3 Sheets—Sheet 1.

W. SELLERS.

MACHINES FOR COMPRESSING BLOOMS AND PUDDLERS' BALLS.

No. 180,798. Patented Aug. 8. 1876.

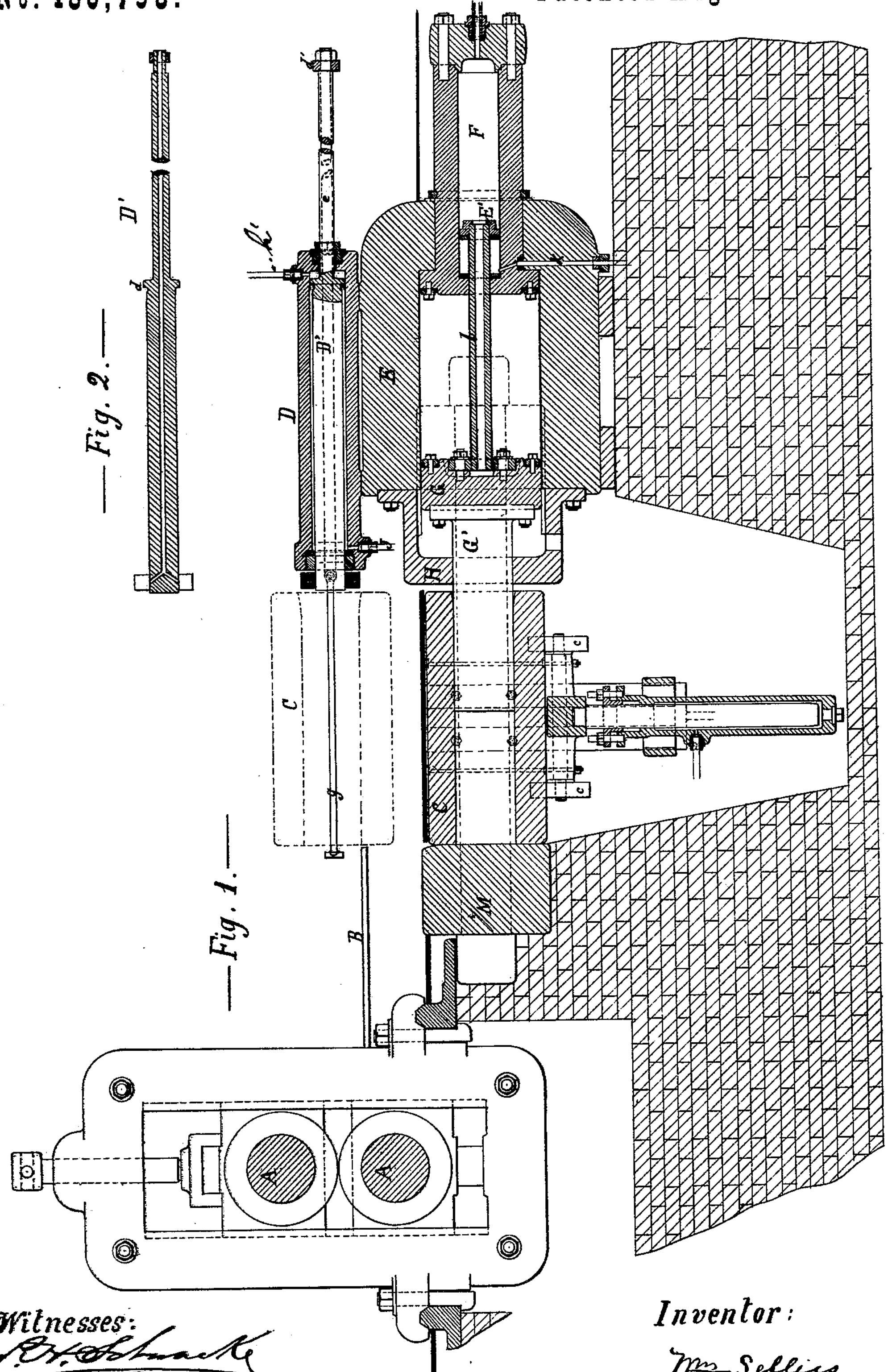

Fig. 1.

Fig. 2.

