(No Model.) 2 Sheets—Sheet 1.

S. W. VAUGHEN.

APPARATUS FOR STOPPING TAPPING HOLES OF FURNACES.

No. 544,551. Patented Aug. 13, 1895.

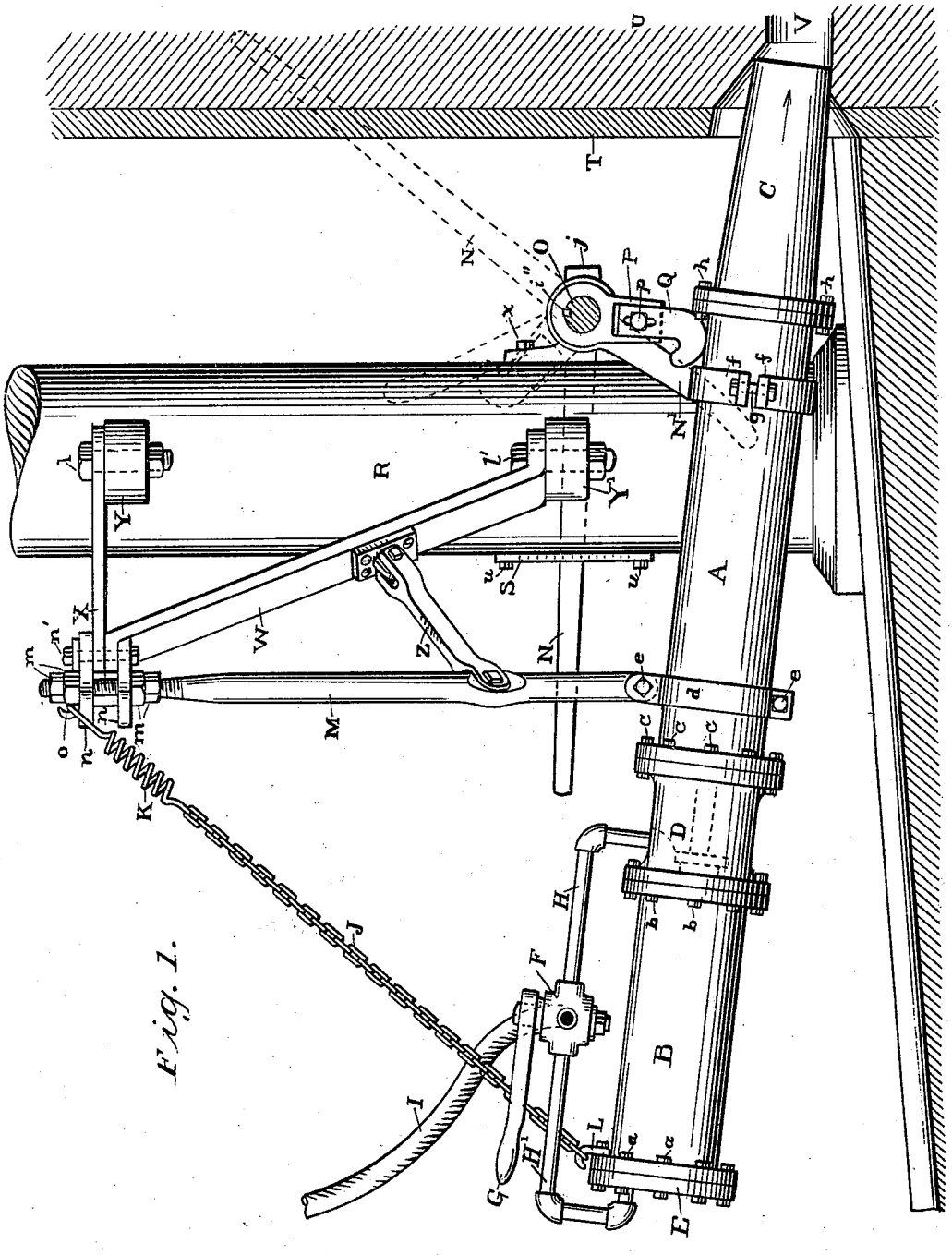

Fig. 1.

