F. H. N. GERWIG.

CLAY GUN.

APPLICATION FILED SEPT. 8, 1911.

1,013,153.

Patented Jan. 2, 1912.

4 SHEETS—SHEET 1.

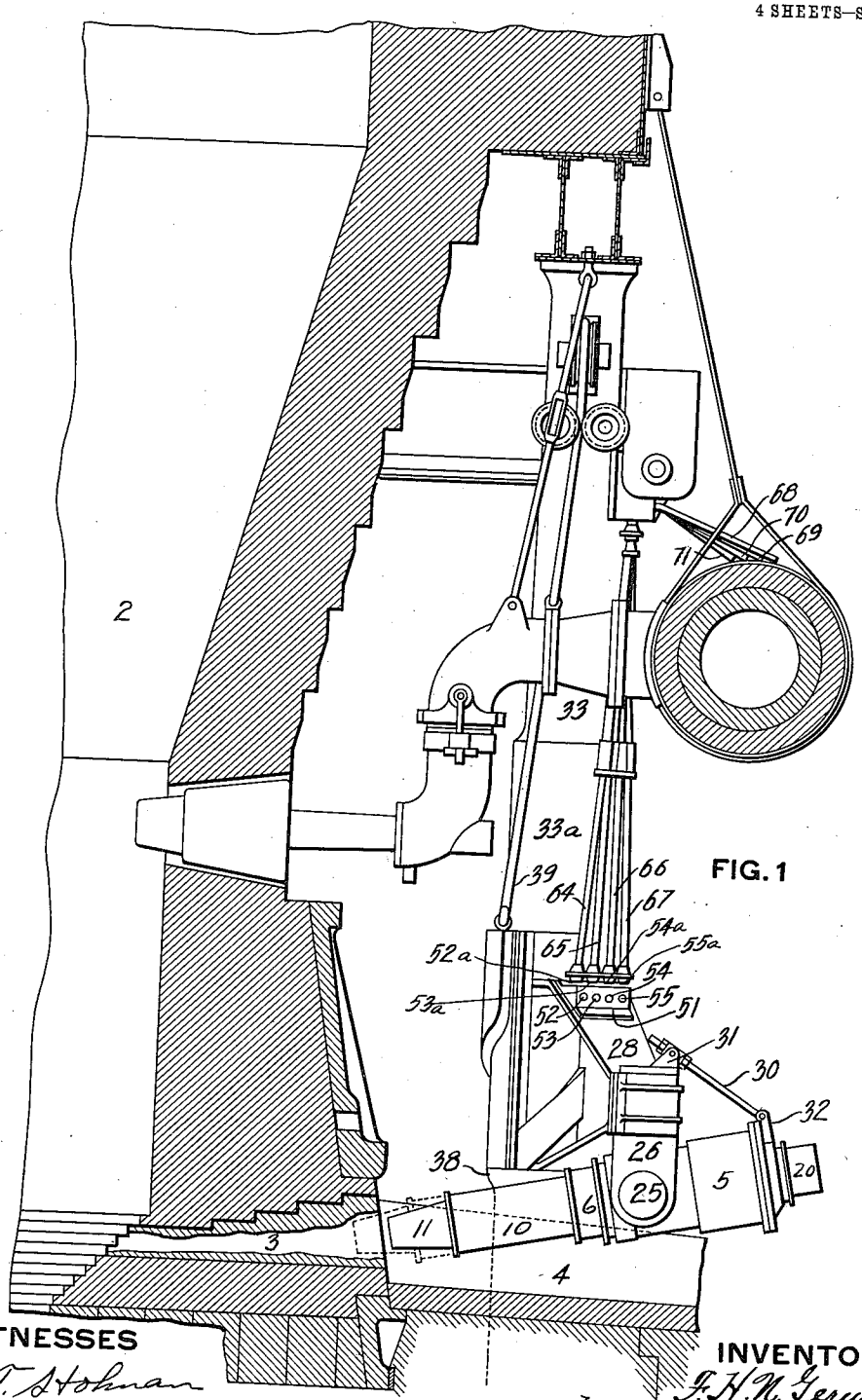

FIG. 1

WITNESSES

W. T. Stohman

R. D. Little

INVENTOR

F. H. N. Gerwig

by Lauthiceum, Belt & Fuller

his Attorneys

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4 SHEETS—SHEET 2.

