H. BESSEMER.

MANUFACTURE OF IRON AND STEEL.

No. 49,053. Patented July 25, 1865.

Fig 1.

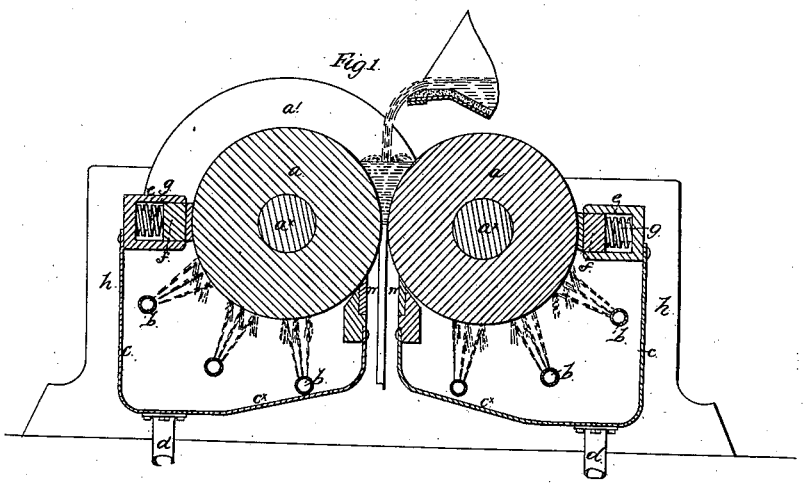


Fig 2.

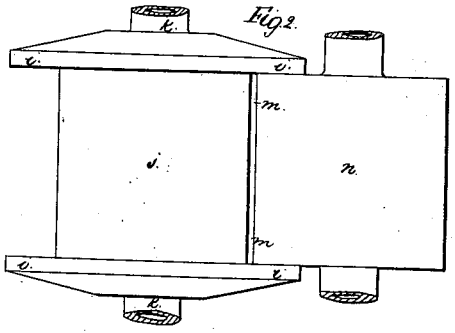


Fig 3.

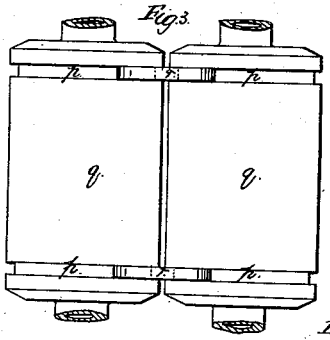


Fig 5.

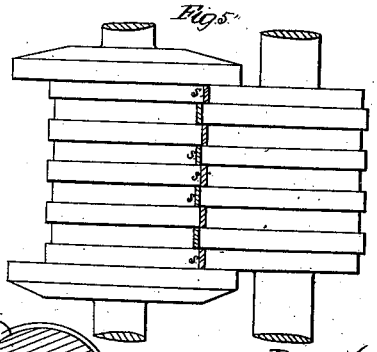
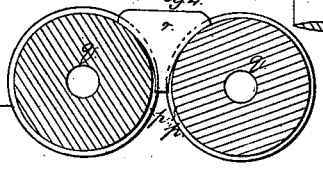


Fig 4.



Witnesses:

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UNITED STATES PATENT OFFICE.

HENRY BESSEMER, OF LONDON, ENGLAND.

IMPROVEMENT IN THE MANUFACTURE OF IRON AND STEEL.

Specification forming part of Letters Patent No. **49,053**, dated July 25, 1865.

To all whom it may concern:

Be it known that I, HENRY BESSEMER, of Queen Street Place, New Cannon Street, in the city of London, in the kingdon of Great Britain, have invented a certain new and useful Improvement in the Manufacture of Iron and Steel; and I do hereby declare the following to be a full and exact description of the same, reference being had to the accompanying drawings.

My invention consists in manufacturing sheets, plates, bars, and other forms direct from fluid malleable iron or steel in place of allowing the same first to cool and set in molds. For this purpose it is preferred to fix a pair of rolls, with their axes in a horizontal position, in a suitable frame, the rolls being placed side by side on the same level. One of the rolls may, however, if desired, be placed at a higher level than the other, so that the lower one may receive the molten metal upon its upper surface. It is preferred that the diameter of the rolls should be large, and that they should have flanged ends so made as to form stops, and thus to determine the breadth of the sheet or pfate or bar or other form produced thereby; or the rollers used may be provided with several grooves of the desired form. The relative position of the rolls is regulated by any convenient means, and they are kept cool by water. The rolls being suitably arranged the fluid malleable iron or steel is poured or allowed to flow from a ladle or crucible, or from a converting vessel or furnace in which such metal has been caused to pass from the crude to the refined or malleable state, into the space between the rollers, which are constantly moved slowly during the flow of the metal between them. The cool surfaces of the rolls will be found rapidly to solidify the fluid metal, and the same will be powerfully pressed and solidified by the pressure of the rolls, and will be of a sectional form, depending on the form of the space between the rolls. The forms of iron or steel thus produced may, if necessary, be passed at once through between other rolls, in order further to perfect the manufacture, or the same may be reheated, either in the forms produced or when cut up and piled.

