

Feb. 18, 1964

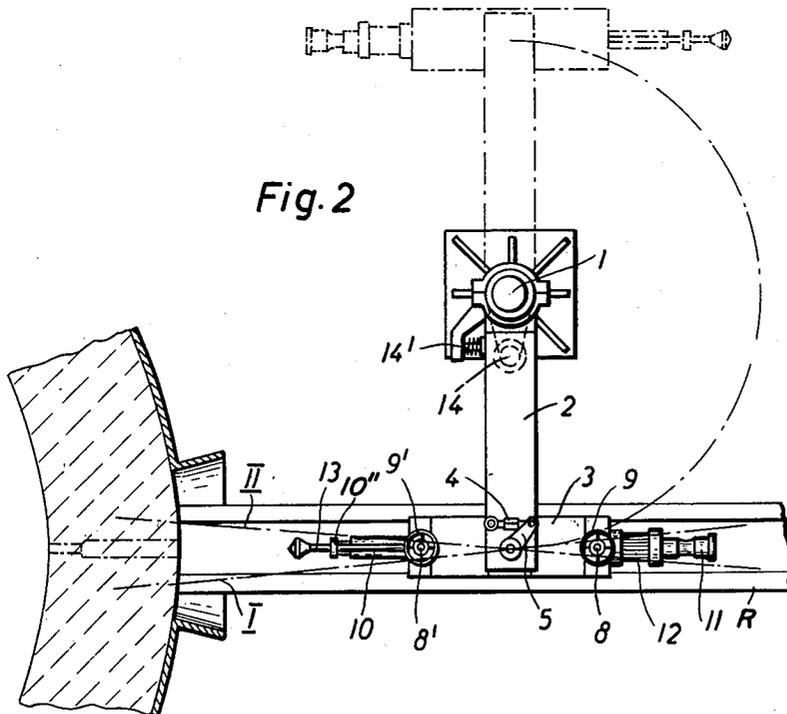
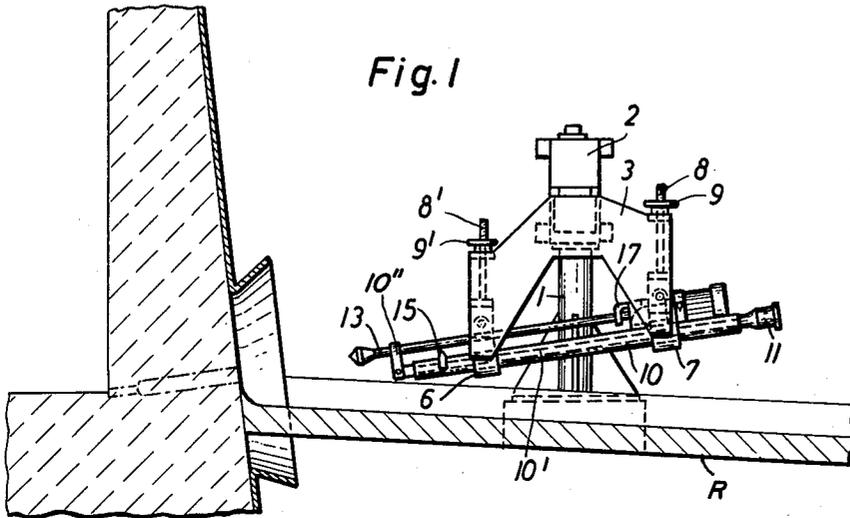
W. HORN