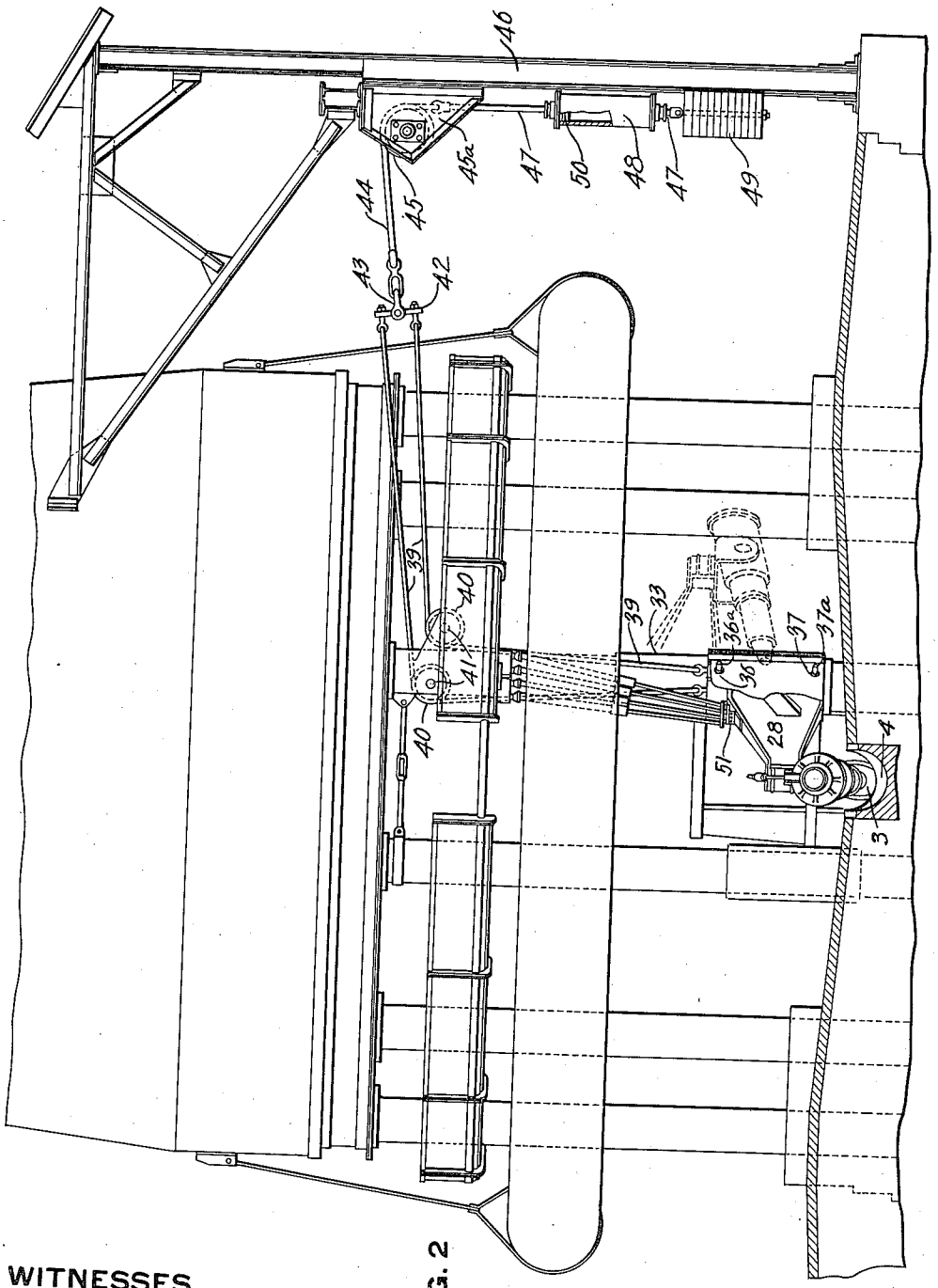

FIG. 2

WITNESSES

W. T. Holman

R. D. Little

INVENTOR

F. H. N. Gerwig

by Lucius Curtis Bolt, Miller

his Attorneys

F. H. N. GERWIG.

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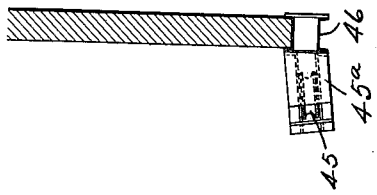
4 SHEETS—SHEET 3.



