Nov. 4, 1930. J. C. HOPKINS ET AL 1,780,485

OPERATING BLAST FURNACES

Filed May 13. 1929 4 Sheets-Sheet 1

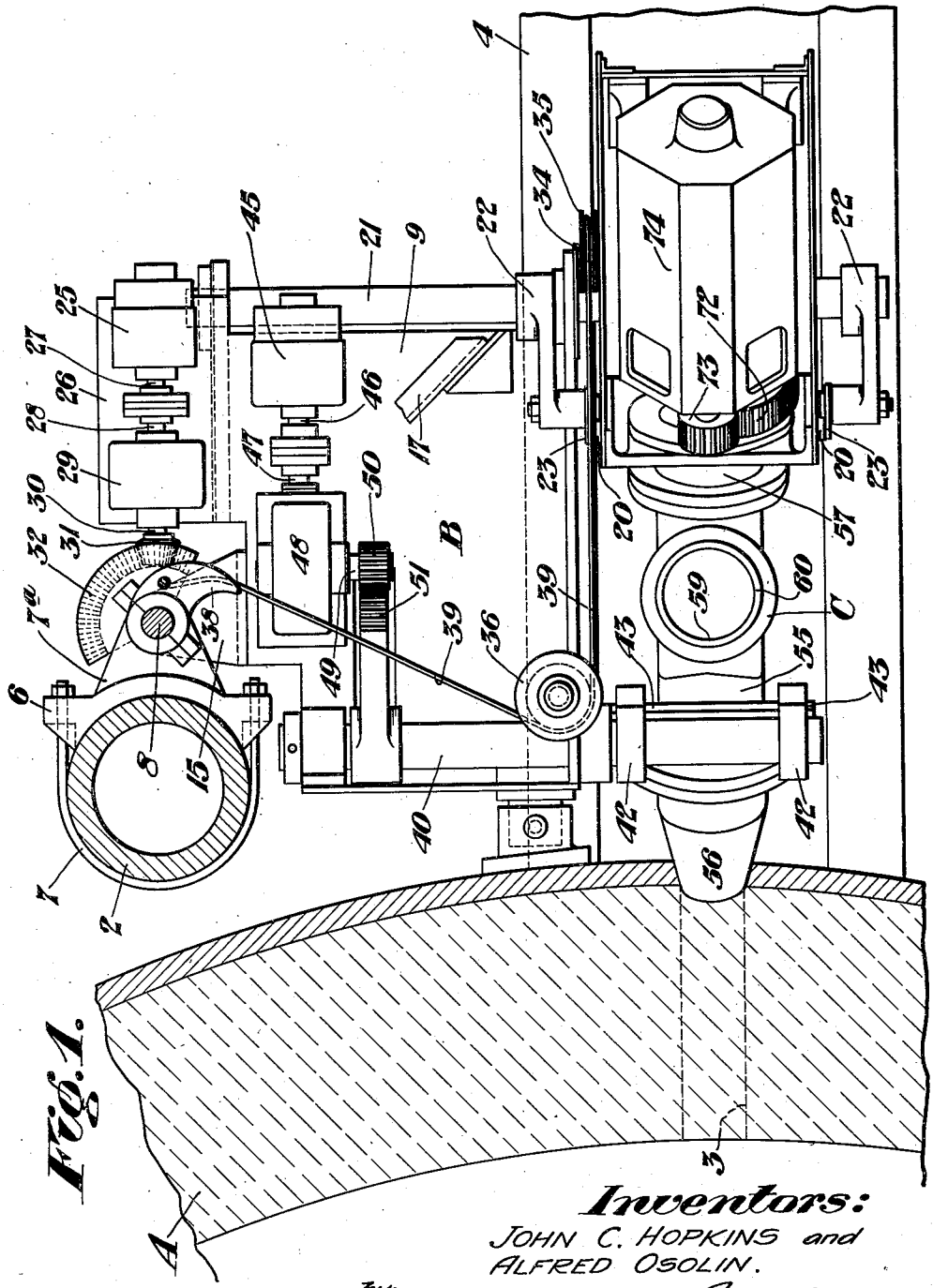


Fig. 1.