3,121,769

APPARATUS FOR OPENING THE TAP HOLE OF A METALLURGICAL FURNACE

Filed Sept. 10, 1959

5 Sheets-Sheet 1



INVENTOR
WALTER HORN
BY
Mestern & Hollin
ATTORNEYS

Feb. 18, 1964

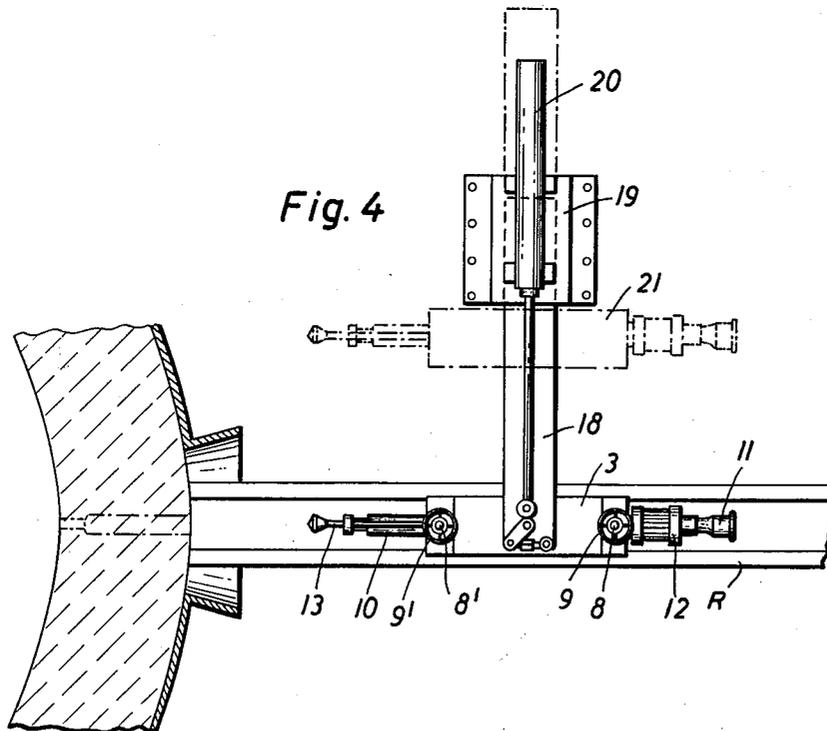
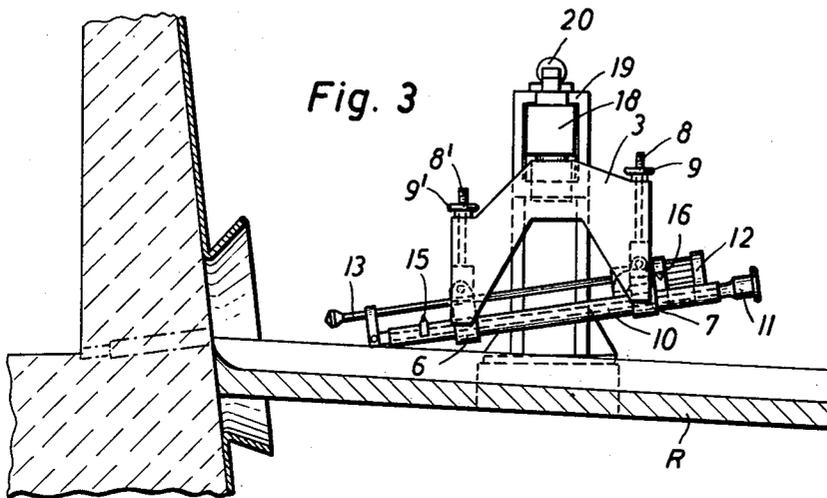
W. HORN