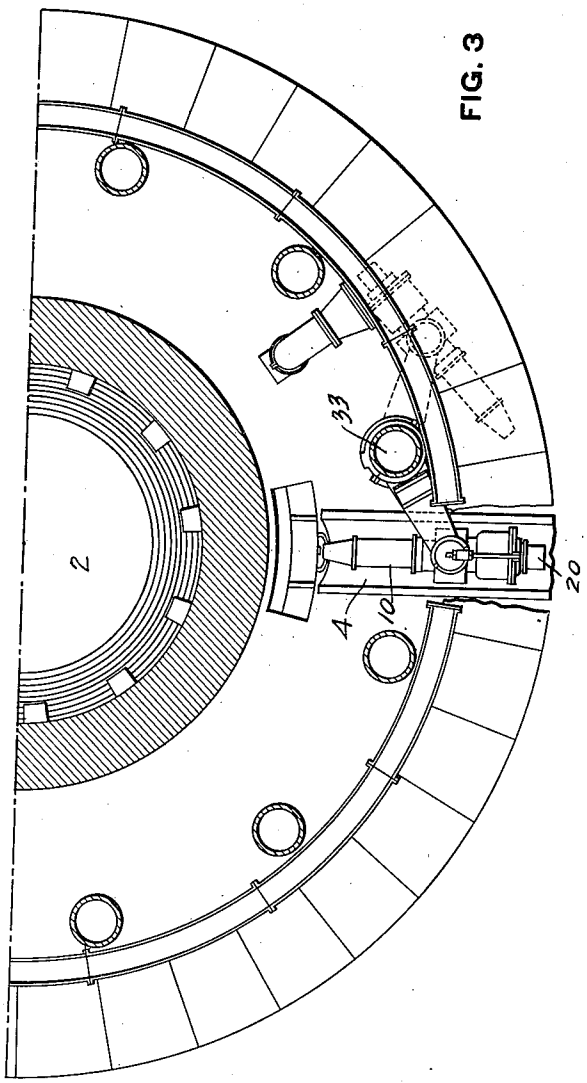


FIG. 3

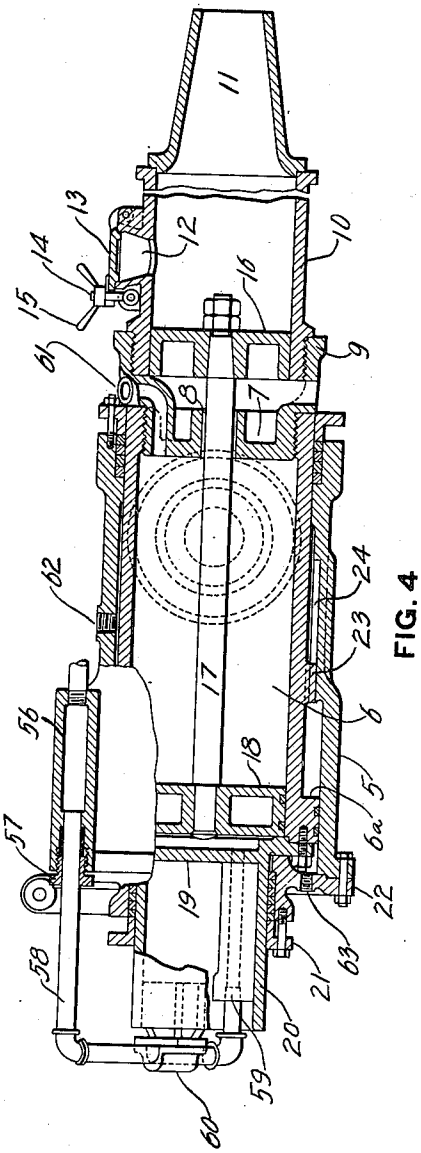


FIG. 4

WITNESSES

W. T. Stohman

R. D. Little

INVENTOR

F. H. N. Gerwig

by Lauthicum Bell & Fuller

his Attorneys

F. H. N. GERWIG.

CLAY GUN.

APPLICATION FILED SEPT. 8, 1911.

1,013,153.

Patented Jan. 2, 1912.