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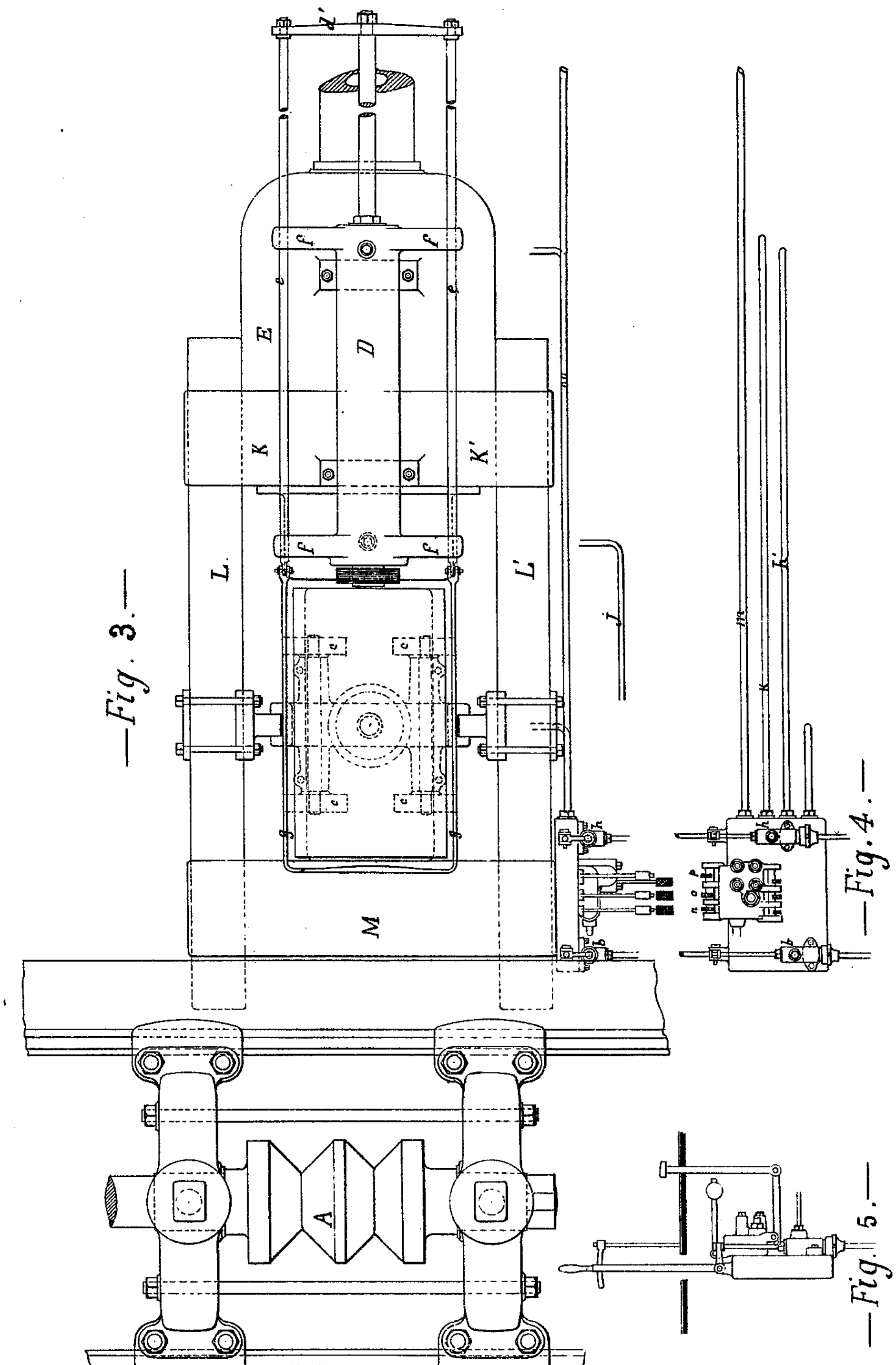

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3 Sheets—Sheet 3.

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MACHINES FOR COMPRESSING BLOOMS AND PUDDLERS' BALLS.

