No. 683,944. Patented Oct. 8, 1901.

J. W. KEFFER & C. B. CUSHWA.

METHOD OF ROLLING SHEET METAL.

(Application filed Apr. 25, 1901.)

(No Model.)

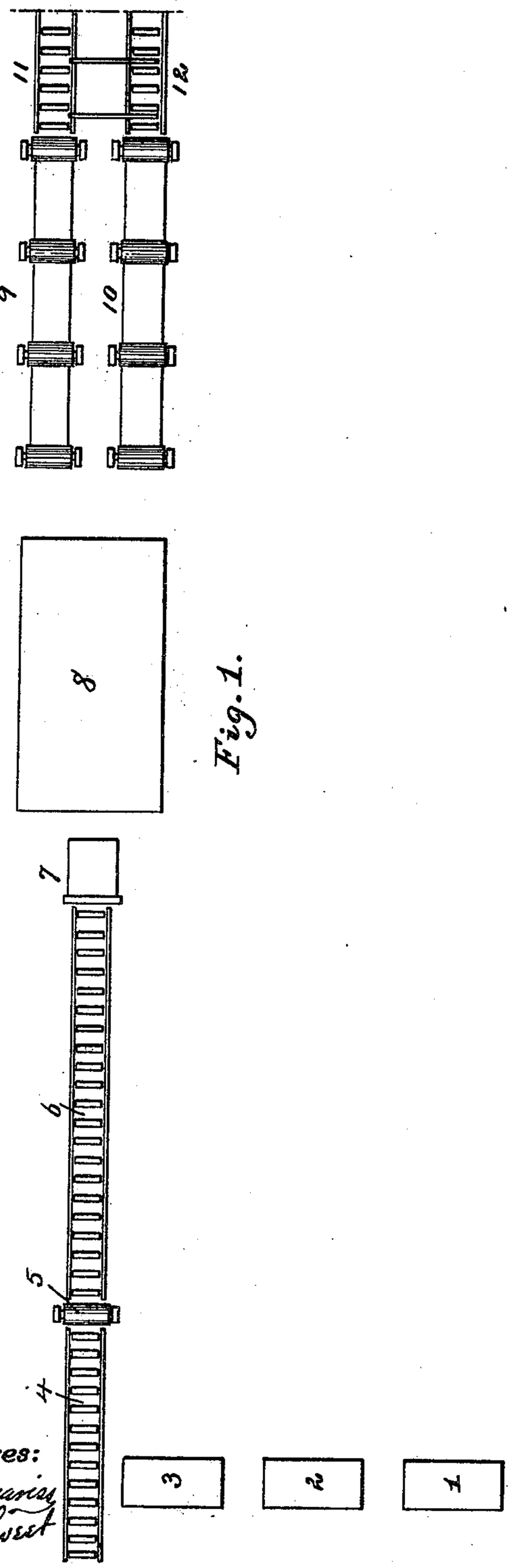

Fig. 1.