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(No Model.) 2 Sheets—Sheet 2.

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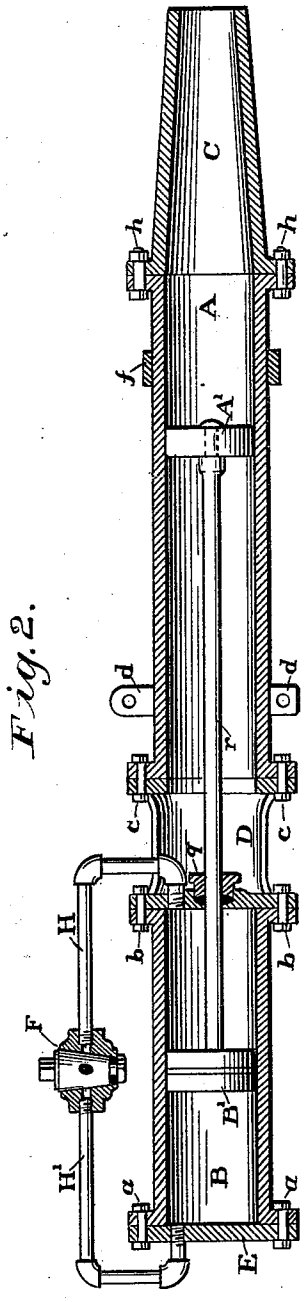

Fig. 2.

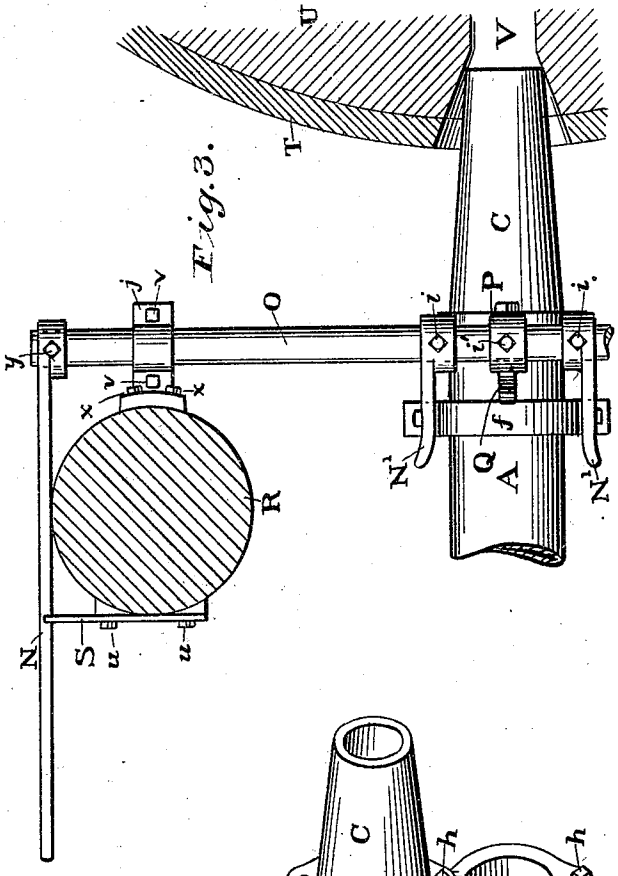

Fig. 3.

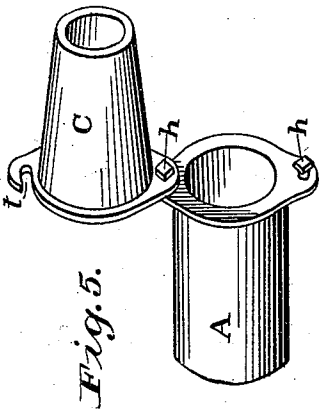

Fig. 5.

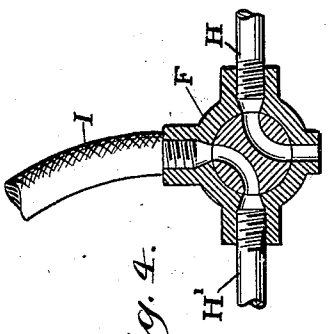

Fig. 4.