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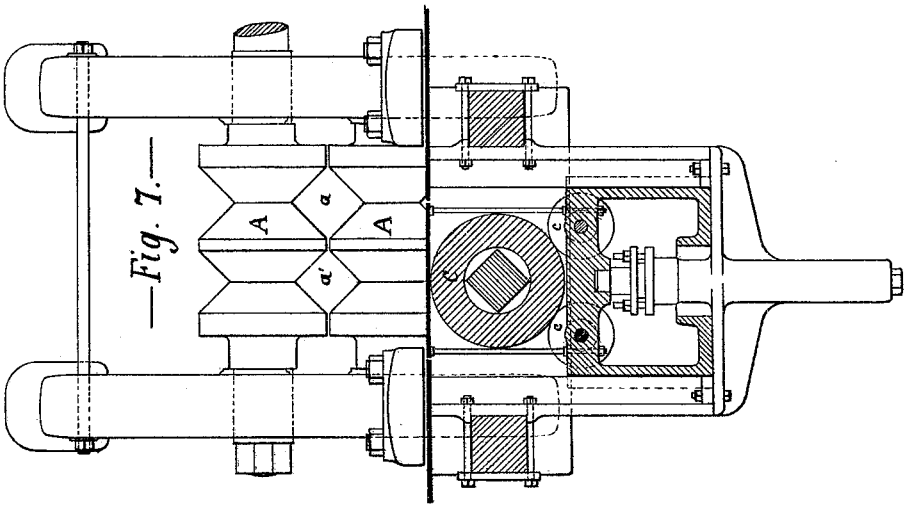
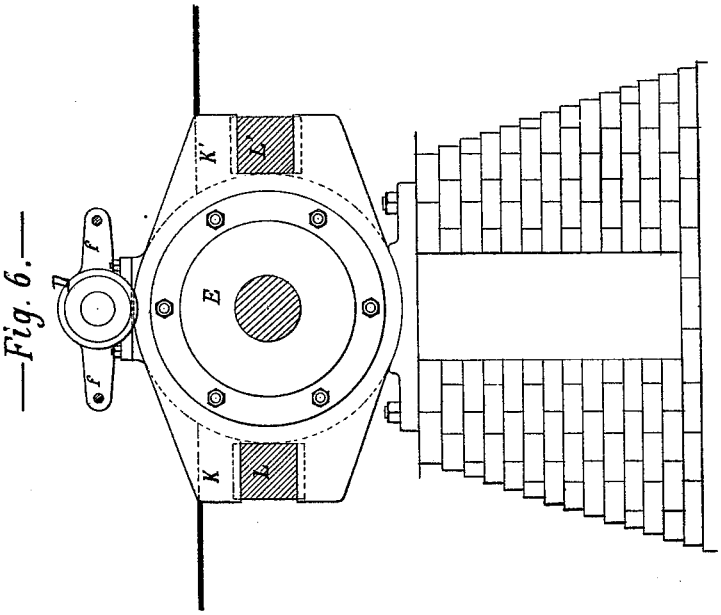
—Fig. 7.—



—Fig. 6.—



Witnesses:
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Inventor:
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UNITED STATES PATENT OFFICE.

WILLIAM SELLERS, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR OF ONE-HALF HIS RIGHT TO JOHN SELLERS, JR., OF SAME PLACE.

IMPROVEMENT IN MACHINES FOR COMPRESSING BLOOMS AND PUDDLERS' BALLS.

Specification forming part of Letters Patent No. **180,798**, dated August 8, 1876; application filed July 3, 1876.

To all whom it may concern:

Be it known that I, WILLIAM SELLERS, of the city and county of Philadelphia, in the State of Pennsylvania, have invented a certain new and useful Process of Refining and Condensing Iron or of Condensing Steel, and certain new and useful improvements in means for practicing said process, of which process and improvements the following is a specification:

My invention relates more particularly to the treatment of puddled iron, although it may be advantageously used in the treatment of blooms that have not been puddled, and also in the treatment of ingots of steel.

As being the most comprehensive application of my invention, I shall proceed to describe my improved process as used in treating puddled iron.

In the manufacture of iron the necessity for removing mechanical impurities inherent in a puddled product has long been recognized; but, so far as I know, prior to the date of my invention, this has only been attempted by reducing, piling, and welding; and although a large proportion of impurities are thus expelled, yet each piling and welding introduces a certain amount of additional impurities, and is attended with lines of welding or division in the mass, upon which lines separation is liable to take place.

It is the object of my invention to refine and condense iron in mass by a short process, and to produce a homogeneous ingot not only purer and denser than a similar mass formed by the piling and welding process, but also free from the lines of division incident to that process, and without the loss of heat incident to piling and welding; and to these ends my invention consists in a method or mode of treatment which alternately reduces and expands the cross-section of the metal, correspondingly increasing and diminishing the length of the mass, so producing these effects as to permit a free escape of impurities between the stages and during the greater part of each operation, and with a rapidity tending to maintain the heat to the termination of the process; and my invention further consists in a new apparatus in which this process is conducted.

The accompanying drawings, which form part of this specification, represent in detail the apparatus which I employ to accomplish the objects of my invention.