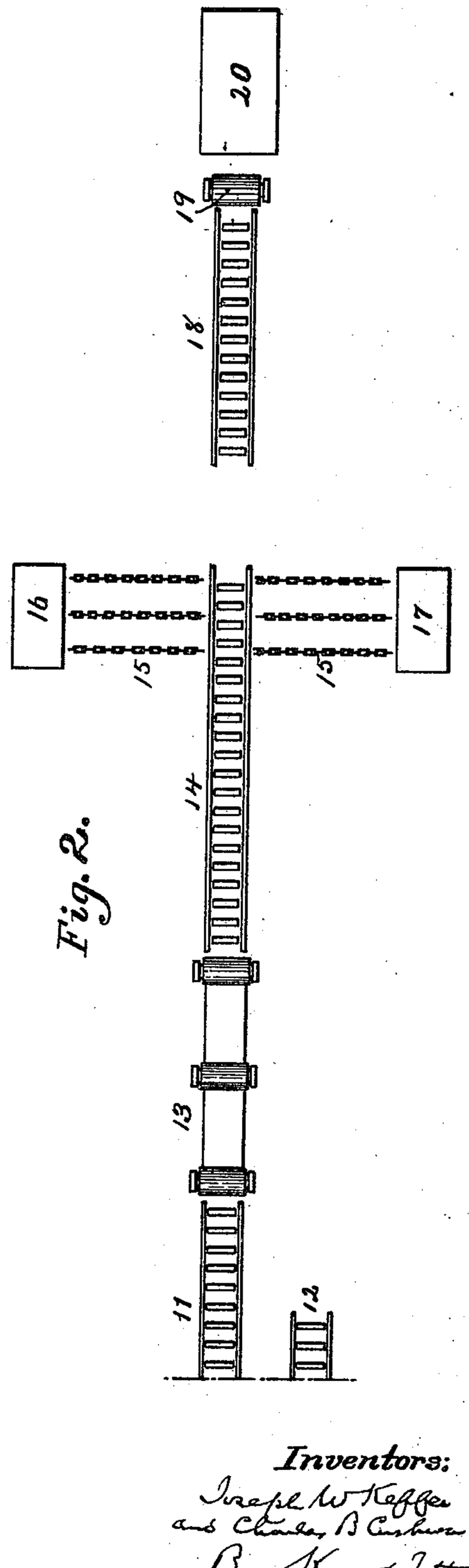

Fig. 2.

Witnesses:
Walter Famariss
Fred D. Sweet

Inventors:
Joseph W. Keffer
and Charles B. Cushwa
By Kay & Potter
Attorneys.

UNITED STATES PATENT OFFICE.

JOSEPH W. KEFFER AND CHARLES B. CUSHWA, OF PITTSBURG, PENNSYLVANIA.

METHOD OF ROLLING SHEET METAL.

SPECIFICATION forming part of Letters Patent No. 683,944, dated October 8, 1901.

Application filed April 25, 1901. Serial No. 57,403. (No model.)

To all whom it may concern:

Be it known that we, JOSEPH W. KEFFER and CHARLES B. CUSHWA, residents of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful improvement in Methods of Rolling Sheet Metal; and we do hereby declare the following to be a full, clear, and exact description thereof.

Our invention relates to a method of rolling sheet metal; and its object is to provide a method of rolling sheet metal which will do away with a large number of the reheatings employed in the ordinary process and also with the many manipulations and handlings thereof, so that the cost of production will be greatly reduced.

In the common process of rolling sheet metal it is the practice to reduce the ingot or billet to bars about five-eighths to three-fourths of an inch in thickness and five to eight inches wide, which are then cut into sections known as "sheet-bars" of a length approximately equal to the width of the sheets to be formed. These sheet-bars are then heated and fed sidewise between suitable breaking-down rolls, it being the common practice for one workman to feed them into the rolls and another workman to receive them therefrom and return them over the rolls, and to save time it is the common practice to work two such bars at the same time. In these rolls the bars are reduced to about one-fourth to one-eighth of an inch in thickness, and the two sheets thus formed are then placed one upon the other and rolled down to about eighteen or twenty gage. These sheets are then separated and a pile consisting of two or more sheets placed one upon the other is formed and heated to a good rolling temperature and then reduced by rolling in suitable rolls. For the coarser gages of sheet-iron this is generally sufficient to bring the sheets down to the desired gage, so that the packs can at once be sheared, opened, cold-rolled, and annealed; but for the finer gages the pack is usually doubled over on itself, making a pile of six or eight sheets, again heated, and rolled until reduced to the desired gage, after which the packs are sheared, opened up, cold-rolled, and annealed. All the operations in this described method—such as roughing down the plates, piling the sheets and folding the packs, and charging the material at different stages into the furnace or furnaces—are performed by hand and the method therefore involves a great expenditure of time and labor.

It is the object of our invention to simplify this process and to reduce the number of handlings, reheatings, and manipulations necessary, and consequently reduce the cost of labor incident to the reduction of the metal to its finished or desired gage. To this end our invention comprises, generally stated, a method of rolling sheet metal, which consists in reducing an ingot, billet, or slab at a single heat into a plate of a width approximately equal to the width desired in the finished sheet and from one-eighth to one-fourth of an inch thick, then shearing such plate into sections of suitable length, placing two or more of such plates on each other and charging them into a reheating-furnace, where they are raised to a good rolling temperature, and then entering two or more such piles of packs simultaneously into parallel-arranged continuous mills, whereby they are further reduced, and still at the same heat piling the reduced packs one on the other and then further rolling said double packs, thereby reducing the sheets to the finished gage, after which the packs are sheared, opened up, cold-rolled, and annealed in the ordinary way.