4 SHEETS—SHEET 4.

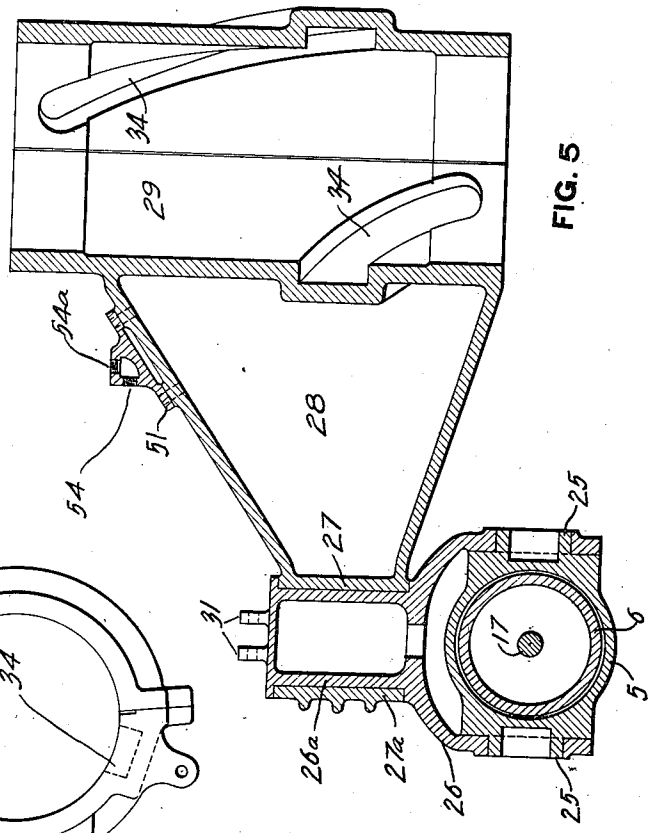


FIG. 5

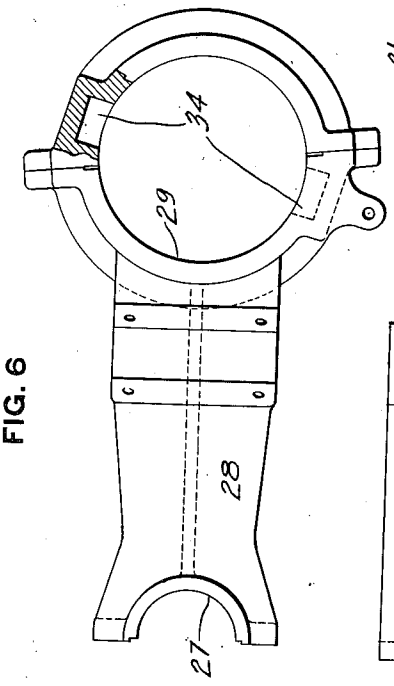


FIG. 6

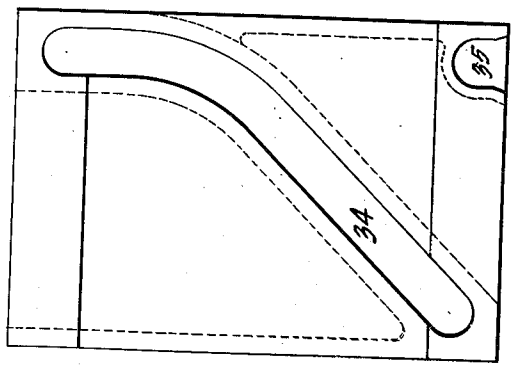


FIG. 7

WITNESSES

W. T. Stohman

R. S. Little

INVENTOR

F. H. N. Gerwig

by Lushbaugh Beebe Fuller

his Attorneys

UNITED STATES PATENT OFFICE.

FREDERICK H. N. GERWIG, OF PITTSBURGH, PENNSYLVANIA.

CLAY-GUN.

1,013,153. Specification of Letters Patent. Patented Jan. 2, 1912.

Application filed September 8, 1911. Serial No. 648,273.

To all whom it may concern:

Be it known that I, FREDERICK H. N. GERWIG, a citizen of the United States, residing at Pittsburgh, in the county of Allegheny, State of Pennsylvania, have invented certain new and useful Improvements in Clay-Guns, of which the following is a specification.

My invention relates to the construction and arrangement of clay guns used in closing or stopping tap holes of furnaces after the casting operations, and more particularly relates to apparatus used in plugging the tap holes of blast furnaces with plastic clay and similar materials.

One object of my invention is to provide a clay gun and actuating mechanism which is positively moved into and out of operative position in front of the tap-hole of the furnace to which it is applied.

Another object of the invention is to provide a clay gun or apparatus for stopping or plugging the tap-holes of blast furnaces which is automatically moved into operative position in the runner or iron trough in front of the furnace tap-hole, and is positively held against backward movement while being actuated to expel the clay from the clay cylinder into the tap-hole to stop the tap-hole or iron notch after each casting operation.

A further object of my invention is to provide apparatus for stopping the tap-holes of blast furnaces by the use of which the necessity of checking the furnace or shutting off the blast therefrom while the tap-hole or iron notch is being closed or plugged is avoided and rendered unnecessary.

A still further object of my invention is to provide apparatus for stopping the tap-holes of furnaces having novel means whereby the apparatus is moved out of its operative position in front of the tap-hole and by which the actuating mechanism is controlled by means located conveniently at a distance from in front of the furnace and still further objects of my invention will appear as more fully explained hereinafter.

Referring to the accompanying drawings forming part of this specification, Figure 1 is an elevation partly in section showing the tap-hole or iron notch of a blast furnace in longitudinal section, and having my improved clay gun and operating mechanism applied for use thereon. Fig. 2 is a front elevation of the furnace and apparatus shown in Fig. 1. Fig. 3 is a plan partly in section of the apparatus shown in Figs. 1 and 2. Fig. 4 is a longitudinal section, on an enlarged scale, showing a detail of the clay gun and clay gun support forming part of the apparatus. Fig. 5 is a sectional side elevation on an enlarged scale showing a detail of the connections between the clay gun and the furnace column and Fig. 6 is a plan partly in section of the same. Fig. 7 is a development of the spiral grooves in the inner faces of the sliding sleeve or support.

In the accompanying drawings, 2 designates a blast furnace having a tap-hole or iron notch 3 with a runner or trough 4 extending lengthwise in front of the tap-hole in the usual manner. Located in front of the tap-hole 3 is the clay gun which is shown, (in full lines) in the position into which it is swung in front of the furnace tap-hole preparatory to moving the nose of the gun forwardly lengthwise into the tap-hole 3 (into the position shown dotted in Fig. 1).