3,121,769

APPARATUS FOR OPENING THE TAP HOLE OF A METALLURGICAL FURNACE

Filed Sept. 10, 1959

5 Sheets-Sheet 2



INVENTOR
WALTER HORN
BY
Western & Hollin
ATTORNEYS

Feb. 18, 1964

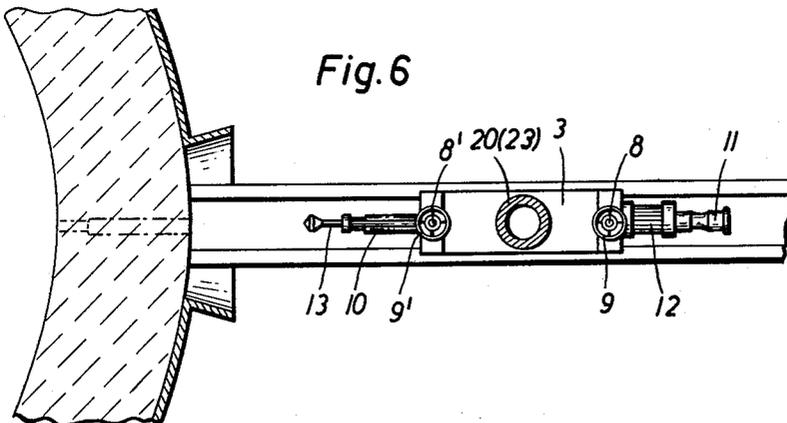
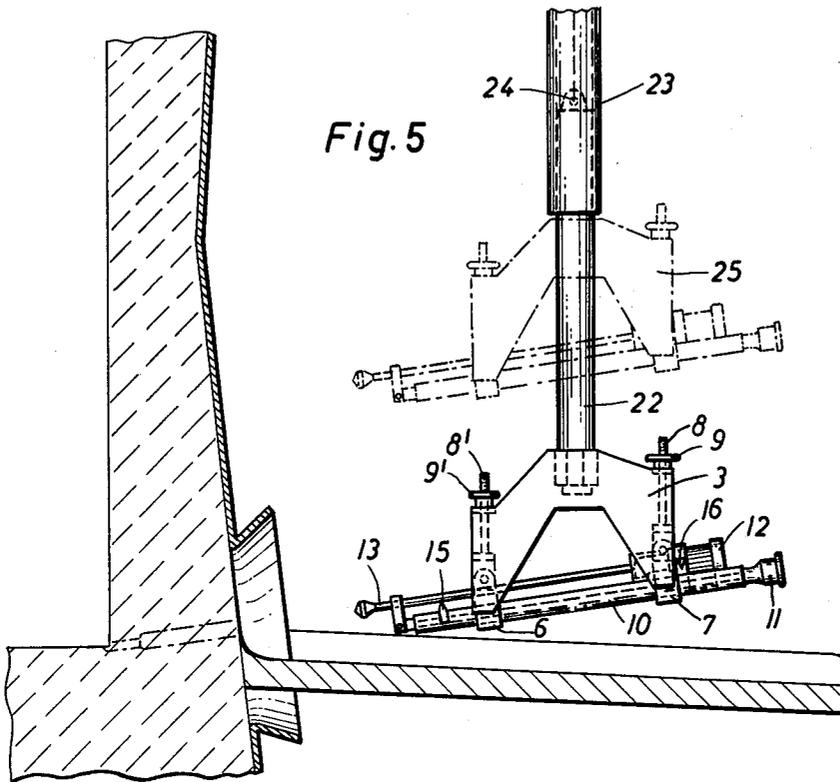
W. HORN