In the accompanying drawings, Figure 1 is a diagrammatic plan view of the first part of apparatus suitable for carrying out our method, and Fig. 2 is a similar view of the continuation of such apparatus.

1, 2, and 3 represent suitable heating-furnaces wherein the ingots, billets, or slabs are heated to a suitable rolling temperature. From these furnaces the heated ingot, billet, or slab is transferred to the feed-table 4 of the rolling-mill 5, the latter being either a two-high reversing-mill or a three-high mill, the latter preferred, said mill being provided on its rear side with the feed-table 6. The heated ingot, billet, or slab is passed back and forth through the mill 5 in the well-understood manner until it is reduced to a plate of approximately the width of the sheets to be

formed and from about one-eighth to one-fourth of an inch thick, depending upon the gage of sheet-plate to be produced, the rolling of this gage from the ingot, billet, or slab being accomplished at a single heat. From the mill 5 the plate is conveyed along the table 6 to the shear 7, where it is sheared into sections of suitable length for convenient piling and rolling. These sections of plate are then formed into piles consisting of two, three, or more, depending upon the gage of sheet-plate to be produced, and are fed into the continuous reheating-furnace 8, said furnace being of a well-known construction wherein the plates are fed in at one end, carried therethrough, and removed from the other end. The piles or packs are heated in the furnace 8 to a suitable rolling temperature, and then two or more such piles or packs are entered simultaneously into two or more parallel continuous or tandem mills. In the drawings we show two such mills 9 and 10, each of said mills comprising four stands of rolls, with suitable guides between the same; but either more or less than four stands may be used, if necessary or desired. From these mills 9 and 10 the reduced packs pass substantially simultaneously upon the feed-tables 11 and 12, and the pack or pile on the table 12 is transferred in any suitable manner over to the table 11 and placed on top of the pack on said table. When the packs or piles leave the mills 9 and 10, they have been reduced to as thin a gage as is possible owing to the spring of the rolls and the slack in the adjusting means of the last stand of rolls in said mill, and a further rolling of these packs singly would not result in any material further reduction of the same, due to the slack and spring of the rolls and their adjusting means. Consequently the reduced packs or piles are assembled one on top of the other, as stated, and being still at good rolling temperature are passed through the continuous or tandem mill 13, the same comprising two or more stands of rolls, as necessary, (three being shown,) with suitable guides therebetween, and in this mill the double packs are further reduced successively in the different stands, and the spring in the rolls and the slack in the adjusting means of the last stand will not be so great as to prevent the double packs being brought to the desired gage. The packs are then conveyed by live rollers 14 and endless chains 15 or any other convenient conveyer means to the shears 16 and 17, where they are sheared to the desired size, after which they are opened up in any preferred way and the sheets conveyed by the live-rollers 18 to the cold-rolls 19, through which the sheets are separately passed to smooth down the surface and finish the same. The sheets as they leave these rolls are again piled, preferably, on the bottom plate of an annealing-box, and when sufficient sheets have been piled thereon they are conveyed by a crane or similar device and placed in the annealing-furnace 20 and subjected to the ordinary annealing process.

According to our method of rolling sheet metal the metal is heated but twice, first in the shape of an ingot, billet, or slab in the furnaces 1, 2, and 3 and then in the reheating-furnace 8, the operations after such reheating being performed in such a manner and so expeditiously as to finally reduce the sheets to their finished gage at the single heat. In the old methods of rolling sheet metal at least three and sometimes four and even more heats are necessary from the ingot or billet down to the finished sheet, this being due largely to the manner of handling or manipulating the metal during the rolling operation. Furthermore, the number of workmen or attendants necessary in our process is very largely reduced and the product correspondingly cheapened. The rolling of the piled sheets after leaving the reheating-furnace 8 simultaneously in two or more parallel continuous or tandem mills enables us to reduce the piles in the most expeditious manner, and it is necessary to form the initial piles only of such a number of sheets as will insure their ready reduction, and the rolling in this manner leaves two or more piles or packs of approximately the same rolling heat, which can be at once placed together and then passed through the continuous or tandem mill 13, and thereby reduced to gage. In the mill 13 the pack or pile comprises four, six, or more sheets, as the case may be, and therefore comprising a pack of sufficient thickness to be reduced to the desired gage in the last stand of said rolls. If the initial packs from the furnace 8 were formed of four, six, or eight sheets, they would not be as readily reduced in the mills 9 and 10, and, furthermore, there would be more liability of the sheets slipping one on the other when entered in the mill, due to the thickness of the packs. Consequently by forming the packs of only half this number of sheets a greater proportional reduction of each sheet is secured and the liability of the sheets slipping one on the other when entered in the rolls is greatly reduced. If such packs were rolled in a continuous mill in succession and not simultaneously, the first pack through such mill would have to be delayed until another one or more arrived in order that they could be assembled to form a pack of sufficient thickness to be further reduced in the next mill or set of rolls. This delay would allow the first pack to cool to such an extent that it would not readily reduce in the next mill; but by entering two or more packs simultaneously in parallel mills we are enabled to form each of said packs of comparatively small number of sheets, so that they will readily reduce in said mill and will leave the mills at the same and a good rolling heat, so that they can be at once assembled and passed to the next mill.