The clay gun comprises an outer fluid pressure cylinder 5 having a second cylinder 6 mounted therein so as to be lengthwise movable relatively thereto. One end of the fluid pressure cylinder 6 is provided with a cylinder head 7 having an internally screw threaded portion 9 in which the screw threaded end of the clay cylinder 10 is secured. The opposite end of the clay cylinder 10 is provided with a conical discharge nozzle 11 through which the clay or other plastic material is forced out of the cylinder in operating the clay gun, and, at an intermediate point in the length of this cylinder 10 an opening 12 is provided through which the plastic clay or other material used in plugging or filling the furnace tap-hole is placed within the clay cylinder. A hinged door or cover 13 is provided to normally close the opening 12, the bolt 14 being pivoted to the cylinder 10 and having a handled locking nut 15 to secure the cover 13 in closing position over the opening 12.

The clay cylinder 10 has a piston 16 connected to one end of a piston rod 17 which extends through an opening 8 in the cylin-

der head 7 into the cylinder 6, a piston 18 fixed to the other end of the piston rod 17 being located in the cylinder 6 to actuate the piston 16 in the clay cylinder 10 in expelling the clay or other plastic material placed therein in the tap-hole plugging or closing operations.

The cylinder 6 which is longitudinally movable in the outer cylinder 5 has a cylinder head 19 secured on its rear end which is provided with a cylindrical tail 20 arranged to extend rearwardly through the gland 21 in the stuffing box formed in the rear cylinder head 22 for the cylinder 5. A projection 23 on the cylinder 6 extends into the longitudinal slot 24 on the inner surface of the cylinder 5 to prevent rotary movement of the cylinder 6 when reciprocated in the cylinder 5, as is clearly shown in Fig. 4. The rear end of the cylinder 6 has an annular enlarged portion forming a piston 6^a, by which the cylinder 6 is reciprocated or moved lengthwise in the cylinder 5.

The cylinder 5 of the clay gun is provided with horizontally extending trunnions 25, 25 by which it is secured to the trunnion yoke 26 so as to be angularly adjustable. The trunnion yoke 26 has a vertically extending neck portion 26^a whereby the clay gun is mounted in the bearing 27 on the outer end of the arm 28 forming part of the sliding sleeve 29, the neck 26^a being axially adjustable in the bearing 27.

The clay gun, when mounted upon the sliding sleeve 29, is adjustable angularly relative to the horizontal in the trunnion yoke 26 to permit adjustment of the clay gun so as to point the nozzle 11 toward the tap-hole 3 at the proper angle when the clay gun is swung around by the arm 28 and sleeve 29 into alinement vertically with the center line of the tap-hole 3 and trough 4, (the position shown in Figs. 2 and 3.) The cylinders forming the clay gun are held in adjusted position in the trunnion yoke 26 by the eye bolt 30 secured in the brackets or lugs 31 on the yoke 26 and lugs 32 on the rear head 22 of the cylinder 5. The neck 26^a of the yoke which is rotatable in the bearing 27 is clamped and held in its axially adjusted position therein by the removable cap 27^a forming part of this bearing.

The sliding sleeve 29 encircles the enlarged portion 33^a of the column 33 forming one of the furnace supporting columns and is made in two sections, as clearly shown in Fig. 6, which are bolted together in movably securing the sleeve on the column 33. The inner surfaces of the sleeve 29 are provided with diametrically opposite slots or grooves 34, 34 which extend vertically downward from the upper end of the sleeve for a short distance and then continue spirally downward. (A development of one of these slots or grooves 34 on the sleeve 29 is shown in Fig. 7). The lower edge of the sleeve 29 is also provided with diametrically opposite slots or recesses 35, 35. The enlarged portion 33^a of the column 33 has a horizontal pin 36 extending transversely therethrough, the end portions 36^a of which project into the recesses 34 in the sleeve 29 to cause this sleeve and the clay gun supported thereon to swing axially around the column 33 when moved vertically by the lifting mechanism for the clay gun. A second horizontally extending pin 37 in the column 33, located at a lower point in the height thereof, has projecting end portions 37^a, 37^a which extend into the recesses 35 on the sleeve 29 so as to lock the sleeve and the clay gun mechanism mounted thereon against axial movement on the column 33 when the sleeve 29 is in its lowermost position. A flange 38 is provided on the column 33 to limit the downward movement of the sleeve and clay gun mechanism supported thereon.

