(No Model.)

J. W. BOOKWALTER.

PROCESS OF CONVERTING CRUDE IRON INTO MALLEABLE IRON OR STEEL

No. 411,419. Patented Sept. 24, 1889.

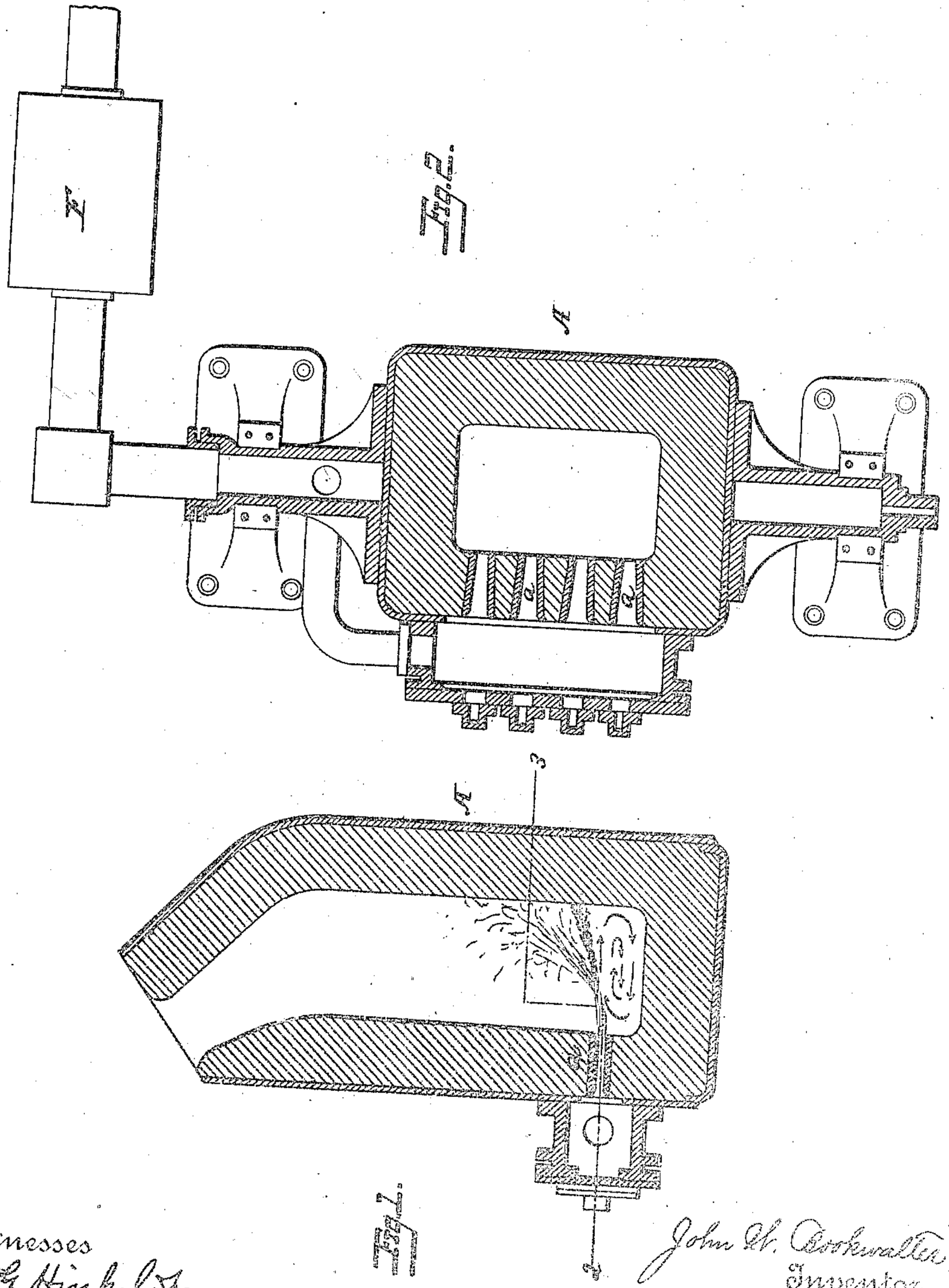

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Fig. 1.

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PROCESS OF CONVERTING CRUDE IRON INTO MALLEABLE IRON OR STEEL.

SPECIFICATION forming part of Letters Patent No. 411,419, dated September 24, 1889.

Application filed November 28, 1888. Serial No. 292,136. (No model.)

To all whom it may concern:

Be it known that I, JOHN W. BOOKWALTER, a citizen of the United States, residing at Springfield, Clark county, State of Ohio, have invented a new and useful Improvement in the Process of Converting Crude Iron into Malleable Iron or Steel, of which the following is a full, clear, and exact specification.