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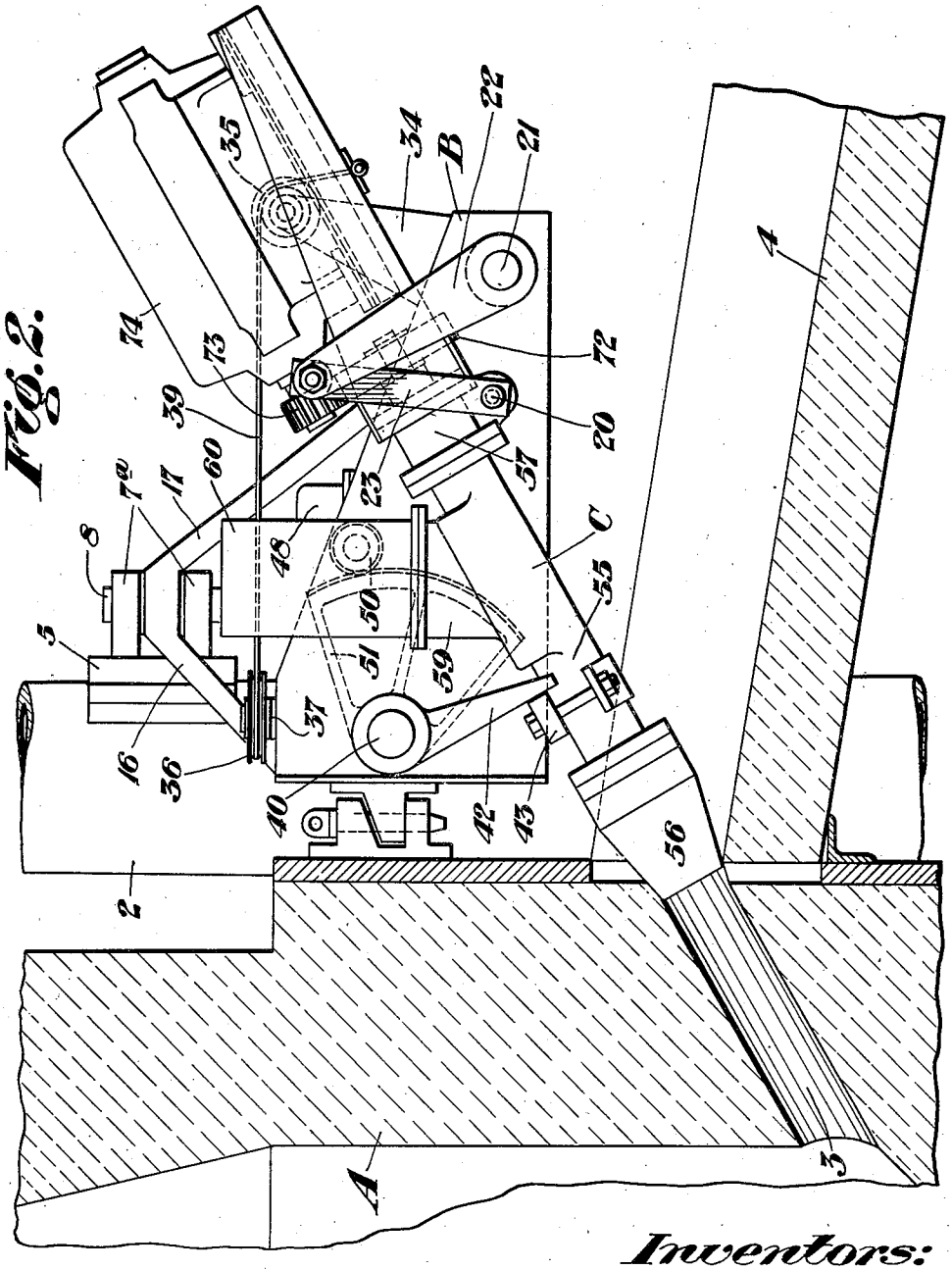
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Fig. 2.