The sleeve or support 29 is secured to one end of the chains or other flexible connections 39, 39, which pass around sheave wheels 40 rotatably mounted by pins 41 to the upper end of the column 33 and which are connected by the other end to the equalizing bar 42, attached by a clevis 43 to one end of the flexible connection 44. The cable or flexible connection 44 is caused to pass around a sheave wheel 45 rotatably secured on the bracket 45^a, which is fixed to one of the building columns 46 supporting the furnace cast house. The lower end of the cable 44 is secured to the upper end of a piston rod 47 which extends through the opposite ends of the fluid pressure cylinder 48. The lower end of the piston rod 47 has a counterweight 49 attached thereto to counterbalance, to a greater or lesser extent, the weight of the lifted parts of the clay gun and supporting mechanism. The piston rod 47, at an intermediate point in its length has a piston 50 which travels lengthwise in the cylinder 48, this cylinder also being attached to the column 46 of the cast house building.

A manifold 51 having a series of separate, independent, screw threaded outlet openings 52, 53, 54 and 55 is secured to the inclined upper surface of the swinging arm 28 carrying the clay gun. One of the outlets 52 is connected by piping to the screw threaded end of the fixed member 56 of the telescopic pipe connection through which fluid pressure is supplied to the rear end of the telescopic or longitudinally movable cylinder 6. The member 56 is formed integral on the outer surface of the cylinder 5 and its opposite end is provided with a stuffing box and gland 57 through which one end of the movable member 58 of the telescopic pipe connection extends. The opposite end of the

member 58 is connected to the port or inlet 59 for the cylinder 6 formed in the tail 20 on the cylinder head 19. A clamp 60 rigidly secures the pipe 58 to the tail 20 so as to reciprocate the movable telescoping member 58 with the cylinder 6. The outlet opening 53 in the manifold is connected by a walking pipe or flexible conductor to the port opening 61 in the opposite cylinder head 7 for the cylinder 6. The port opening 62 on the cylinder 5 is connected to the outlet 54 and the port opening 63 in the head 22 for the cylinder 5 is likewise connected by suitable piping to the other outlet 55 in the manifold 51. The piping just described other than the telescopic connection has not been shown in the drawings for the sake of clearness. Each of the four inlets 52^a, 53^a, 54^a and 55^a on the manifold 51 is connected by telescoping swivel pipes 64, 65, 66 and 67 (see Fig. 1) with stationary pipes 68, 69, 70, and 71 through which fluid pressure is supplied to and exhausted from the cylinders in actuating the clay gun cylinders. The stationary pipes 68 and 69 are connected to a four way operating valve of any known type which is located adjacent to the building column 46 on which the lifting cylinder 48 is secured. The stationary pipes 70 and 71 likewise are connected to a similar four way valve in the same location and a third four way valve is connected by suitable piping to the ports in the opposite ends of the lifting cylinder 48 so that the apparatus may be manipulated from a point adjacent to the building column 46 and far enough away from the iron notch 3 to be out of danger of injury to the operator. The valves are provided with suitable exhaust pipes and are connected to a source of fluid pressure supply.

The operation of my improved apparatus is as follows:—The clay gun and actuating mechanism being swung into the position shown dotted in Figs. 1 and 2, the opening 12 is uncovered and the clay cylinder 10 is filled with plastic clay, or a plastic mixture of clay and plumbago. Water ordinarily is used in rendering the material plastic. When the cylinder 10 is being filled the piston is in its retracted position (that shown dotted in Figs. 2 and 3). The operating valve for the lifting cylinder is then manipulated to admit fluid pressure to the lower side of the piston 50 in the cylinder 48 and the piston 50 is thereby caused to rise or lift in this cylinder. At the beginning of the lifting movement of the piston 50 the swinging arm 28 and sleeve support 29 with the clay gun mechanism carried thereby begins to move downwardly into lowered position. When downward movement of the arm 28 and the clay gun mechanism supported thereon commences, the spiral grooves 34 on the interior of the sleeve 29 which surrounds the enlarged machined portion 33^a of the column 33 by engagement with the ends 36^a of the pin 36 causes the sleeve 29 formed integral with the supporting arm 28 and mechanism thereon to move downwardly in a spiral path. This movement gradually swings or advances the clay gun from the position shown dotted in Figs. 2 and 3, toward that shown in full lines in these figures. When the spiral movement of the sleeve 29 has progressed so as to swing the clay gun into position in alinement vertically with the tap-hole 3 and trough 4 the vertically extending portions of the opposite grooves 34 in the bore of the sleeve 29, by engagement with the ends 36^a, 36^a of the pin 36 in the column 33 cause the clay gun in its further downward movement into operative position to descend vertically into the trough 4, without further spiral movement, into the position shown in full lines in Fig. 1. The vertically downward movement of the sleeve 29 on the column 33 brings the projecting ends 37^a, 37^a of a second pin 37 into locking engagement with the sides of the opposite recesses 35, at diametrically opposite points on the lower marginal edge of the sleeve 29 so as to prevent swinging of the arm 28 and sleeve 29 on the column 33 when in this position. The flange 38 limits the downward movement of the sleeve 29 by engagement with the end of this sleeve. Its controlling valve is then manipulated to cause the cylinder 6 to move lengthwise in the cylinder 5 until the nozzle 11 on the discharge end of the clay cylinder 10 is advanced into the furnace tap-hole 3 from the position shown in full lines in Fig. 2 into that shown by dotted lines, and when gaseous fluid pressure is used, the valve is maintained in open position to hold the cylinder 6 in advanced position in the cylinder 5 while the clay is being expelled from the clay cylinder. The operating valve for the cylinder 6 is then manipulated to cause the piston 16 to advance in the clay cylinder 10 and expel the clay or other material therein into the tap-hole 3 of the blast furnace, so as to effectively plug or close the tap-hole. The clay cylinder 10 is made of sufficient size to hold a quantity of clay sufficient to insure the tap-hole 3 always being filled. After the clay has been expelled from the clay cylinder 10 the operating valve is manipulated so as to retract the cylinder 6 in the cylinder 5 and fluid pressure is then admitted to the upper end of the lifting cylinder 44. The clay gun is thereby caused to first lift vertically until out of and clear of the trough 4, and, upon continuing the lifting movement, the clay gun is automatically swung about the axis of the column 33, to which the apparatus is secured, until again in the position shown dotted in Figs.