3,121,769

APPARATUS FOR OPENING THE TAP HOLE OF A METALLURGICAL FURNACE

Filed Sept. 10, 1959

5 Sheets-Sheet 3



INVENTOR
WALTER HORN
BY
Mestem, & Kollin
ATTORNEYS

Feb. 18, 1964

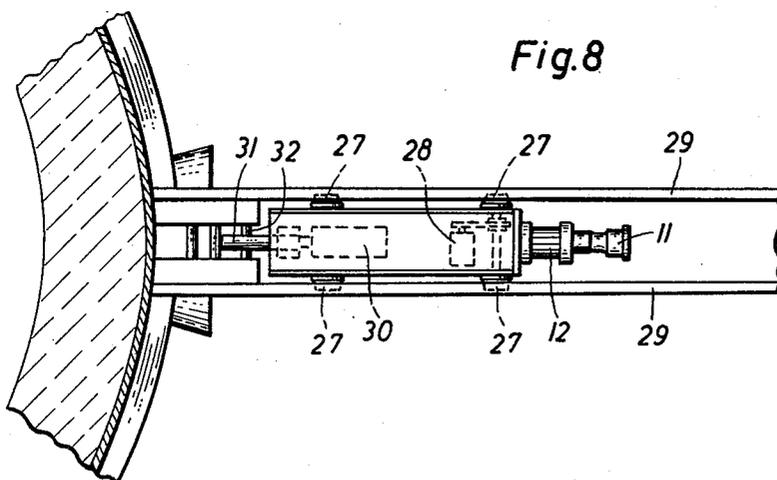
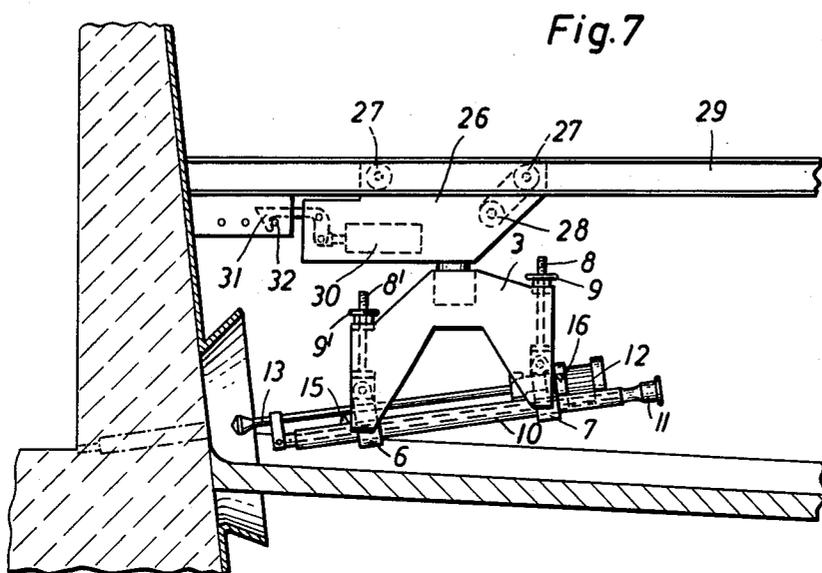
W. HORN

