(No Model.)

J. I. WILLIAMS.

METAL ROLLING MILL.

No. 275,309. Patented Apr. 3, 1883.

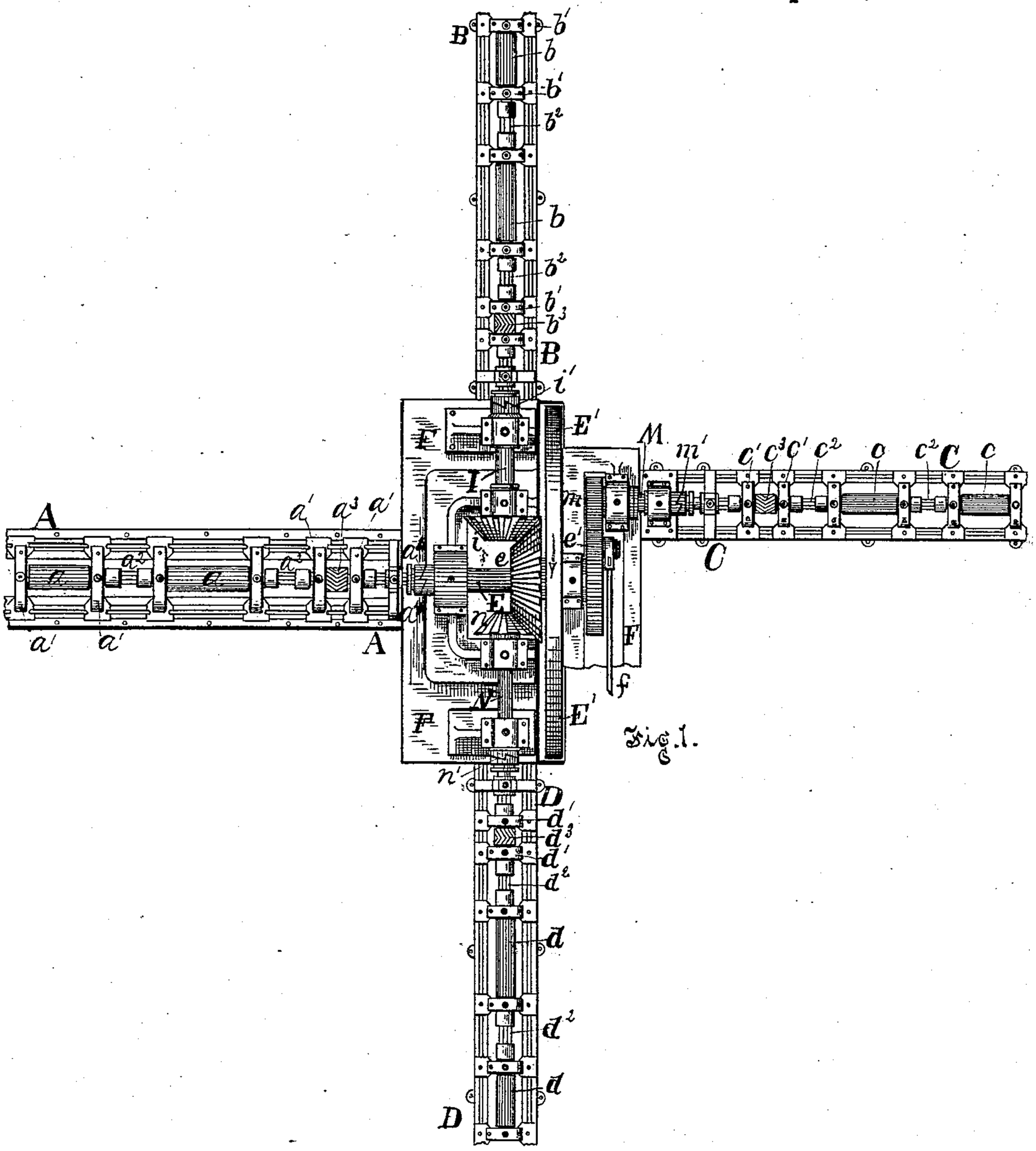

Fig. 1.