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OPERATING BLAST FURNACES

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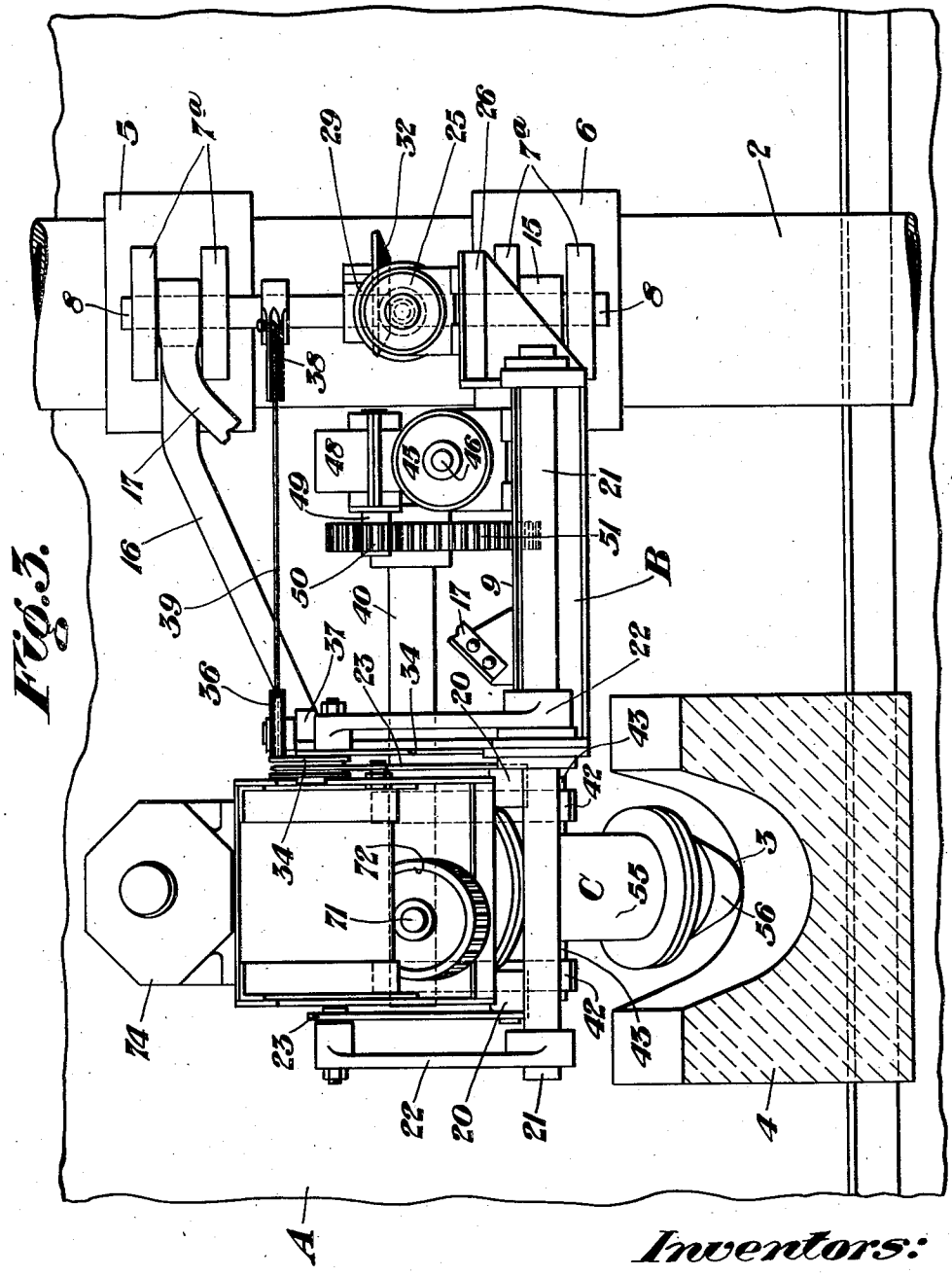


Fig. 3.