3,121,769

APPARATUS FOR OPENING THE TAP HOLE OF A METALLURGICAL FURNACE

Filed Sept. 10, 1959

5 Sheets-Sheet 4



INVENTOR
WALTER HORN
BY
Meston & Rollin
ATTORNEYS

Feb. 18, 1964

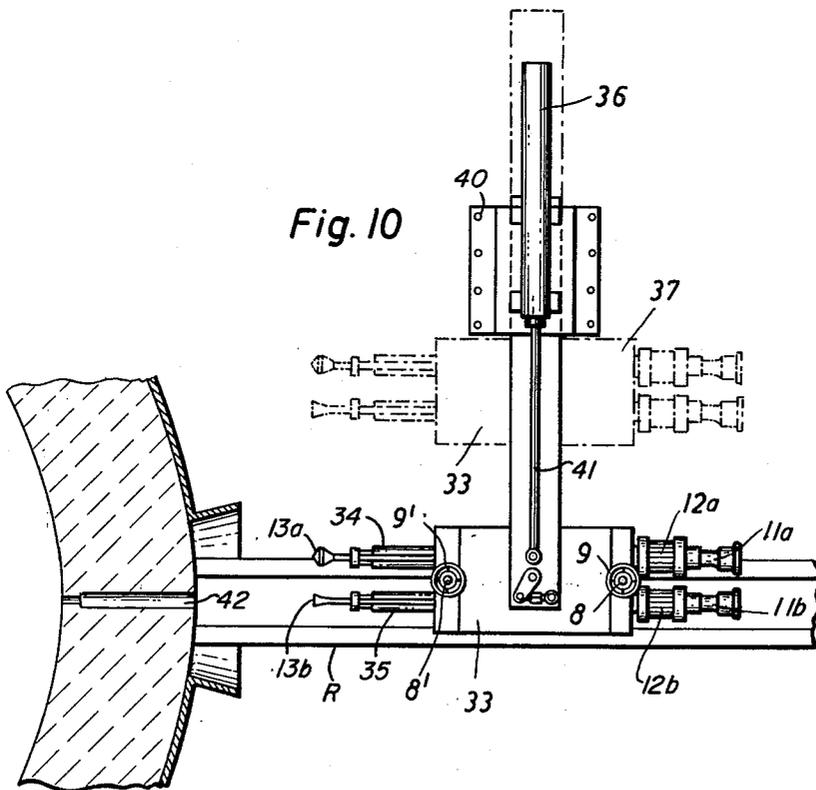
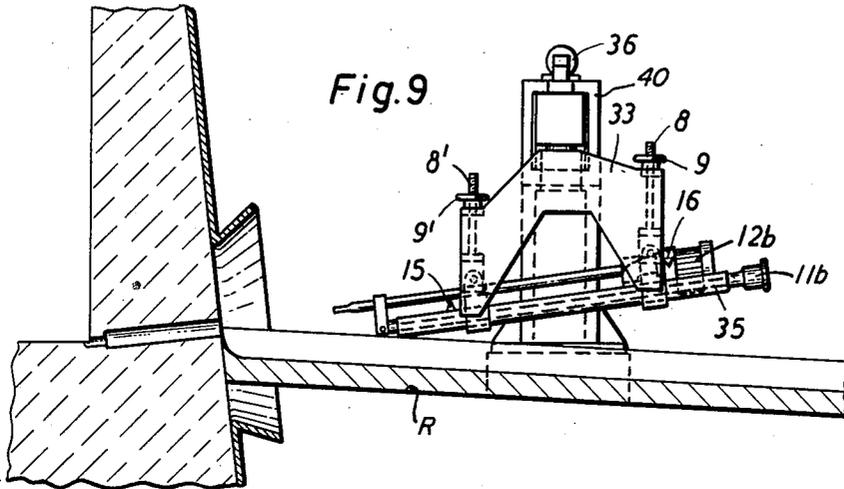
W. HORN

3,121,769

APPARATUS FOR OPENING THE TAP HOLE OF A METALLURGICAL FURNACE

Filed Sept. 10, 1959

5 Sheets-Sheet 5



INVENTOR
WALTER HORN
BY
Western & Hollin
ATTORNEYS

1

2

3,121,769

APPARATUS FOR OPENING THE TAP HOLE OF A METALLURGICAL FURNACE

Walter Horn, Dortmund, Germany, assignor to Bernhard Dango and Herbert Dienenthal, responsible partners of Dango & Dienenthal K.G., Westphalia, Germany

Filed Sept. 10, 1959, Ser. No. 839,159

Claims priority, application Germany Sept. 16, 1958

6 Claims. (Cl. 266-42)

To open the tap hole of shaft furnaces and in particular blast furnaces, high-speed drilling machines, which are manually operated and guided, are used inter alia. There is no assurance, in this case, that when the tap-hole is repeatedly opened the tap hole passage or duct will be struck and bores extending towards the interior of the furnace at different slopes will not be made. Owing to the varying application and inclination of the drilling machine, intersecting drill holes in which the drills are deflected and become jammed are formed in the region of the tap hole. More important still, however, is also the gradual reduction of the strength of the tap hole itself resulting from the use of such a method, which strength reduction can lead to ruptures which are particularly dangerous at this part of the furnace.

The invention eliminates these difficulties arising in connection with the manipulation of the tap hole by means of high-speed, manually-controlled drilling machines by using for opening the tap hole, for example of a blast furnace, an apparatus by means of which the drilling machine, which forms a unit with the apparatus, drills the same tap-hole passage with the same inclination every time. The passage then retains the required direction and shape, so that the closing of the tap-hole by means of a tap hole gun can now also be effected more rapidly and with greater reliability than heretofore.