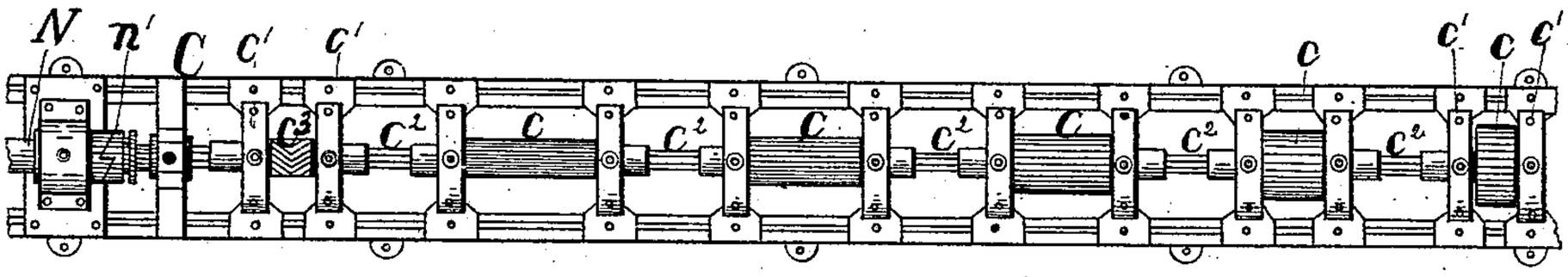

Fig. 2.

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METAL-ROLLING MILL.

SPECIFICATION forming part of Letters Patent No. 275,309, dated April 3, 1883.

Application filed November 27, 1882. (No model.)

To all whom it may concern:

Be it known that I, JOHN I. WILLIAMS, a citizen of the United States, residing at Youngstown, county of Mahoning, State of Ohio, have invented or discovered a new and useful Improvement in Metal-Rolling Mills; and I do hereby declare the following to be a full, clear, concise, and exact description thereof, reference being had to the accompanying drawings, making a part of this specification, in which—like letters indicating like parts—

Figure 1 is a top plan view of a metal-rolling mill illustrative of my invention; and Fig. 2 is a similar view, to an enlarged scale, of one train of rolls forming a part of my improved mill, and illustrative of certain modifications in the rolls.

In the manufacture of iron and steel rods, bars, &c., by rolling, it is desirable that the finished article be reduced from a comparatively large pile, billet, bloom, or ingot, in order, among other things, to secure the beneficial effects upon the metal of the increased working required, and to prevent loss by numerous crop ends. It is also very desirable that the reduction be made at a single heat, to prevent the loss in time and materials involved in reheating.

The purpose of my invention is to secure these and other advantages in metal-rolling, and this I do by means of a combined mill capable of use either in separate parts for reduction to different sizes, each part forming, if desired, a complete mill in itself, or in combination and conjointly, all the parts co-operating to form a mill capable of greater reduction than any one of its parts, and also capable of much more rapid reduction than would be secured by a similar number of parts constructed and arranged as heretofore practiced in the art.

In general terms, my invention may be described as consisting of two or more trains of rolls, arranged, by preference, at or near right angles to each other, or in radial order about the driving mechanism, and all being driven in directions for continuous feed from train to train in orderly succession, as hereinafter more fully described and claimed.