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Filed May 13. 1929 4 Sheets-Sheet 4

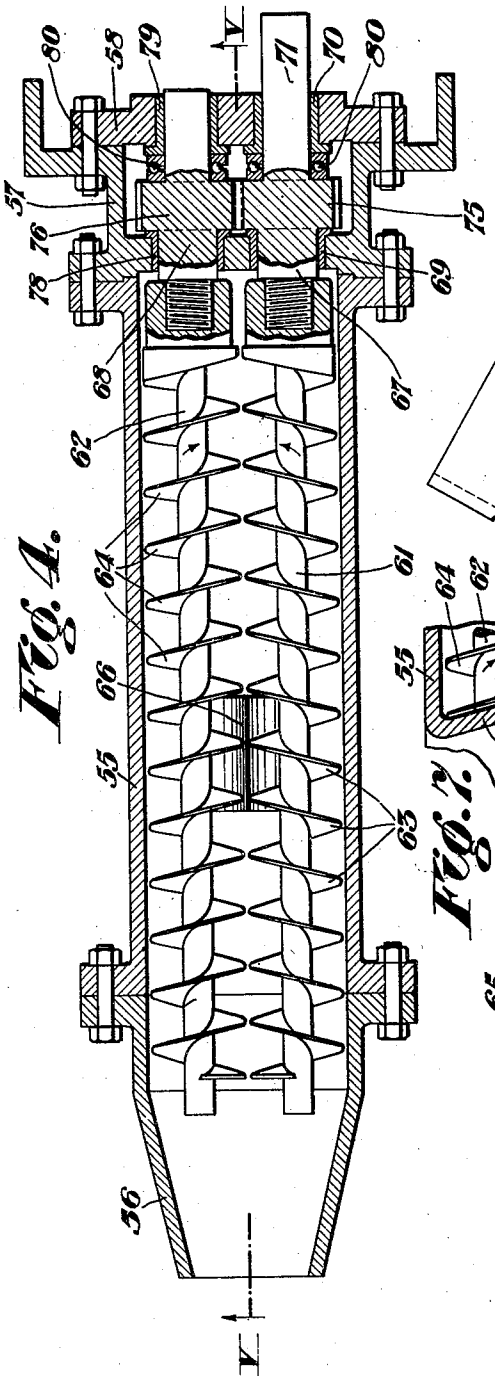


Fig. 4.