The invention therefore is concerned with an apparatus for opening the tap hole of a metallurgical furnace, for example a shaft or blast furnace, by means of a drilling machine. According to the invention, the drilling machine, which is mounted so as to be axially shiftable in a drill mounting, is arranged together with the drill mounting and a feed motor on a supporting device of yoke-like construction which can be moved out of the region of the tap hole and can be adjusted by means of this supporting device both in the horizontal direction and in a direction inclined with respect to the horizontal. The apparatus can be brought into and out of its operative position in various ways, for example by suspending the supporting device from an arm adapted to be swung about a tubular column located laterally of the tap hole runner. Instead of this, the supporting device may be suspended from a beam displaceable at right angles to the axis of the tap-hole runner in a stand or frame disposed laterally of the runner. In this case, the supporting device can be moved sideways into its inoperative position, namely parallel to the tap runner. However, it is also possible to move the supporting device away from the tap hole and to bring it into the region of the tap hole again by raising and lowering it. To this end, the supporting device is mounted on the end of a tubular plunger which is telescopically displaceable in a vertically disposed tubular column. Finally, for bringing the apparatus and its supporting device into and out of the operative position, it is also possible to use a travelling trolley on which the supporting device is suspended. The trolley runs on rails parallel to the axis of the tap-hole runner and arranged at a height above the tap hole. In the working position, the trolley and the supporting device suspended from it are locked against movement to the rear.

Since the drilling machine can readily be swung out

of the danger zone of the tap hole on the supporting frame, advantageously by remote control, without its position in relation to the axis of the tap hole being altered in the process, it is also possible to use an extremely advantageous two-stage drilling method for opening the tap hole. This consists in first pre-drilling the tap hole with a particularly effective drilling tool, for example a crown drill, until it reaches the red part of the refractory material. The drilling machine is then swung out of range of the tap hole, the crown drill made of high-quality steel is exchanged in this position for a drill rod made of cheaper steel and the tap hole is pierced with this tool after the drilling machine has been swung back. It is advantageous to use as a finishing drilling tool a rod of Monier iron provided with longitudinal flutes and then twisted and having a bit forged to its end. This drilling method, which is particularly practicable especially where large blast-furnace units are concerned, is possible without any danger only when practiced with the drilling apparatus according to the invention, since the changing of the drilling tools can be effected safely only out of range of the tap hole.

The invention therefore also includes an apparatus comprising two drilling machines which are arranged side by side on a supporting and adjusting apparatus. One of these machines is equipped with the preliminary drilling tool and the other with the finishing drill. The two drilling machines are moved into the working position in succession. It is unnecessary to change the drilling tools when the machine is swung out of position.

Various embodiments of the apparatus according to the invention for opening the tap hole of a metallurgical furnace are illustrated by way of example in the accompanying drawing, in which:

FIGS. 1 and 2 are a side elevation and a plan view respectively of an apparatus suspended from the jib of a stationary slewing crane;

FIGS. 3 and 4 illustrate, again in side elevation and plan view respectively, another embodiment, in which the apparatus can be moved out of the operative position normally to the tap-hole runner of the furnace;

FIGS. 5 and 6 show in similar views an apparatus in which the supporting arm and the drilling machine are moved into and out of position in the vertical direction;

FIGS. 7 and 8 show, again in side elevation and plan view respectively, an apparatus which can be moved in the direction of the tap runner; and

FIGS. 9 and 10 show the arrangement of two drilling machines on a supporting device which can be moved into and out of position parallel to the tap runner.

In the arrangement according to FIGS. 1 and 2, there is mounted on a round column 1, above the tap-hole runner R of a furnace, a swingable arm or jib 2 at whose front end a supporting yoke 3 is rotatably mounted and is adjustable in a horizontal plane by means of a turnbuckle 4 and a lever 5. Bearings 6, 7, by which a drill mounting 10 is suspended from yoke 3, are connected to this supporting yoke by way of spindles 8, 8'. By means of the spindles 8, 8', the drill mounting can be brought into any desired inclined position. The mounting 10 forms a linear guide track for the drilling machine 12 and the drill rod 13 which are axially displaceable therein as a unit by means of a reversible motor 11 and a lead screw 10' located in the mounting 10, the rod 13 sliding in a bracket 10'' at the forward end of the mounting. A motor 14 mounted in the jib 2 can swing the jib out of the inoperative position into the drilling position limited by a stop 14' and back into the initial position after the tap hole has been opened. It is possible to see from a distance on indicating devices 15, 16 how deeply the tap hole has been drilled open. When this has been done, the drill rod or boring tool 13 is drawn out of the tap hole by