In the drawings I have illustrated my invention by four trains of metal-reducing rolls, (indicated by the letters A, B, C, and D, respectively.) These trains may be of the form and construction known as "two-high" or "three-high," as may be preferred; or both these forms may be employed, some of the trains being three-high and others two-high. Each train is made up of the usual or any suitable form of rolls, a b c d, respectively, housings a' b' c' d', couplings a^2 b^2 c^2 d^2, and gears a^3 b^3 c^3 d^3, respectively; also, the usual or any desired form of adjusting mechanism may be employed for setting the rolls in each train at the required distance apart. The roll-faces may be plain, as shown, or grooved in the usual way, for the purpose of producing the desired shape of article. The several trains are placed or arranged at angles to each other, by preference at or near right angles, and radiating toward a common center, or approximately so, where the driving mechanism is placed. This mechanism, as shown, consists of a driving-shaft, E, mounted on any suitable frame or bed, F, and carrying gears e e' and fly-wheel E'. The shaft may be driven by pitman-connection f, leading to any suitable horizontal or vertical engine mounted on the bed F or other support; or the shaft may be driven by belts or other suitable connection with a driving-power. Train A may be coupled direct to the end of the driving-shaft, as at a^4, with which it is in line, or it may be geared to such shaft, if preferred. Train B, which is at right angles to train A, is driven from bevel-gear e by pinion i and shaft I, to which the train is coupled, as at i'. Train C is driven from gear e' by pinion m and shaft M, with which the train is coupled, as at m', and train D is driven from bevel-gear e by pinion n and shaft N, with which the train is coupled, as at n'. These couplings a^4 i' m' n', in three-high mills, are by preference with the middle roll, but in two-high mills may be with either the upper or lower roll, and in either case the direction of rotation is such as to afford continuous feed or passage through the rolls from mill to mill A B C D in orderly succession. In three-high mills this pass may be from the upper or lower rolls, though I prefer to make it from the lower, and in this case the upper pass will be backward or in reverse direction, and any desired number of passes back and forth may be given on each set of rolls before passing the article to the next set in the succession.

In Fig. 1, I have illustrated the four trains as of different sizes, train A being, say, what is termed a "twelve-inch" mill, train B a "ten-inch" mill, train C an "eight-inch" mill, and train D a "six-inch" mill. These sizes may be increased or diminished, however, at pleasure, or all four mills may be of the same size, as hereinafter described. These several trains may be geared to run at any desired speed. I prefer, when mills of different sizes are employed, to gear them to run at speeds increasing as the diameters of the rolls decrease—say in mill A one hundred and twenty revolutions per minute, in mill B two hundred revolutions, mill C three hundred revolutions, and in mill D four hundred revolutions per minute. If larger or smaller trains be added, their speed may be increased or diminished with relation to the others, corresponding to their diameters; or, if the mills be all of the same size, they may be geared to run at uniform speed, and the speed of the whole may be varied at pleasure by increasing or diminishing the speed of the engine or driving-power.

In operation, a pile, billet, ingot, or bloom to be reduced is taken from the heating-furnace, say, to train A, by which it is broken down and more or less reduced, as may be desired. From the last, or from any one of the passes of train A, it may be fed conveniently and without loss of time directly to the first or any one of the passes of train B, and by this train given any desired degree of reduction, and then again from any one of the passes in train B it may be fed directly and quickly to any desired part of train C, and again in like manner to train D. In other words, the article may be passed through the successive rolls of mill A, and then, if desired, through some or all the passes of the succeeding mills, B, C, or D, finishing with any one of them or with any desired pass in any of them; or it may be fed from, say, the first pass of mill A to the first of B and C and D in succession, and then to second of A, B, C, D, &c., and so on in circuit any desired number of times, (one or more,) finishing with any pass in any one of the mills, as may be desired. In this "circuit-rolling," as it may be termed, I prefer to drive the rolls in the several mills at uniform speed, and either to make all the rolls of uniform diameter, or to increase their diameters and correspondingly increase their feed or surface velocities from the inner toward the outer extremities, the first or breaking-down passes being at the inner ends of the train, and the smaller or finishing passes being at or toward the outer extremities. By this means the rolling and manipulation of the article is greatly facilitated, the feed motion being slow and the distance between trains comparatively small where the billet or article is comparatively short and its elongation by reduction slow; but as the billet is passed toward the extremities, where its elongation is more rapid, the surface velocities of the rolls are increased, and, also, by the radial divergence of the several trains, more space is secured, in which elongation of the article can be disposed on the floor in case the velocity of the succeeding pass is not sufficient to pass or take up such elongation. In practice the article may be allowed to buckle, bend up, and accumulate somewhat between trains, in order to prevent possibility of stretching or drawing it in case it be passing through two or more trains at one time. The radial divergence referred to provides the requisite space for such accumulations in such places and in such proportions as will afford the greatest convenience in manipulation without unnecessary waste of space where there is less occasion for accumulation. By permitting such accumulation it will not be essential that the successive rolls or successive mills be increased in speed, though I prefer to increase the surface-speed of the rolls toward the outer extremities, as above described, in order to effect reduction as rapidly as possible. This feature of construction is illustrated in Fig. 2, where I have shown one train, as C, drawn full length and to a larger scale than in Fig. 1, and have shown the rolls *c* increased in diameter from the inner end on the left of the figure toward the outer end on the right of the figure.