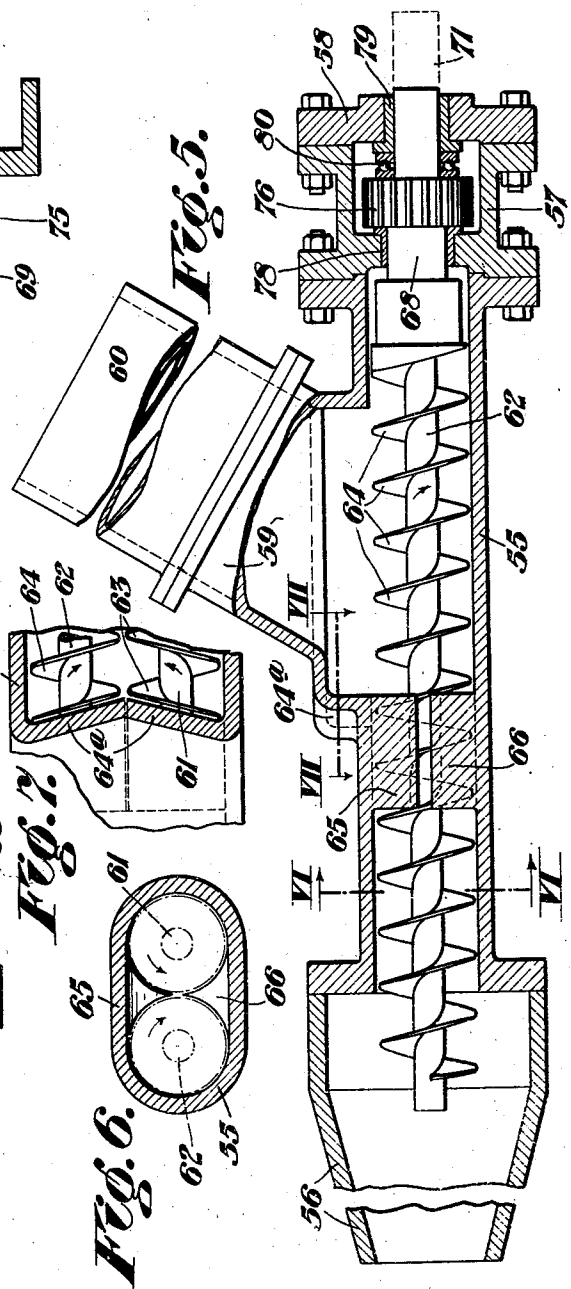


Fig. 5.

Fig. 7.

Fig. 6.

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UNITED STATES PATENT OFFICE

JOHN C. HOPKINS, OF LAKEWOOD, AND ALFRED OSOLIN, OF CLEVELAND, OHIO

OPERATING BLAST FURNACES

Application filed May 13, 1929. Serial No. 362,794.

This invention relates to an improved method of operating blast furnaces and has for its object the provision of a novel method whereby the blast may be maintained constant or substantially constant throughout the operation of the furnace.

Heretofore it has been the universal practice to reduce the blast pressure to a minimum when plugging the tapping-hole of a blast furnace in order to permit the intermittent charges of clay to be forced into the hole by the reciprocating plungers of the air and steam guns commonly used. When the blast pressure is reduced or taken off in this old practice the stock has a tendency to pack, with the result that when the blast is again applied the pressure instead of staying at its customary reading frequently goes from two to five pounds higher. Within an hour if the blast pressure has not receded to normal, the blast must be checked until the stock contracts and falls into the melting zone. This condition is never found when the method of this invention is practiced since the blast pressure is always maintained substantially constant. Also when the blast pressure is maintained constant on a blast furnace, the production of iron is materially increased. In one commercial operation of this method comparison of the charging records show that under the method of this invention, the stack is taking one more round per cast than it did when the practice of checking the blast at casting times was followed. This increased production is equivalent to twenty-eight tons of iron each twenty-four hours having a monetary value of approximately five hundred dollars.

It is not possible to commercially plug the tapping-holes of blast furnaces with the blast on by the use of the steam and air guns of the prior art due to their intermittent action and the danger of the blowing out of the clay plug while the plunger is retracted to receive a new supply of clay.

The present method contemplates the forcing of a continuous, uninterrupted flow of clay into the tapping-hole under enormous pressure and while the blast is on the furnace so as to completely plug the tapping-hole in a single uninterrupted operation.

In the drawings, which show one form of apparatus for carrying out the method of this invention:

Figure 1 is a plan view, partly in section, showing a mud gun constructed in accordance with this invention, in operative position on a furnace.

Figure 2 is a side elevation thereof.

Figure 3 is a rear elevation thereof.

Figure 4 is a sectional plan through the gun, per se, showing the internal mechanism thereof.

Figure 5 is a sectional elevation taken on the line V—V of Figure 4.

Figure 6 is a transverse section taken on the line VI—VI of Figure 5.

Figure 7 is a fragmentary sectional plan taken on the line VII—VII of Figure 5.

Referring more particularly to the drawings, the letter A designates a portion of blast furnace wall and the numeral 2 designates a furnace column. The furnace wall A is of usual construction and has the usual iron tap-hole 3 which opens into an iron runner-trough 4.

A mud gun carriage B is hingedly supported on the furnace column 2. A pair of hinge-brackets 5 and 6 are secured in vertical spaced relation on the column 2 by U-bolts 7. The hinge-brackets 5 and 6 are each provided with spaced apertured hinge-lugs 7^a. A hinge-shaft 8 is fixed in the apertured lugs 7^a against rotary and vertical movement.

A carriage platform 9 is hingedly supported on the shaft 8 and is provided with a hinge member 15 journaled on the hinge-shaft 8 between hinge-lugs 7^a on the lower hinge-bracket 6. A pair of supporting brace-rods 16 and 17 are secured to the platform 9 and have their upper ends joined and journaled on the hinge-shaft 8 between the hinge-lugs 7^a on the upper hinge-bracket 5.