2 and 3. The clay cylinder is then again filled with the plastic material used in stopping or closing the tap-hole in the same manner as before described. The apparatus is then in operative condition in readiness to be again automatically swung into position and actuated to plug the tap-hole of a furnace when required, and after each casting operation the above described operations are repeated in plugging the tap-holes of such furnaces.

The advantages of my invention will be apparent to those skilled in the art. By its use the clay gun is easily and quickly shifted into position in line with the tap-hole of the furnace and secured in operating position without manual labor, other than manipulating the remotely located operating valves. The nozzle of the clay gun is brought in close proximity to the tap-hole so that by expelling the clay from the clay cylinder the tap-hole is quickly and effectively stopped or plugged. The clay gun is locked in operative position in front of the tap-hole and backward movement thereof during the clay expelling operation is prevented. After the completion of the stopping or plugging operation the apparatus is automatically moved backwardly into position away from in front of the furnace.

A distinct advantage of my invention lies in constructing the clay cylinder of the apparatus of a size to hold a sufficient quantity of clay to fill the tap-hole of the furnace at a single stroke of the clay expelling piston.

Modifications in the construction and arrangement of the parts may be made without departing from my invention as defined in the claims. The mechanism for supporting the clay gun may be changed and other variations may be made.

I claim:—

1. Apparatus for stopping furnace tap-holes comprising a clay gun, a vertically movable supporting arm to which the clay gun is secured, a stationary support on which the supporting arm is movably mounted and means on the supporting arm and stationary support co-acting to swing the supporting arm and clay gun axially on the stationary support when the supporting arm is moved vertically.

2. Apparatus for stopping furnace tap-holes comprising a clay gun, a movable supporting arm to which the clay gun is secured, a stationary support on which the supporting arm is movably mounted, means for moving the supporting arm vertically on the stationary support and means on the supporting arm and stationary support co-acting to swing the supporting arm and clay gun axially on the stationary support when the supporting arm is moved vertically.

3. Apparatus for stopping furnace tap-holes comprising a clay gun, a movable supporting arm to which the clay gun is secured, a stationary support on which the supporting arm is movably mounted, means for moving the supporting arm vertically on the stationary support and means on the stationary support engaging the supporting arm whereby the supporting arm is swung axially around the axis of the stationary support when the supporting arm is lowered on the stationary support to thereby move the clay gun into operative position in front of the furnace tap-hole.

4. Apparatus for stopping furnace tap-holes comprising a clay gun, a movable supporting arm to which the clay gun is secured, a stationary support on which the supporting arm is movably mounted, means for moving the supporting arm vertically on the stationary support and means on the stationary support engaging the supporting arm to swing the clay gun axially about the axis of the stationary support when the support is lifted to thereby move the clay gun out of operative position in front of the furnace tap-hole.

5. Apparatus for stopping furnace tap-holes comprising a clay gun, a movable supporting arm to which the clay gun is secured, a stationary support on which the supporting arm is movably mounted, means for moving the supporting arm vertically on the stationary support, means on the supporting arm and stationary support co-acting to swing the supporting arm and clay gun axially on the stationary support when the supporting arm is moved vertically and means on the stationary arm support and supporting arm co-acting to automatically lock the clay gun against backward movement when in position in front of the furnace tap-hole.

6. Apparatus for stopping furnace tap-holes comprising a clay gun, a movable supporting arm to which the clay gun is secured so as to be angularly adjustable, a stationary support on which the supporting arm is movably mounted, means by which the clay gun is secured in adjusted position on the supporting arm, means for moving the supporting arm vertically on the stationary support and means on the supporting arm and stationary support co-acting to swing the supporting arm axially on the stationary support when the supporting arm is moved vertically.