In the case of the coarser gages of sheet metal it may not be necessary to pile the

packs as they emerge from the parallel continuous mills 9 and 10, in which event the packs would be passed in succession through the mill 13, and, indeed, in that event the mill 10 could be dispensed with. It is essential, however, that the mills be continuous or tandem ones in order that the metal may be given a large number of passes in quick succession and before the temperature of the plates can fall below a rolling heat.

What we claim as our invention, and desire to secure by Letters Patent, is—

1. The method of rolling metal sheets, which consists in reducing an ingot, billet or slab by rolling without reheating to a plate of a width approximately equal to the width desired in the finished sheets and from one-eighth to one-fourth of an inch thick, shearing such plate into sections of suitable length for piling and rolling, piling two or more such plates on each other, reheating such packs, simultaneously reducing by rolling two or more such packs, piling said reduced packs one on the other as they emerge simultaneously from the reducing-rolls, and then immediately further reducing by rolling such compound pack without reheating to the finished gage.

2. The method of rolling metal sheets, which consists in reducing an ingot, billet or slab by rolling without reheating to a plate of a width approximately equal to the width desired in the finished sheets and from one-eighth to one-fourth inch thick, shearing such plate into sections of suitable length for piling and rolling, piling two or more such plates on each other, reheating such packs, simultaneously reducing by rolling two or more such packs, piling the reduced packs on each other as they emerge simultaneously from the reducing-rolls, then immediately further reducing by rolling such compound packs without reheating to the finished gage, opening up such packs and cold-rolling the sheets separately.

3. The method of rolling metal sheets, which consists in reducing an ingot, billet or slab by rolling without reheating to a plate of a width approximately equal to the width desired in the finished sheets and from one-eighth to one-fourth of an inch thick, shearing such plate into sections of suitable length for piling and rolling, piling two or more such plates on each other, reheating the same, simultaneously entering two or more such packs into parallel reducing-rolls and reducing the same therein, piling such reduced packs as they emerge simultaneously from the reducing-rolls on each other, and then immediately further reducing by rolling such compound packs without reheating to the finished gage.

4. The method of rolling metal sheets, which consists in reducing an ingot, billet or slab by rolling without reheating to a plate of a width approximately equal to the width desired in the finished sheets and from one-eighth to one-fourth of an inch thick, shearing such plate into sections of suitable length for piling and rolling, piling two or more such plates on each other, reheating the same, simultaneously entering two or more such packs into parallel continuous or tandem mills and reducing the same therein, piling such reduced packs as they emerge simultaneously from the parallel mills one on the other, and then immediately further reducing by rolling such assembled packs without reheating to the finished gage.

5. The method of rolling metal sheets, which consists in reducing an ingot, billet or slab by rolling without reheating to a plate of a width approximately equal to the width desired in the finished sheets and from one-eighth to one-fourth of an inch thick, shearing such plate into sections of suitable length for piling and rolling, piling two or more such plates on each other, reheating the same, simultaneously entering two or more such packs into parallel continuous or tandem mills and reducing the same therein, piling such reduced packs as they emerge simultaneously from the parallel mills one on the other, and then immediately entering such assembled packs without reheating into a continuous or tandem mill and further reducing the same therein to the finished gage.

In testimony whereof we, the said JOSEPH W. KEFFER and CHARLES B. CUSHWA, have hereunto set our hands.

JOSEPH W. KEFFER.
CHARLES B. CUSHWA.

Witnesses:
F. W. WINTER,
ROBERT C. TOTTEN.