A mud gun C, having trunnions 20, is mounted on the carriage platform 9 so as to have a swinging and pivotal movement relative thereto. A shaft 21 is rigidly mounted on the carriage 9 and projects outwardly

beyond the iron runner side of the carriage. A pair of bracket-arms 22 are secured in spaced relation on the projecting end of the shaft 21 and extend upwardly and forwardly on an angle toward the furnace. A pair of hanger-bars 23 are provided, one of which is pivotally connected to the upper end of each of said bracket-arms, and depend therefrom.

The lower end of the hanger-rods or bars 23 are provided with bearings in which the trunnions 20 of the mud gun C are journaled. The trunnions 20 of the gun are positioned intermediate the ends of the gun at the line of balance so that the gun will be balanced on the trunnions.

A motor 25 is mounted on a motor-bracket 26, secured on the carriage and has its armature shaft 27 coupled to a shaft 28 of a gear reducer 29, which has a shaft 30 provided with a pinion 31. The pinion 31 is meshed with a segmental rack-member 32 which is fixedly mounted on the fixed hinge-shaft 8.

When power is supplied to the motor 25 the shaft 30 and pinion 31 will be rotated and since the rack 32 is fixed, the pinion 31 will be compelled to travel around the rack and will, therefore, pull or swing the platform around the hinge-shaft 8.

A vertical bracket 34 is secured to the rear corner of the carriage platform nearest the mud gun and carries a vertically disposed sheave 35 at its upper end. A horizontally disposed sheave 36 is journaled on a bracket 37 secured to the upper forward corner of the carriage 9. A cam-arm 38 is secured to the shaft 8 at a point above the rack-member 32. An elevator cable 39 is secured to the gun B adjacent its rear end and is trained around the sheaves 35 and 36, and over the cam-arm, and has its other end secured to the cam-arm 38.

When the carriage is swung toward the furnace, the cable 39 will be moved against the cam-arm 38 and will thereby be forced to lift or elevate the rear end of the mud gun C, so as to rock the gun about the trunnions 20 and lower the forward or nose end of the gun down into line with the tap-hole 3 of the furnace A.

When the carriage is swung away from the furnace, the cable 39 will be moved away from the cam-arm 38 so as to slack the tension on the cable, and the gun C will automatically be brought to a horizontal position by gravity since it is substantially balanced on its trunnions 20.

A shaft 40 is journaled on the carriage 9 and has its one end projected over the mud gun C. A pair of gun-holding dogs or arms 42 are secured to the shaft 40 and are adapted to engage lugs 43 on the gun and to swing or force said gun forwardly into the iron tap-hole 3 and hold said gun in position.

A motor 45 is mounted on the carriage 9 and has its armature shaft 46 coupled to a shaft 47 of a worm and worm-wheel speed reducing gearing 48 which has a shaft 49 provided with a pinion 50, which is meshed with a segmental curved rack 51 secured on the shaft 40.

The mud gun C to which this application is particularly directed comprises a screw conveyer housing or gun barrel 55 having a tapered nozzle 56 secured to its forward end and a gear housing 57 secured to its rear end. The gear housing 57 is closed by a cover-plate 58. The conveyer housing or barrel 55 has its upper wall stepped upwardly intermediate its ends forming a hopper portion 59 that is provided with a hopper extension 60.

A pair of screw conveyers 61 and 62 are mounted in the barrel or conveyer housing 55 and extend from the rear end of said housing forwardly into the nose or nozzle portion 56.

The screw conveyer 61 is provided with left-hand spiral flights 63 and is adapted to be rotated in a clockwise direction, while the conveyer 62 is provided with right-hand spiral flights 64 and is adapted to be rotated in a counter-clockwise direction.

The conveyers 61 and 62 are adapted to force clay or other plastic material from the hopper 59 through the conveyer housing or gun barrel, and out of the nozzle 56 under pressure to plug the tap-hole of the furnace. Therefore, it is essential that there be no back flow of the clay or plastic material.