7. A clay gun for closing furnace tap-holes comprising a clay cylinder and a motive cylinder arranged in tandem, pistons in said cylinders operatively connected together, a support for said cylinders permitting lengthwise movement thereof in the support, means on which the cylinder support is mounted, mechanism for moving the cylinders on the support to bring the clay cylinder nozzle into and out of operative po-

sition in front of the tap-hole, and independent means for moving the cylinder support, said independent cylinder moving means being arranged to automatically swing the cylinder support and cylinders into and out of position in front of the furnace tap-hole.

8. A clay gun for closing furnace tap-holes comprising a clay cylinder and a motive cylinder arranged in tandem, pistons in said cylinders operatively connected together, a support for said cylinders permitting lengthwise movement thereof in the cylinder support, means on which the cylinder support is mounted, mechanism for moving the cylinders on the support to bring the clay cylinder nozzle into and out of operative position in front of the tap-hole, independent means for moving the cylinder support, said means being arranged to automatically swing the cylinder support to move the cylinders into and out of position in front of the furnace tap-hole and means whereby the cylinder support is locked against backward movement when in operative position in front of the furnace tap-hole.

9. A clay gun for closing furnace tap-holes comprising a clay cylinder and a motive cylinder arranged in tandem, pistons in said cylinders operatively connected together, means for supporting said cylinders permitting lengthwise movement thereof in the cylinder support, means for moving the cylinders on the support to move the clay cylinder nozzle into and out of operative position in front of the tap-hole and means for raising and lowering said cylinder support and cylinders carried thereby, said lifting means being arranged, when being lifted, to automatically swing the supports, and cylinders away from in front of the furnace tap-hole.

10. A clay gun for closing furnace tap-holes comprising a clay cylinder and a motive cylinder arranged in tandem, pistons in said cylinders operatively connected together, means for supporting said cylinders permitting lengthwise movement thereof in the cylinder support, means for moving the cylinders on the support to bring the clay cylinder nozzle into and out of operative position in front of the tap-hole and means for raising and lowering said cylinder support and cylinders carried thereby, said lifting means being arranged when being lowered to automatically swing the support and cylinders into position in front of the furnace tap-hole.

11. A clay gun for closing furnace tap-holes comprising a clay cylinder and a motive cylinder arranged in tandem, pistons in said cylinders operatively connected together, means for supporting said cylinders permitting lengthwise movement thereof in the cylinder support, means for moving the cylinders on the support to bring the clay cylinder nozzle into and out of operative position in front of the tap-hole, and power means for raising and lowering said cylinder support and cylinders carried thereby, said lifting means being arranged when being lowered to automatically swing the support and cylinders into position in front of the furnace tap-hole and lock the gun in such position.

12. A clay gun for closing furnace tap-holes comprising a clay cylinder and a motive cylinder arranged in tandem, pistons in said cylinders operatively connected together, means for supporting said cylinders permitting lengthwise movement thereof in the cylinder support, means for moving the cylinders on the support to bring the clay cylinder nozzle into and out of operative position in front of the tap-hole and means for raising and lowering the cylinder support and cylinders carried thereby, said means being arranged to automatically swing the cylinders into and out of operative position in front of the furnace tap-hole.

13. A clay gun for closing furnace tap-holes comprising a clay cylinder, a motive cylinder, pistons in said cylinders and operatively connected together, a support to which said cylinders are pivotally secured and clamping means for adjusting the cylinders angularly with respect to the support, said clamping means being arranged to secure the cylinders in adjusted position on said support.

14. A clay gun for closing furnace tap-holes comprising a clay cylinder, a motive cylinder, pistons in said cylinders and operatively connected together, a trunnion yoke on which the cylinders are pivoted, means for securing the cylinders in angularly adjusted position on said yoke, a support to which said yoke is pivotally secured and clamping means for adjusting the yoke and cylinders angularly with respect to the support, said clamping means being arranged to secure the cylinders in adjusted position on said support.

15. An apparatus for stopping furnace tap-holes comprising in combination, a clay gun, a vertically movable support for said gun and means on said support whereby the support and gun is moved axially during said vertical movement.

16. A clay gun for closing furnace tap holes comprising a clay cylinder, a support to which said cylinder is pivotally secured and clamping means for adjusting the cylinder angularly with respect to its support, said clamping means being arranged to secure the cylinder in adjusted position on the support.

17. Apparatus for stopping furnace tap holes comprising a clay gun, a movable sup-

port to which the clay gun is secured, a stationary support on which the movable support is movably mounted, and means on the movable support and stationary support coacting to swing the movable support and clay gun axially on the stationary support when the movable support is moved.

In testimony whereof, I have hereunto set my hand.

FREDERICK H. N. GERWIG.

Witnesses:
L. H. PARK,
JOHN W. TOPPES.