means of the reversible motor 11 at a speed greater than the drilling speed. A latch 17 hingedly arranged on the drilling machine 12 ensures during this process that the drill rod 13 remains connected to the drilling machine. Should a break-out of iron occur during the drilling of the tap hole, the latch 17 is lifted up by remote control. It then breaks the connection between the drilling machine and the drilling tool, so that the apparatus can be moved rapidly out of the danger zone. The drilling tool is left behind in the top hole, where it is burnt up. Positions I and II of the machine illustrated in chain-dotted lines in FIG. 2 are produced by means of the turnbuckle 4 by way of the lever 5, whereas the vertically inclined position of the drilling tool is brought about by varying the adjustment of the spindles 8 and 8'. An adjustment of the machine which has once been found to be correct and suitable remains unchanged during further use.

In the embodiment illustrated in FIGS. 3 and 4, the supporting yoke 3, with the drill mounting 10, is suspended from an arm 18 which is guided in a stand or frame 19 arranged laterally of the tap hole runner. A cylinder 20 can shift the arm 18 and with it the supporting yoke 3, its drill mounting and the drilling machine out of the working position into the position 21 shown in chain-dotted lines parallel to the tap-hole runner R.

FIGS. 5 and 6 shows an arrangement in which the supporting yoke 3, together with the drilling mounting 10, is mounted on a tubular plunger 22 which moves up and down telescopically in a tube 23 disposed vertically above the tap-hole runner and can be brought out of the working position into the raised position 25 by means of a suitable hoisting gear attached at 24.

In the embodiment according to FIGS. 7 and 8, the supporting yoke 3 is suspended, together with the drill mounting 10, from a traveling carriage or trolley 26 movable by a motor 28 on four rollers 27 which run on rails 29 extending in the direction of the tap-hole runner and above the latter. A latch 31 actuated by a cylinder 30 engages a pin 32 advantageously arranged on a double strap or plate provided on the shaft furnace, so that the trolley 26 is locked in position during the drilling operation.

Another, extremely practical, embodiment of the apparatus is shown in FIGS. 9 and 10.

As already mentioned, with two-stage drilling, quicker opening of the tap hole is obtained, namely by using a particularly effective tool, for example a crown drill, for the preliminary drilling and a cheap tool, made for example of fluted Monier steel, for the final drilling. So as to be able to obviate the changing of the crown drill for the Monier drill and to work particularly quickly, the apparatus is provided with two drill mountings forming linear guide tracks 34, 35 arranged side by side on a yoke-shaped suspension device 33. The drilling machine 12a with its motor 11a on the guide-track 34 pre-drills the tap hole with a crown drill. Thereafter a horizontal guiding device in the form of a cylinder 36, rigid with a supporting post 40, acts through its piston 41 to displace the yoke 33 in a direction transverse to runner R until the track 35 carrying the cheaper drilling tool 13a is in the working position in which it is aligned with a point 42 on the furnace wall. The tap hole is then pierced with the drilling machine 12b and its motor 11b carried on the track 35, in the position illustrated in FIG. 10. After the drill rod 13b has been withdrawn, the cylinder 36 displaces both assemblies 11a, 12a, 34 and 11b, 12b, 35 into the inoperative position 37 shown in chain-dotted lines.

The feed of the drilling machine and the swinging of its supporting device into and out of position can be effected pneumatically, hydraulically or electrically. In the case of the arrangement shown in FIGURES 1 and 2, the motor 14 enables the drilling machine to yield during the work. The motor then takes up an excess pressure occurring during the drilling process. For this reason,

it must be more strongly constructed than if it merely had to swing the jib. It is therefore advisable not to retain the jib in the working position by means of the slewing motor but to lock it on its round column by means of a pin or bolt, for example. The locking action can also be carried out by means of a motor or by means of a cylinder.