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UNITED STATES PATENT OFFICE

SAMUEL W. VAUGHEN, OF COOPERSDALE, PENNSYLVANIA.

APPARATUS FOR STOPPING TAPPING-HOLES OF FURNACES.

SPECIFICATION forming part of Letters Patent No. 544,551, dated August 13, 1895.

Application filed April 12, 1895. Serial No. 545,448. (No model.)

To all whom it may concern:

Be it known that I, SAMUEL W. VAUGHEN, a citizen of the United States, residing at Coopersdale, in the county of Cambria and State of Pennsylvania, have invented certain new and useful Improvements in Apparatus for Stopping the Tapping-Holes of Furnaces; and I hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

Metallurgical furnaces as ordinarily constructed are provided at or near the lower portions of their crucibles or hearths with a tapping-hole or notch formed therein, through which metal, slag, or similar material is drawn. This opening or tapping-hole is ordinarily rammed or stopped with refractory material, which in some cases consists of clay or fire-brick, or a mixture of the two in proper proportions. Ordinary practice in tapping iron from the above-described notch or tapping-hole consists in driving a bar through this clay stopping to permit the outflow of iron from the furnace-hearth.

Although my improved apparatus may be applied for use in connection with any metallurgical or similar furnaces in which tapping-holes are used, I will, for the sake of simplicity in the description, refer only to its use in connection with the iron-notch of the blast-furnace. After the iron is tapped from the notch, as above described, it has hitherto been customary to plug the same by placing the stopping material in the hole in small quantities at a time, and ramming the same into position by means of a bar operated by manual labor. In blast-furnace practice this bar is generally of large size, and is driven against the clay stopping by means of heavy sledges in the hands of the workmen, who, during this operation, are subjected to great inconvenience and danger on account of their proximity to the highly-heated and liquid iron or slag in the neighborhood of the tapping-hole after a cast has been made. In addition to this it is found necessary in blast-furnace practice to stop the blast in order to allow the iron-notch to be properly plugged, for the reason that if the blast-pressure were continued under these circumstances the iron and slag would be forced against the stopping, making it impossible to compact the same properly in the tapping-hole, besides forcing the molten metal outward in such a manner as to endanger the workmen or interfere with the work. This necessary stoppage of the blast has a serious effect upon the regularity of operation of a blast-furnace, and causes a diminution in its product, as may be readily understood when it is considered that from this cause a total delay of at least one hour is caused in each day of twenty-four hours.

It is the object of my invention to provide an apparatus whereby the tapping-hole of a furnace may be stopped expeditiously and in such a way as to avoid the delays and difficulties above mentioned, and at the same time secure immunity from danger to the workmen who conduct this operation.

My invention consists in general of a cylinder or tube in which is placed the clay or stopping material, this clay being forcibly pushed out of the cylinder by means of a piston fitting loosely therein, the piston being connected to a suitable source of power, whereby it may be moved backward or forward in said cylinder to any degree required for this operation.

Although other means may be used, I prefer to operate the clay-piston by means of a fluid-pressure cylinder in which is another piston connected with the same rod which actuates the clay-piston. The fluid-pressure cylinder is supplied at either end with the required medium for operation through a system of pipes controlled by an ordinary four-way valve or other device suitable for this purpose. In order to facilitate the handling of my apparatus, placing the same in position for operation and withdrawing same after the operation has been completed, I mount it on a swinging crane or other suitable device, whereby it may be moved conveniently without unnecessary labor. In order to withstand the reaction or thrust of the machine as the clay is discharged from it into the tapping-hole, I provide an abutment to withstand this thrust, said abutment being preferably so arranged as to be easily removed to allow the apparatus to be placed in position for opera-

tion and withdrawn when the operation is completed; but I do not confine myself to this arrangement. In connection with this abutment I may also use an adjustable gage, which bears against the top of my stopping apparatus, which gage is so adjusted as to cause the machine to properly enter the tapping-hole previous to the actual operation of the stopping mechanism. One form of abutment which I use, and which is shown in the drawings herewith, consists of two arms mounted on a revoluble shaft, which latter is carried in suitable fixed bearings, the outer end of said shaft being provided with a lever securely fastened thereto in a position at right angles to the axis of the shaft, and a latch so arranged and adjusted as to hold the lever firmly in its proper working position, and thereby maintain the aforesaid arms fixedly in a proper manner to withstand the reaction of the machine when in operation.

