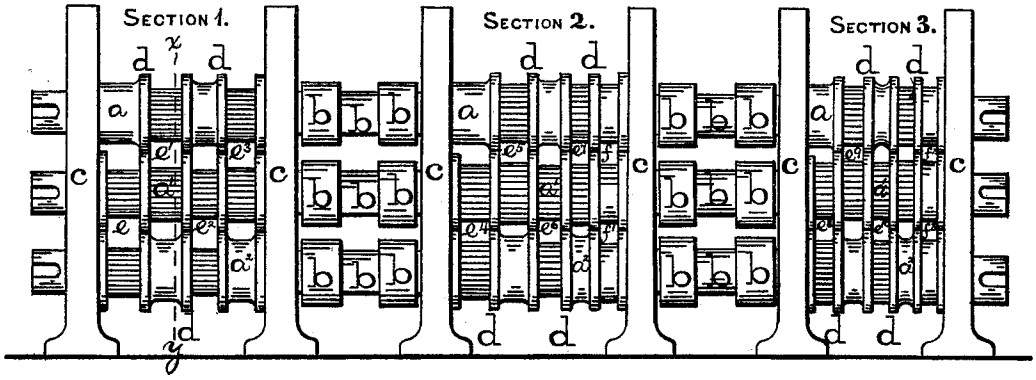
G. W. BILLINGS.

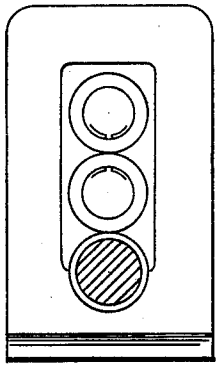
PROCESS OF COMPRESSING AND REDUCING STEEL AND OTHER INGOTS.

No. 175,267. Fig. 1. Patented March 28, 1876.



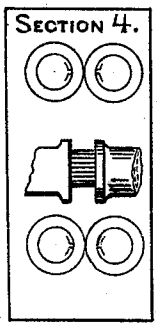

Scale 1/4 inch = 1 foot.

Fig. 2.



Section on line x, y.

Fig. 3.




Scale 3/16 inch = 1 foot.

Fig. 4.

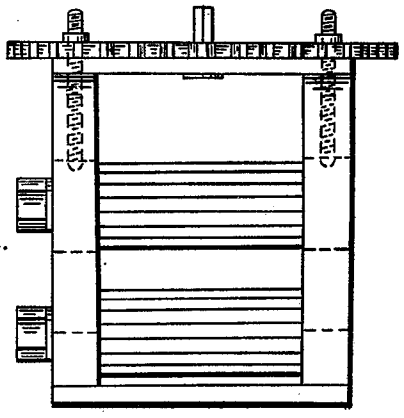
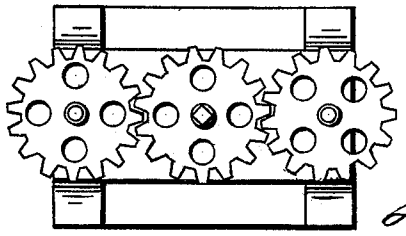


Fig. 5.



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# UNITED STATES PATENT OFFICE.

GEORGE W. BILLINGS, OF CLEVELAND, OHIO.

## IMPROVEMENT IN PROCESSES OF COMPRESSING AND REDUCING STEEL AND OTHER INGOTS.

Specification forming part of Letters Patent No. **175,267**, dated March 28, 1876; application filed November 10, 1875.

*To all whom it may concern:*

Be it known that I, GEORGE W. BILLINGS, of Cleveland, Ohio, have invented a Process for Compressing and Reducing Steel Ingots, Piles, and Plates, of which process the following is a specification:

Letters Patent No. 139,359 were granted to me May 27, 1873, for a process of manufacturing rolled iron. The machinery employed by me in that process I now employ in a somewhat modified form in the treatment of steel ingots.

In the annexed drawings, Figure 1 is a front elevation of the three-high rolls, with their housings, couplings, and spindles, constituting the machine employed by me in compressing and reducing steel ingots. Fig. 2 is a vertical section of the same on the line *x y* of Fig. 1. Fig. 3 represents, partly in cross-section and partly in front elevation, the arrangement of the rolls I employ in compressing and reducing piles made up of bars of steel. Figs. 4 and 5 are, respectively, an elevation and a plan of the rolls I employ for compressing and reducing plates and sheets of steel.

In Fig. 1 the rolls are marked *a* $a^1$ $a^2$, the couplings and spindles *b*, and the housings *c*.

The rolls *a* $a^1$ $a^2$ are divided, respectively, by collars *d*, into several cogged and plain spaces, as shown. The opposing cogged spaces in the several rolls correspond in diameter, and they, with the collars, form boxes or ways, *e* $e^1$ $e^2$ $e^3$ $e^4$ $e^5$ $e^6$ $e^7$ $e^8$ $e^9$ $e^{10}$, for the passage of the steel ingots or piles of steel bars, as shown in Fig. 1.