To enable others skilled in the art to more fully understand and construct and use my invention, I have here annexed a sheet of drawings on which the same is represented, and a more complete description of the process.

Figure 1 of the annexed sheet of drawings is a vertical section, where *a a* represent the rolls and *a** openings in the center of them for the purpose of allowing a stream of water to pass through for the purpose of absorbing a portion of the heat communicated to them by the molten metal.

In addition to this method of cooling the rolls I also provide a means of lowering the temperature of them by the application of water to their external surfaces, for which purpose the pipes *v v* are made to extend from end to end of the rolls. They are each united to a supply-pipe, (not shown in the drawings,) by means of which the pipes *v* are made to communicate with an elevated tank or other source of water-supply.

On that side of the pipes *v* which is nearest to the rolls numerous perforations are made, through which jets of water will escape and be projected against the rolls as they revolve, the water afterward falling onto the inclined surfaces *c** of the inclosed boxes or chambers *c c*, whereby the water, after acting on the rolls, will be made to flow into the waste-pipes *d d* and escape.

On the upper side of the chamber *c c* grooves or channels *e e* are formed, into which blocks of wood *f* are fitted, one side of them being curved to fit against the rolls. The side so fitted is to be covered with felt or other suitable material for the purpose of removing any drops of water which may adhere to the surface of the rolls.

At the back of the blocks *f* there are springs *g* for the purpose of pressing the blocks tightly against the rolls; but in lieu of this mode of removing the water from the surface of the rolls a plate or brush may be employed, if preferred.

In order to prevent the fluid metal from soldering to or uniting itself to the rolls it will be found advantageous to allow the surface of them to become rusty. They may also be black-leaded or greased from time to time, either by hand or by allowing them to revolve against or in contact with the black lead, grease, or other material, in any convenient way; and in order to remove the plate or bar of rolled metal from the rolls, in case of any adhesion thereto, I use two steel bars or scrapers, W W,

which extend the entire length of the rolls and have their ends let into suitable slots formed in the side frames of the roller-mill, and are to be kept in contact with them by adjusting-screws or wedges acting in these slots, or by other convenient means, the object being to keep the scrapers in contact with the rolls and thereby prevent the plate or bar of rolled metal from being carried round with the rolls. When grooved rolls are used the bars W are to be notched so as to fit the grooves.

The distance apart of the rolls may be regulated by set-screws acting on the bearings in which the rolls revolve, as generally practiced in rolling-mills.

It is desirable that the rolls should be in close contact before commencing to pour the fluid metal between them, in order that it may not fall through. I therefore prefer to use a weighted lever or other suitable contrivance to cause the rolls to come in contact at all times when there is nothing between them to prevent it, but which weighted lever will be allowed to rise whenever the solidified metal accumulates between the rollers, which will thereby be forced asunder until their bearings find a firm support against the end of the set-screws, the position of which will determine the thickness of the sheet or bar formed between the rolls.

The mode of regulating the thickness of the plates or bars of metal by the use of set-screws and the use of weighted levers to force them in contact, as well as the gearing by which the rolls are driven, as above explained, will be readily understood by the manufacturers of plate and bar iron, though they are omitted in the drawings in order that other parts may be more clearly shown, and although I have shown and described the rolls as being placed in the frame *h* at the same horizontal level it will be understood that one of the rolls may, however, if desired, be placed at a higher level than the other, so that the lower one may receive the molten metal upon its upper surface. It is preferred that the diameter of the rolls should be large, and that they should have flanged ends, so made as to form stops, and thus to determine the breadth of the sheet, or plate, or bar, or other form produced thereby.

As the metal is to be used in a molten state it becomes necessary to prevent it from flowing away at each end of the rolls. For this purpose I form at each end of one of the rolls a large flange, and the other roll forming the pair is made without any flanges, and of such a length as to fit in between the flanges of the roll, as before described. One of the flanges used to form a stop is shown at *a'*, Fig. 1, but may be better understood by reference to Fig. 2 of the drawings, which represents a pair of rolls in the relative position they would occupy when in use.

i i are the flanges, and *j* the body, of the roll; *k k* the axis or bearings. (Shown broken off.) *n* is the plain roll fitting in between the flanges *i i*, and *m* shows the space between them, which determines the thickness and breadth of the sheet or plate of metal formed between them, the end flanges serving to close the ends and form a sort of trough between the rolls for the reception of the fluid metal.