In the conversion of crude iron into malleable iron or steel by what is known as the "Roberts" process, in which the body of metal in the converter is acted upon by a blast that strips off from the body of metal and finely divides small portions thereof at one time, while imparting a gyratory motion to the main body that feeds every portion in succession into position to be acted upon by the blast, there are certain variable conditions which vary the ultimate results unless provision is made to counteract them. Thus when the molten metal is placed in the converter it is much cooler and therefore more viscid or less fluid than it afterward becomes, as during the process of conversion its temperature is increased. This increasing temperature results from the increased combustion of the combustible elements contained in the iron, as they are brought more rapidly and intimately in contact with the converting agent, and where the air-blasts are applied at or near the surface of the bath, as in the Roberts process, the extent to which the oxygen in the blast is brought into contact and combines with the combustible elements of the iron is dependent to a great degree upon the rapidity of the circulation of the metal brought about by the mechanical action of the air upon the mass of the metal.

In proportion as the metal first placed in the converter is cooler and more viscid a blast of greater force must be applied to overcome the inertia of the metal and set it in motion and impart and maintain the requisite speed of the gyratory motion. It therefore follows that the amount of pressure of air admitted at the preliminary state of conversion that will impart the proper circulation to the metal would be too great when the liquid becomes more liquid and the particles are more mobile and yield more readily to the applied force, because in that condition the blast will tend to produce a too rapid motion to the metal and act too violently upon the same. This variation in the degree of the fluidity and mobility of the metal at different stages of the process of conversion can be compensated for with partial success by gradually diminishing the quantity of the air and the pressure of the blast as the fluidity of the metal increases, or by varying the angle at which the air is forced upon the metal; but it is the object of my invention to provide more complete means for securing this result by maintaining more constant and fixed relations in the act of conversion throughout the whole period of the same than can be done by varying the quantity of air and pressure or the angle of the blast.

In carrying out my invention I make use of an apparatus of any suitable construction—as, for instance, such an apparatus as is illustrated in the accompanying drawings, in which—

Figure 1 is an elevation in section of a converter of the Roberts type which could be used in carrying out my invention. Fig. 2 is a sectional plan on the line 2 3, Fig. 1.

The charge is introduced into the converter A, as usual, and in order to produce at the beginning of the act of conversion, when the metal is in a more viscid state, a sufficient rapid circulation of the entire body of metal to bring the combustible elements held by the iron within the sphere of the oxidizing influence of the atmosphere passing through the tuyeres *a* in the form of a blast, as in the Roberts process, I at the beginning employ a blast of maximum volume and pressure, which will soon overcome the inertia of the metal and quickly impart the desired speed of gyration and rapidly bring the combustible elements held by the iron into position to be subjected to the oxidizing influence of the air, thus avoiding the tendency to over-conversion, which would result if the metal circulated but slowly and a strong blast continuously impinged upon a limited portion of the surface of the metal.

In order to further reduce the danger of overoxidizing the metal at any stage of the

process, but without interfering with the desired mechanical effect of the blast, I vary the proportion of the oxidizing agent in any suitable way—as, for instance, by reducing the amount of oxygen contained in the blast. Thus a portion of the oxygen may be burned out from the air employed for the blast by passing the same to the tuyeres through a furnace F, containing a bed of ignited charcoal, so that while the requisite volume and high degree of pressure required to secure the maximum mechanical effect of the blast may be maintained, such result is effected without necessarily supplying to the metal at any stage during the conversion a larger quantity of oxygen than is necessary to thoroughly consume the combustible elements presented to it by the circulation of the metal.

The deoxygenizing of the air will vary with the varying conditions of the metal. Thus it is effected to the maximum extent at the beginning of the process and is continued until the metal acquires the requisite gyratory motion, and is then varied throughout the process of conversion to meet the requirements growing out of the reduction in the quantity of carbon, silicon, and other combustible elements held by the iron. As the conversion proceeds the quantity and the pressure of the air are reduced in proportion to the increase in the fluidity of the metal, so as to avoid any tendency to produce too rapid a circulation or too violent an action upon the metal in the bath, which would result in returning the impurities generated in the process of conversion to and mixing them with the body of the metal. By keeping up the volume and pressure of the air at the beginning of the operation to a point to suit the less mobile character of the metal when first put into the converter, and by reducing the quantity of oxygen contained in the blast, and thus avoiding the danger of overoxidizing the metal, and afterwards by reducing the volume and pressure of the air to suit the increased mobility that results from a greater fluidity of the metal, and by further reducing the quantity of oxygen contained in the air in proportion to the reduction of the quantity of carbon and silicon and other combustible elements to be burned out as the process of conversion proceeds, I am enabled to maintain throughout the whole period of conversion a more perfect relation of the essential conditions necessary to a thorough and complete conversion of the metal than would be possible if a fixed volume and pressure of air with its full proportion of ogygen was admitted throughout the whole process of conversion, or even by the use of a variable quantity and pressure of air admitted without varying the proportion of oxygen contained in the air.

I claim—

The within-described improvement in the process of converting crude iron into malleable iron or steel by a blast acting upon part of a body of metal to impart a gyration thereto and strip therefrom limited portions in succession, the said improvement consisting in diminishing the proportion of oxygen in the blast and in also varying the quantity and pressure of the blast during the process of conversion, substantially as and for the purpose set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

JOHN W. BOOKWALTER.

Witnesses:
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