The apparatus according to the invention is distinguished by an extremely simple and absolutely reliable construction. With it, particularly careful treatment of the tap hole is obtained and, therefore, also a substantially lower consumption of tap-hole material than heretofore. The margin of safety from accidents is substantially larger and the danger of ruptures at the most dangerous part of the shaft furnace is considerably reduced.

The apparatus of the invention can be employed with equal success with all shaft furnaces and also with hearth-type furnaces, such as, for example, electric furnaces, Siemens-Martin furnaces and mixers.

I claim:

1. Apparatus for tapping a wall of a metallurgical furnace, comprising mounting means forming a linear guide track, a drilling machine carried by said mounting means for reversible displacement along said track, motor means on said mounting means coupled with said drilling machine for effecting the reversible displacement thereof, stationary supporting means, suspension means for said mounting means on said supporting means and mechanism on said supporting means coupled with said suspension means for selectively displacing said mounting means into an operative position and an inoperative position, and latch means swingably secured to said drilling machine for normally holding an elongated boring tool in engagement with said drilling machine for actuation and reversible entrainment thereby, said latch means being swingable on said drilling machine to release a stuck boring tool preparatorily to a withdrawal of said mounting means from said operative position.

2. Apparatus for tapping a wall of a metallurgical furnace provided with a tap-hole runner, comprising mounting means forming a linear guide track, a drilling machine carried by said mounting means for reversible displacement along said track, motor means on said mounting means coupled with said drilling machine for effecting the reversible displacement thereof, stationary supporting means independent of said runner, suspension means for said mounting means on said supporting means and mechanism on said supporting means coupled with said suspension means for selectively displacing said mounting means into an operative position adjacent said runner and an inoperative position remote therefrom, said track extending generally horizontally above said runner in said operative position, stop means on said supporting means for positively arresting said mounting means in said operative position upon displacement from said inoperative position, and latch means swingably secured to said drilling machine for normally holding an elongated boring tool in engagement with said drilling machine for actuation and reversible entrainment thereby, said latch means being swingable on said drilling machine to release a stuck boring tool preparatorily to a withdrawal of said mounting means from said operative position.

3. Apparatus according to claim 2 wherein said supporting means comprises a column laterally offset from said runner, said suspension means including an arm swingable about said column in a substantially horizontal plane, said mechanism comprising drive means for swinging said arm.

4. Apparatus according to claim 2 wherein said supporting means comprises a substantially horizontal rail extending generally parallel to said runner above the latter, said suspension means including a carriage displaceable along said rail.

5. Apparatus according to claim 2 wherein said suspension means comprises a yoke disposed above said

5

runner in substantial alignment therewith in said operative position, said yoke being limitedly swingable about a vertical axis, and a pair of vertical spindles on opposite extremities of said yoke adjustably engaging said mounting means for varying the angle of elevation of said track.

6. Apparatus for tapping a wall of a metallurgical furnace, comprising a tap-hole runner; mounting means forming a pair of linear guide tracks; a pair of drilling machines carried by said mounting means alongside each other for reversible displacement along said tracks, respectively; stationary supporting means independent of said runner; substantially horizontal guide means rigid with said supporting means; suspension means for said mounting means on said guide means; mechanism on said supporting means coupled with said suspension means for selectively displacing said mounting means along said guide means in a direction generally transverse to said runner into an inoperative position remote from said

6

runner and two alternate operative positions in the vicinity of said runner whereby either of two boring tools respectively carried by said machines may be selectively aligned with a predetermined point of the furnace wall to be tapped; and two motors on said mounting means respectively coupled with said drilling machines and operable independently of each other for effecting the reversible displacement of either of said machines toward and away from said wall in a position of alignment of the corresponding tool with said point.

References Cited in the file of this patent

UNITED STATES PATENTS

1,276,252	Mullen -----	Aug. 20, 1918
1,688,327	Brosius -----	Oct. 23, 1928

FOREIGN PATENTS

302,305	Great Britain -----	Aug. 8, 1929
409,539	Great Britain -----	May 3, 1934