In order to prevent a back flow of the clay or plastic material, the forward end wall of the hopper at its point of juncture with the conveyer housing or gun barrel is inclined from the side walls of the conveyer housing rearwardly and toward the longitudinal axis of the conveyer housing on an angle, as designated by the numeral 64^a, parallel with the angle of the flights on the conveyers 61 and 62. By forming the lower end of the forward wall of the hopper on the angles, as above described, the flights on the respective conveyers will simultaneously close the space between the forward edge of the hopper and the conveyer flights as said conveyers are rotated.

The upper and lower walls of the conveyer housing 55 are provided with substantially wedge-shaped projections 65 and 66, respectively, immediately forward of the hopper 59, which extend into the spaces between the conveyers so as to seal said spaces and prevent a back flow of the clay under pressure through these spaces.

The rear ends of the conveyers 61 and 62 are provided with threaded apertures or sockets in which shafts 67 and 68, respectively, are threaded. The shaft 67, secured to the conveyer 61, is journaled in bearings 69 and 70 in the gear housing 57, and is extended, as at 71, materially beyond the gear housing, and carries a gear 72 which is meshed with the

drive pinion 73 of a drive motor 74 carried by the gun. The motor 74 may be powered by electricity, fluid, or any other source of power.

A pinion 75 is either formed integral with or secured to the shaft 67 and is meshed with a pinion 76 on the shaft 68, which shaft is journaled in bearings 78 and 79 in the gear housing 57.

The motor 74 is adapted to rotate the shaft 67 in a clockwise direction and consequently since the shaft 67 is secured directly to the conveyer 61 the conveyer 61 will likewise be rotated in a clockwise direction, while the shaft 68 and conveyer 62 will be rotated counter-clockwise since the shaft 68 is connected directly to the conveyer 62 and is driven by the shaft 67 through the pinions 75 and 76.

The shafts 67 and 68 are provided with a thrust bearing 80 mounted between their respective pinions 75 and 76, and the cover-plate 58, forming the rear end of the gear housing 57. The bearings 80 are adapted to take up the rear thrust of the conveyers as they force the clay forward through the gun.

Throughout this specification and accompanying claims the term mud is to be construed broadly and is meant to cover clay, or any plastic material used to seal the iron or other tap-holes in furnaces or similar structures where guns of the class to which this invention belongs are used.

In carrying out the method of this invention the furnace will be operated and tapped in the usual manner with the blast pressure on. The iron will run through the runner or trough 4 in the usual manner.

The hopper 59 of the gun will be filled with clay, and when it is desired to stop the iron flow the motor 25 will be operated to swing the platform and gun around into tapping-hole plugging position, in which position the nozzle 56 of the gun will enter the tapping-hole 3. The motor 74 will then be started and will rotate the shafts 67 and 68, thereby rotating the screw conveyers 61 and 62 simultaneously in opposite directions so as to cause the clay to be pulled out of the hopper 59 and forced forward in a continuous uninterrupted stream into the tapping-hole 3 until said hole is completely filled and plugged. The screw conveyers 61 and 62 are capable of exerting enormous pressure on the clay and, therefore, will plug or stop the tapping-hole 3 while the blast is on and when a flow of iron is flowing through the hole.

The novel features of this invention are the feeding of a continuous, uninterrupted stream of clay under enormous pressure into the tapping-hole while the blast pressure is on full, and until the tapping-hole is completely filled.

We claim:

1. In the operation of blast furnaces the steps consisting of tapping said furnaces with the blast pressure on, and then stopping the iron flow while the blast pressure is maintained by forcing a continuous and uninterrupted flow of clay into the tapping-hole under sufficient pressure to stop the flow of iron and until the tapping-hole is completely plugged.

2. In the operation of blast furnaces the step of plugging the tapping-hole by forcing a continuous and uninterrupted flow of clay into the tapping-hole until the tapping-hole is completely plugged.

3. In the operation of blast furnaces the step of plugging the tapping-hole while maintaining the blast at substantially normal pressure by forcing a continuous and uninterrupted flow of clay into the tapping-hole until the tapping-hole is completely plugged.

In testimony whereof, we hereunto set our hands.

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ALFRED OSOLIN.