The portion of each of the rolls *a* $a^1$ $a^2$ comprised in sections 1 and 2 are twenty-eight inches in diameter, (measuring through the collars *d*,) and the portion of each of them comprised in section 3 is twenty-six inches in diameter.

The size of the box *e* is eleven by twelve inches; box $e^1$, ten by twelve inches; box $e^2$, eleven by ten inches; box $e^3$, ten by ten inches; box $e^4$, nine by ten inches; box $e^5$, eight by ten inches; box $e^6$, eight by nine inches; box $e^7$, eight by eight inches; box $e^8$ seven by eight inches; box $e^9$, six by eight inches; box $e^{10}$, six by seven inches.

The box *e* (eleven by twelve inches) is arranged for an ingot twelve by twelve inches in the cross-section, so that at each passage of the ingot through this box it shall be reduced one inch in thickness. When the ingot has been passed through the rolls twice—that is to say, through the box *e* and then through the box $e^1$—it is reduced to ten by twelve inches. It is then turned on edge, and the third passage—to wit, through the box $e^2$—reduces it to ten by eleven inches; the fourth passage—to wit, through the box $e^3$—to ten by ten inches; and so on through the boxes of diminishing size until it has been reduced to the desired size.

The boxes *f* and $f^1$ (each eight by eight inches) and the boxes $f^2$ and $f^3$ (each six by six inches) are smooth, the opposing rolls being, for these spaces, without cogs. These smooth spaces are provided for smoothing the ingots, and for removing the corrugations formed on the surfaces of the ingots during their passage through the cogged spaces *e* $e^1$, &c.

The cogs are constructed in regular gear form. For rolls of the size represented in Fig. 1, the cogs should measure two inches from center to center and one inch in depth, the face or width of each cog being about fifty-three one-hundredths of their two-inch pitch, thus giving to the face of each cog more than one-half of the space between the cogs.

I prefer to run the rolls at the rate of twenty inches per second, but this speed may be varied as required.

The action of the cogs is to force the metal from the top and bottom to the middle of the ingot or pile, and, the pressure being great, causes the silicon to flow into the cracks, seams, and porous places, (the surplus silicon to escape through the pores and at the ends of the ingot as it passes through the machine,) and when the ingot or pile leaves the machine it is thoroughly worked, and is solid and freed of foreign matters.

The rolls above described are adapted to the working of ingots and piles of all the usual sizes; but the rolls and boxes may be varied in size, observing the proportions stated.

For ingots or piles less than six inches square in the cross-section, rolls of eighteen or twenty inches diameter are large enough,

and cogs arranged from one-quarter to one and three-quarter inch pitch will answer the purpose.

For compressing and reducing plates and sheets, I make use of the two-high rolls represented in Figs. 4 and 5. These rolls are cogged from end to end, or fluted, no dividing-collars being employed, and the top of the roll is adjusted by screws at each end, as in ordinary plate-mills.

The cogged rolls herein referred to are essentially different from, and are not to be confused with, the corrugated rolls commonly used in rolling steel ingots. When my cogged rolls are employed the bearing of the cogs on the metal is only at intervals; but when the corrugated rolls are used, the bearing of the rolls is continuous, owing to the shallowness of the flutes or furrows.

Power is applied to the rolls in the ordinary manner. The power required to compress ingots by the above-described process is only one-fifth of the amount of power required to effect the same results by the ordinary draft process.

A twelve-inch-square ingot, when drawn by ordinary plain or uncogged rollers, is drawn asunder the entire square of one hundred and forty-four inches, whereas, by my above-described process, only twelve inches of the metal are acted upon by the cogs at one and the same instant.

The capacity for work of the machine represented in Fig. 1 is ten tons per hour.

For piles composed of bars of steel I employ rolls arranged as shown in Fig. 3—viz., two pairs of horizontal rolls and one pair of upright rolls, these several rolls being cogged and otherwise constructed as shown in Fig. 1. A pile of the description last referred to I pass once through these rolls, when it is in condition to be drawn by the ordinary draft process.

I use the described process and machinery for brass and copper ingots as well as for steel ingots.

I claim—

1. The process of compressing steel ingots, piles, and plates, and brass and copper ingots, which consists in passing them through the cogged rolls, constructed and arranged substantially as set forth.

2. The process which consists in passing steel ingots and piles through the boxes or cogged spaces of the rolls to disengage the silicon and force it into the seams and porous parts of the ingot or pile, and to express the surplus silicon through the pores and out at the ends of the ingot, and then smoothing the corrugations on the compressed ingot or pile by passing the same through the smooth boxes of the rolls, substantially as set forth.

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