Figure 1 represents an end view of a roll-train in which the section of the iron is reduced and the length increased in the usual manner, a vertical section through the axis of the condensing-chamber, and the cylinder which raises and lowers the same, and a vertical section through the axis of the upsetting-cylinder, its drawback, and the charging and discharging cylinder. Fig. 2 represents a longitudinal section of the plunger and piston for the charging and discharging cylinder. Fig. 3 represents a plan of the parts shown in Fig. 1. Fig. 4 represents a front elevation of the hydraulic valves which admit and discharge the water to and from the several cylinders. Fig. 5 represents a side elevation of the valves shown in Fig. 4 and their operating-levers. Fig. 6 represents an end elevation of the upsetting-cylinder and of the charging and discharging cylinder. Fig. 7 represents a side elevation of the roll-train and a cross-section of the condensing-chamber and its carriage.

In connection with the hydraulic mechanism illustrated in the drawing, I provide for economically working two accumulators—one for high, the other for low, pressure water, the latter having a pressure of, say, six hundred pounds per square inch; but, as these are merely the reservoirs of power, and form no part of my improvement, and their construction and operation are, moreover, well understood, any further description of them herein is deemed unnecessary.

The puddle-ball is transferred from the puddler to a squeezer, which shapes the irregular mass into a cylinder with flat ends.

The rolls A A receive the puddle-ball in the form that it has from the squeezer, and, by a series of passes through the grooves *a* and *a'*, convert it into a square bar, which the final pass delivers upon the table B. The valve *b* is then opened, which admits the low-pressure

water upon the plunger of the lifting carriage, upon which the condensing-chamber C is carried. This raises the chamber to the position shown by the dotted lines in Fig. 1. The condensing-chamber C is cylindrical in form, and is carried upon wheels *c c c c*, for the purpose of turning it conveniently, as may be required, from time to time, for cooling or other purposes. The charging and discharging cylinder D is provided with a plunger, D′, (shown in Fig. 2,) which projects through both ends of the chamber, and has a piston, *d*, near its center, which is provided with hydraulic packing, to prevent any escape of water from the larger toward the smaller diameter of the plunger. Upon the small end of the plunger a cross-head, *d′*, is placed, to the ends of which are attached the rods *e e*, having a length about twice that of the cylinder D, and sliding freely in the guides *f f f f*, cast with or firmly attached to the cylinder D.

The ends of the rods *e e* opposite the cross-head *d′* are formed as one-half of a rule-joint, to which, by a corresponding half-joint, is attached the charging-hook *g g*. The ends of the cylinder D are provided with stuffing-boxes, which fit the respective ends of the plunger, and prevent the escape of water at these points. The larger end of the plunger is provided with a wire swab to brush out the scale from the condensing chamber, and the plunger itself has a hole passing through it from the smaller to the larger end, and at this end communicating laterally with the swab, for the purpose of slushing the interior of the condensing-chamber with plumbago and oil. When the square bar has been deposited upon the table B, and the condensing-chamber has been raised to the point indicated by the dotted, lines, (see Fig. 1,) as before described, the valve *h* is opened, which admits low-pressure water (through pipe *h*) behind the piston of the cylinder D, when the larger end of the plunger will be carried forward through the chamber C until its motion is arrested by the piston coming in contact with the other end of the cylinder D. In this movement of the plunger the rods *e e*, with the charging-hook *g g*, will be carried forward, and during this movement the hook *g g* must be raised to pass over the square bar upon the table B. When this is accomplished the valve *h* is reversed, which opens its exhaust-port, and the constant pressure from the low-pressure accumulator upon the piston *d* through the pipe *j* will force back the plunger D′, and if the hook *g g* is at the same time lowered, the square bar from the rolls will be carried forward by the hook into the condensing-chamber C, (see Fig. 7,) in which a cross-section of the square bar is shown in position in the condensing-chamber. The valve *b* is then reversed, opening its exhaust-port, and the condensing-chamber will descend by its own weight, forcing out the water which raised it until it reaches the position shown in the drawing. (See Fig. 1.) In this position the axes of the condensing-chamber and of the upsetting-cylinder E are in one line. The upsetting-cylinder E is provided with a drawback-cylinder, F, which is in constant communication with the low-pressure accumulator by the pipe *k*, so that a constant pressure is exerted upon the drawback-piston E′, and, by means of the hollow piston-rod *l*, upon the main piston G, to draw this piston back as far as it can go within the upsetting-cylinder E. The main piston G has upon its outer side a plunger, G′, securely bolted. This plunger is of a size to fit loosely within the condensing-chamber C, and it slides freely through, and is guided by, a head, H, securely bolted to the outer or front end of the upsetting-cylinder E. When the condensing-chamber is in the position last described the low-pressure water is admitted through the pipe *m*, by means of the valve *n*, to the drawback-cylinder F, and, passing through the hollow piston-rod *l*, will escape into the upsetting-cylinder through grooves provided for that purpose in the piston G. At the same time, the water pressing upon the drawback-piston E′, the pressure upon the opposite side of this piston will be eliminated, and the plunger G′ will be carried forward with a force due to the water-pressure upon the whole area of the upsetting-cylinder E. Upon opposite sides of the upsetting-cylinder E are provided heavy lugs K K′, (see Figs. 3 and 6,) by means of which the heavy T-headed bolts L L′ are securely attached to this cylinder, the other ends of these bolts being attached in a similar manner to the upsetting-block M. As the plunger G′ is carried forward by the water-pressure the square bar in the condensing-cylinder will be upset between the end of the plunger G′ and the block M, and if the pressure is sufficient and is continued long enough the square bar will assume the shape of the condensing-chamber; but until it has assumed this shape—that is, until the condensing-chamber is full—there is room for the escape of cinder at the flat sides of this bar.