In order to provide a proper bearing for the two arms above mentioned, I provide on each side of the cylinder of my apparatus a suitable lug or projection against which the arms are pressed when in their working position. Intermediate between these arms and carried upon the same shaft is secured a gage, which is curved at its outer portion and whose length is adjustable. As the shaft is revolved by means of the lever before mentioned, the arms are brought into connection with the lugs on the sides of the cylinder and the gage is pressed against the upper side of the cylinder and against a projection or flange formed thereon, thus serving to hold the cylinder downward, and also to assist in pushing it forward into position for operation.

Having thus given this general description of my invention, I will now refer to the annexed two sheets of drawings, which form part of this specification, and in which like letters refer to like parts.

Figure 1 is a general side elevation of my machine, showing the tapping-hole and runner of a blast-furnace in vertical section. Fig. 2 is a central vertical section of the principal working portions of my machine. Fig. 3 is a plan view showing the forward portion of my machine in position for operation, the rear part and supporting mechanism being omitted for the sake of clearness. Fig. 4 is a cross-section of an ordinary four-way valve which is used to control the flow of fluid to and from the working-cylinder of the machine. Fig. 5 is a view of the forward end of my machine, showing one form of nozzle turned into position to allow the clay-cylinder to be charged with the stopping material.

In the different figures, A is the main clay-cylinder; B, the working-cylinder, and C is one form of nozzle. Although this form of nozzle is shown as of tapering form, I do not limit myself to this particular shape, as it may be made cylindrical or otherwise. Nozzle C is secured to the main clay-cylinder by the bolts *h h*, upon one of which the nozzle may be revolved, the slotted hole *t* in the nozzle-flange allowing this motion.

It is not essential that the nozzle-section be made separate from the body of the clay-cylinder; but I prefer this construction, as it allows the nozzle portion, which is subjected to the greatest wear and destructive action of heat, to be easily and cheaply renewed.

A′ is a clay-piston which may be moved backward or forward in the cylinder A by the movement of the piston-rod *r*, which works through the gland *q*, at the other end of which rod is secured the piston B′, which works in the fluid-pressure cylinder B.

D is a yoke connecting the clay-cylinder A with the fluid-pressure cylinder B by means of the bolts *b b* and *c c*, while E is the back cylinder-head of the fluid-pressure cylinder B and secured to the same by bolts *a a*.

H and H′ are supply-pipes connected with the front and back piston-heads of the cylinder B, while F is a four-way valve for controlling the flow of fluid in said pipes, G being the hand-lever attached to the plug of said valve.

I is a supply pipe or hose connected to one of the ports of the valve F, as shown, and at the other end with a suitable supply of fluid under pressure.

J is a chain which serves to support the outer end of my machine, as shown, being attached at one end to the hook L on the cylinder, and at the other end to the hook *o* at the head of the swinging crane.

K is a coiled spring which serves to equalize any jar or shock occasioned by the impact of the machine as it comes in contact with any fixed object.

M is the main hanging rod which carries my apparatus and which is secured to the same by means of the collar *d* and the bolts *e e*. The rod M is secured to the apex of the small swinging crane, as shown, by means of the nuts *m m*, plates *n n*, and the bolt *n′*.

X is the crane-jib; W, the main brace, and Z is an intermediate brace secured to the rod M and the brace-rod W for the purpose of preventing an excessive swinging motion of the apparatus as the crane revolves.

Y Y′ are the upper and lower pintle-bearings of the crane, respectively, and *l l′* are the upper and lower pintle-bolts of the same.

R represents the column which carries the crane, and to which is also attached a bearing *j*, in which latter is mounted a revoluble shaft O.

