current. The arrangement of the burners is so chosen that uniform temperature is assured. The heating gases escape in stationary constructions through a chimney and in portable furnace through hoods.

The present invention offers the following advantages:

No lowering of temperature can take place since during the rolling operation the material is only for about 3% of the duration of the operation outside the influence of the heat source.

The material remains soft and plastic up to the end so that any desired thickness can be obtained.

Carrying out the rolling operation is no longer limited to a certain length dependent on thickness and temperature. As a result, the rolling costs for the same dimensions of thickness amount to only a fraction of those of former processes.

A superior quality of product is obtained. By coiling the strip into a tight ring simultaneously with the rolling operation, heat interchange takes place so that the colder portions of the strip become warmer and the warmer portions become colder and that at the end of the rolling operation, no matter how long the strip, a thoroughly uniformly warm material leaves the roll with an accurately adjustable temperature.

The finished product is a qualitatively uniform and soft material and need not be annealed. The surface of the strip is smooth and of clean appearance, the strip being turned after each passage so that the descaling is facilitated and made less expensive.

The production of thin strips of any desired length of very hard steel is, compared to the usual processes, extremely simple and inexpensive and the finished product is qualitatively perfect. What now is obtained in a few passes

was heretofore possible only by the use of a great many passes, up to one hundred.

I claim:

1. A process for rolling metal articles in the form of sheets or strips in a hot state on continuously arranged mills with furnaces interposed therebetween, the article entering on one side and leaving on the opposite side of each mill, consisting in coiling the article substantially in a vertical plane while in motion in one direction in a furnace, then reversing the direction of motion of said article while traveling substantially in the same vertical plane and thereupon introducing the article into the next mill for repeated rolling.

2. A process in accordance with claim 1 in which the duration of the time when the article is outside of the furnace amounts to about 3% of the entire rolling period.

3. A process for rolling metal articles in the form of sheets or strips in a hot state on mills and furnaces adjacently arranged, consisting in coiling the article substantially in a vertical plane while in motion in one direction in said furnaces, then reversing the direction of motion of the article in the same vertical plane in the furnace and then introducing the article moving in the opposite direction into the next mill for repeated rolling.

4. A process in accordance with claim 3 in which the duration of the time when the article is outside of the furnace amounts to about 3% of the entire rolling period.

LOUIS EMIL BROEMEL.