It will be obvious that in lieu of having both flanges on one roll one flange may be formed on opposite ends of each roll, and so, also, instead of using any flanges at all, a stop may be formed, as shown in Figs. 3 and 4, Fig. 3 being a plan, and Fig. 4 a cross-section, of a pair of rolls without flanges.

p p are grooves formed in the body of the roll *q*, and *r r* are segmental plates fitting into the grooves *p*, and thereby forming a stop and retaining the molten metal in the trough or cavity formed between the rolls; or the rollers used may be provided with several grooves of the desired form.

The relative position of the rolls is regulated by any convenient means, and they are kept cool by water, as before described.

For the purpose of making bars of iron or steel the surface of the rolls should have grooves formed around them, in addition to the flanges or stops, as represented in Fig. 5, which shows a pair of bar-rolls in plan, the spaces *s s* representing the sectional area of the bars that would be formed by them; and so in like manner round, triangular, or other sectional forms may be made by giving a corresponding form to the grooves formed upon the rollers, and which may be used either for producing plain parallel prisms, plates, or rods, for producing raised or depressed parts thereon of any required shape or configuration, by forming a counterpart of such forms or configurations on one or both of the rolls, as may be required. And here I would observe that by making raised ribs on the rolls parallel to the axis of them, the plates or other forms may be cut off or so indented as to be easily broken into such lengths or sized pieces as may be required for various purposes, such as the division of steel into small strips for the convenience of remelting in lieu of pouring the fluid steel into water and forming it into shot, as heretofore practiced by me in the manufacture of cast-steel ingots, or the division of iron in convenient pieces for conversion or other purposes. The rolls being suitably arranged the fluid malleable iron or steel is poured or allowed to flow from a ladle or crucible, or from a converting vessel or furnace in which such metal has been caused to pass from the crude to the refined or malleable state, into the space between the rollers, which are constantly moved slowly during the flow of the metal between them. The cool surfaces of the rolls will be found rapidly to solidify the fluid metal, and the same will be powerfully pressed and solidified by the pressure of the rolls, and will be of a sectional form depending on the form of the space between the rolls. The forms of iron or steel thus produced may, if necessary, be passed at once through between other rolls in order fur-

ther to perfect the manufacture, or the same may be reheated, either in the forms produced or when cut up and piled.

In carrying into practice this mode of rolling plates, bars, or other form of iron and steel I have found it preferable in all cases to set the roller-mill in motion previous to pouring the metal between the rolls, and also to allow the rolls to make one or more revolutions before bringing the water in contact with their surfaces, so that they may be sufficiently heated to dry off the moisture left on them after passing the blocks *f*.

If a wide sheet of metal is to be rolled, I prefer to use a wide-lipped pouring-vessel, or one that has several openings at intervals on the same level, so as to get the metal as uniformly distributed as may be along the length of the rolls. I also prefer to have an accumulation of metal between the rolls, so that the stream of molten metal may fall into a trough of fluid metal instead of pitching onto the rolls, the speed of which should be under the control of the workman in charge of them, so that he may apportion the speed of the rolls to the thickness of the plates or bars he is making.

The solidification of a sufficient body of metal to form a thick plate requiring more time than for a thin one will render it necessary to move the mill more slowly for thick plates and more rapidly for thin ones, a proper knowledge of which will be easily acquired in practice.

The continuous sheets or bars thus formed may be used in the state in which they are thus made, or they may be rerolled at the same heat in a mill placed near the apparatus; or the bars or plates may, if desired, be cut up and piled, or otherwise treated, according to the purpose for which they may be required.

Having described the nature of my invention, and in what manner the same may be carried into effect, I desire it to be understood that I do not confine myself to the precise details herein described, provided the peculiar character of my said invention be retained.

What I claim, and desire to secure by Letters Patent, is—

1. Rolling sheets, plates, bars, and other forms from fluid malleable iron or steel by running or pouring said fluid metal between the rolls, substantially as described.

2. The blocks *f* and springs *g*, for the purpose of removing water from the surface of the rolls.

3. The scrapers W, for the purpose of removing the plate or bar of rolled metal from the rolls in case of adhesion thereto.

4. Holding the rolls in close contact with each other previous to pouring in the molten metal, substantially as and for the purposes described.

5. Rolling fluid metal by means of rolls cooled by passing water through suitable passages formed in the said rolls, substantially as described.

HENRY BESSEMER.

Witnesses:

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DAVD. LONGSDON.