Referring to plan view, Fig. 3, the shaft O is broken away for the sake of convenience of illustration, as is also the clay-cylinder A. This shaft O may extend to any reasonable degree, said extension being carried in a suitable bearing similar to *j*, or otherwise, as may be readily understood.

N is a lever secured to the end of the shaft

O by the set-screw *y*, while S is a latch or lock secured to the column R by means of the bolts *u u*. *j* is a bearing which carries the revoluble shaft O, said bearing being secured to the column R by the bolts *x x* and also provided with the cap-bolts *v v*.

f f is a split collar secured to the cylinder A by means of the bolts *g g* and provided with projections, as shown, against which the arms N′ N′ take a bearing, these arms being secured to the revoluble shaft O by means of the set-screws *i i*.

P is an arm secured to the shaft O by means of the set-screw *i′* and the key *i″* and is provided with an adjustable portion Q, which may be set in the required position and secured there by means of the bolt *p*, which passes through a slotted hole formed in the upper portion of the arm Q, as shown in Fig. 1.

T represents the outer or iron casing of a furnace; U, the refractory lining or brickwork of the same, and V is a tapping-hole or iron-notch formed therein.

The operation of my machine is as follows: The machine is first swung on the crane to a convenient position, whereupon the cylinder A is filled with plastic clay or other material with which to stop the tapping-hole, the piston being withdrawn toward the rear end of the cylinder to allow the required amount of material to be so introduced. After the furnace has been tapped and the iron, or so much of it as is desired, has been withdrawn, the machine is swung quickly into working position, as shown in Figs. 1 and 3, and held there by throwing the lever M into the position shown in full lines on the drawings referred to. At this instant the valve F is quickly turned, allowing the fluid under pressure to force the piston forward, thus discharging the clay contained within the cylinder into the tapping-hole, the force and speed of this discharge being easily regulated by means of the valve. This whole operation requires but a very few seconds, and can be so conducted as not to interfere with the regular operation of the furnace, nor does it require that the blast be shut off.

Having thus described my apparatus and its method of operation, what I claim as my invention, and desire to secure by Letters Patent, is—

1. In apparatus for stopping the tapping hole of furnaces, a tube adapted to receive clay or other refractory material, a piston or plug fitted therein; means for moving said piston within said tube, in combination with a removable abutment adapted to engage with the aforesaid apparatus, to resist the reaction of the same in operation, substantially as set forth.

2. In apparatus for stopping the tapping hole of furnaces, a tube adapted to receive clay or other refractory material, a piston or plug fitted therein, means for moving said piston within said tube, in combination with an abutment adapted to engage with the aforesaid apparatus, to resist the reaction of the same in operation, and a gage bar adapted to bear on the upper portion of said tube, substantially as set forth.

3. In apparatus for stopping the tapping hole of furnaces, a tube adapted to contain clay or other refractory material, a piston or plug fitted within said tube, means for moving said piston, in combination with a removable abutment, consisting of one or more arms secured to a revoluble shaft, said arms being adapted to bear against the aforesaid tube, said shaft being carried in suitable fixed bearings and provided with an operating lever and locking device, substantially as set forth.

4. In apparatus for stopping the tapping hole of furnaces, a tube adapted to contain clay or other refractory material, said tube being provided with one or more projections or lugs, a piston or plug, fitted within said tube, means for moving said piston, in combination with a removable abutment, consisting of one or more arms secured to a revoluble shaft; said arms being adapted to bear against said projections, said shaft being carried in suitable fixed bearings and provided with an operating lever, substantially as set forth.

5. In apparatus for stopping the tapping hole of furnaces, a tube adapted to contain clay or other refractory material, a piston or plug fitted within said tube, means for moving said piston; in combination with a removable gage bar curved at its lower end and adapted to bear upon the upper surface of said tube; said gage being mounted upon a revoluble shaft and provided with means for adjusting its radial length, substantially as set forth.

In testimony whereof I affix my signature in presence of two witnesses.

SAMUEL W. VAUGHEN.

Witnesses:
H. L. BOYLE,
D. J. JONES.