For economical use of the power, I admit low-pressure water upon the piston G until the plunger has commenced to operate upon the square bar in the condensing-chamber. I then close the valve *n* and open the valve *o*, which admits the high-pressure water, through the pipe *m*, upon the piston G. This pressure is graduated to promptly complete the upsetting operation. When the forward motion of the plunger G′ has been arrested, either by the resistance equaling the water-pressure or by shutting off the water-supply by closing the valve *o* at an indicated pressure upon the upsetting-cylinder, the exhaust-valve *p* is then opened, permitting the escape of water from the upsetting-cylinder, when the constant pressure from the accumulator upon the drawback-piston E′ will retract the plunger G′ from the condensing-chamber C, and drive out the water from the upsetting-cylinder.

When this has been accomplished, the valve *b* is opened, and the condensing-chamber will be again raised to the position shown by the dotted lines in Fig. 1. The valve *h* is then opened, and the discharging-plunger D′ will force the condensed ingot out of the condensing-chamber upon the table B, and the operation is completed. From this point the ingot may be carried to the finishing-train, which gives the shape required for the finished product; or it may again be passed through the rolls A A, and the condensing operation repeated as often as the character of the iron under treatment may require. In my practice I have found three condensations sufficient, and if the iron has been well treated in the squeezer one condensation is enough.

I have described the condensing-chamber as performing its function in conjunction with an upsetting-plunger and an upsetting-block as the most economical, and as sufficiently effective when the ingot is of moderate length; but in any case, when it is desirable or necessary to condense ingots of extraordinary lengths, I contemplate using an upsetting-plunger at each end of the condensing-chamber. I have also described the condensing-chamber as a cylinder, which changes the form as well as the area of the cross-section of the metal which it operates upon, and this is the best practice; but the form of this chamber is not essential, nor is it essential in condensing to change the form of the metal under treatment.

I have described the squaring of the metal with its longitudinal extension as being effected in rolls, this being the most economical method of accomplishing this result with the desirable uniformity; but this stage of the process may be conducted under a hammer, as is well understood.

In condensing steel, the ingot is delivered to the rolls or subjected to the hammer, and treated in the manner hereinbefore described for the puddle-ball after it has passed from the squeezer.

Having thus described the objects and nature of my invention, and the mode and means for practicing the same, what I claim as new, and desire to secure by Letters Patent, is—

1. The hereinbefore-described process of refining and condensing iron or of condensing steel by alternately extending the mass by lateral compression, and condensing it in a chamber by longitudinal compression, the area of its cross-section being alternately reduced and enlarged at each stage of the process, substantially as and for the purposes set forth.

2. The combination, with a roll-train and its table, of a condensing-chamber, substantially as and for the purposes set forth.

3. The combination, with the roll-train, the table, and the condensing-chamber, of a device for raising and lowering the condensing-chamber, substantially as and for the purposes set forth.

4. The combination of the upsetting-plunger, the upsetting-block, and the raising and lowering condensing-chamber, substantially as described.

5. The combination, with the condensing-chamber, of a charging and discharging apparatus, substantially as described.

6. The combination, with the charging and discharging apparatus, of the swab and cleaner.

7. The combination of the condensing-chamber and carrying-rollers, substantially as and for the purposes set forth.

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