The trains A B C D in Fig. 1, as represented, only form a part of their usual or preferred length; but they may be extended to any desired length, substantially as represented in Fig. 2. Ordinarily I prefer to make, say, five or six sets of rolls in each train, though this number may be increased or diminished; also, instead of four, any desired number of mills may be combined in radial order, as described—say two, three, five, six, or more. I do not wish therefore to limit my invention to any specific number. I prefer, however, to employ four mills or trains of rolls and arrange them radially at or near right angles, in order to facilitate the use of each separately as a complete mill for breaking down, reducing, and finishing, when desired, and also to provide for or render practicable the conjoint use of any two or more mills in breaking down, reducing, and finishing, either by using the whole or a part of the trains in succession, or by circuit-rolling, as above described. This feature of construction and combination, by which the mills are adapted for such use, either separately or conjointly to any desired extent in working out the desired product, is a very valuable improvement in rolling-mill construction. By means of it any desired degree of reduction can be made rapidly and conveniently. Several billets or blooms may be in course of reduction at one time in different parts of the combined trains, and thus various sizes and forms of product be made, enabling the manufacturer to fill several different orders at the same time without stopping for changes, as heretofore required.

Any desired number and construction of

heating-furnaces may be employed for heating the various forms of billets, blooms, piles, &c., preparatory to rolling.

If desired, the several trains of rolls may be driven from their outer instead of their inner radial ends, or the different sets in some or all the trains may be driven separately by belt or gear connection, with a driving-shaft located above or below in any convenient position; also, the successive sets of rolls in each train may be driven at different speeds, increasing from the inner or "roughing" set toward the outer or finishing set. This feature of driving the rolls may be applied to advantage with the construction illustrated in Fig. 2, where the diameters of successive sets of rolls are increased from the inner toward the outer ends of the trains, whereby the rapidity of passage through successive sets of rolls is increased as the article is elongated, not only by increase in surface velocity of such rolls, as before described, but also by an actual increase in the rate of rotation. For example, the inner or roughing set may receive, say, one hundred and twenty revolutions per minute, the next in succession outward, say, one hundred and seventy-five revolutions, the next two hundred and twenty-five, the next two hundred and seventy-five, and the next three hundred and twenty-five, and so on; and these and other like modifications in the size and speed of rolls I consider as coming within my invention.

I claim herein as my invention—

1. Two or more trains of metal-reducing rolls combined in radial order, at or near right angles to each other, with power mechanism for driving the rolls of the several trains in direction for passing the article in circuit from train to train in direct succession, substantially as set forth.

2. The combination of two or more trains of metal-reducing rolls arranged in radial order, at or near right angles to each other, the successive trains being of different sizes, with power mechanism for driving the several trains at different speeds in direction for passing the article from train to train in succession, substantially as set forth.

3. A succession of two or more trains of metal-reducing rolls combined in radial order, at or near right angles to each other, the rolls being increased in diameter toward the outer extremities of the trains, with power mechanism for driving the rolls in direction for passing the article in circuit from train to train in succession, substantially as set forth.

4. Three or more trains of metal-reducing rolls combined in radial order, such trains containing a series of two or more sets of rolls having passes therein decreasing in size toward the outer extremities of the trains, substantially as set forth.

5. Three or more trains of metal-reducing rolls combined in radial order, such trains having two or more sets of rolls which increase in diameter toward the outer extremities of the trains, with a succession of passes in such rolls which decrease in size toward the outer extremities of the trains, and with power mechanism for driving the rolls in direction for passing the article in circuit from train to train, substantially as set forth.

6. Four trains of metal-reducing rolls combined in radial order at or near right angles, such trains having a succession of graded passes therein, with power mechanism for driving the rolls in direction for passing the article in orderly succession from train to train, substantially as set forth.

In testimony whereof I have hereunto set my hand.

JOHN I. WILLIAMS.

Witnesses:
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