

Sept. 23, 1952

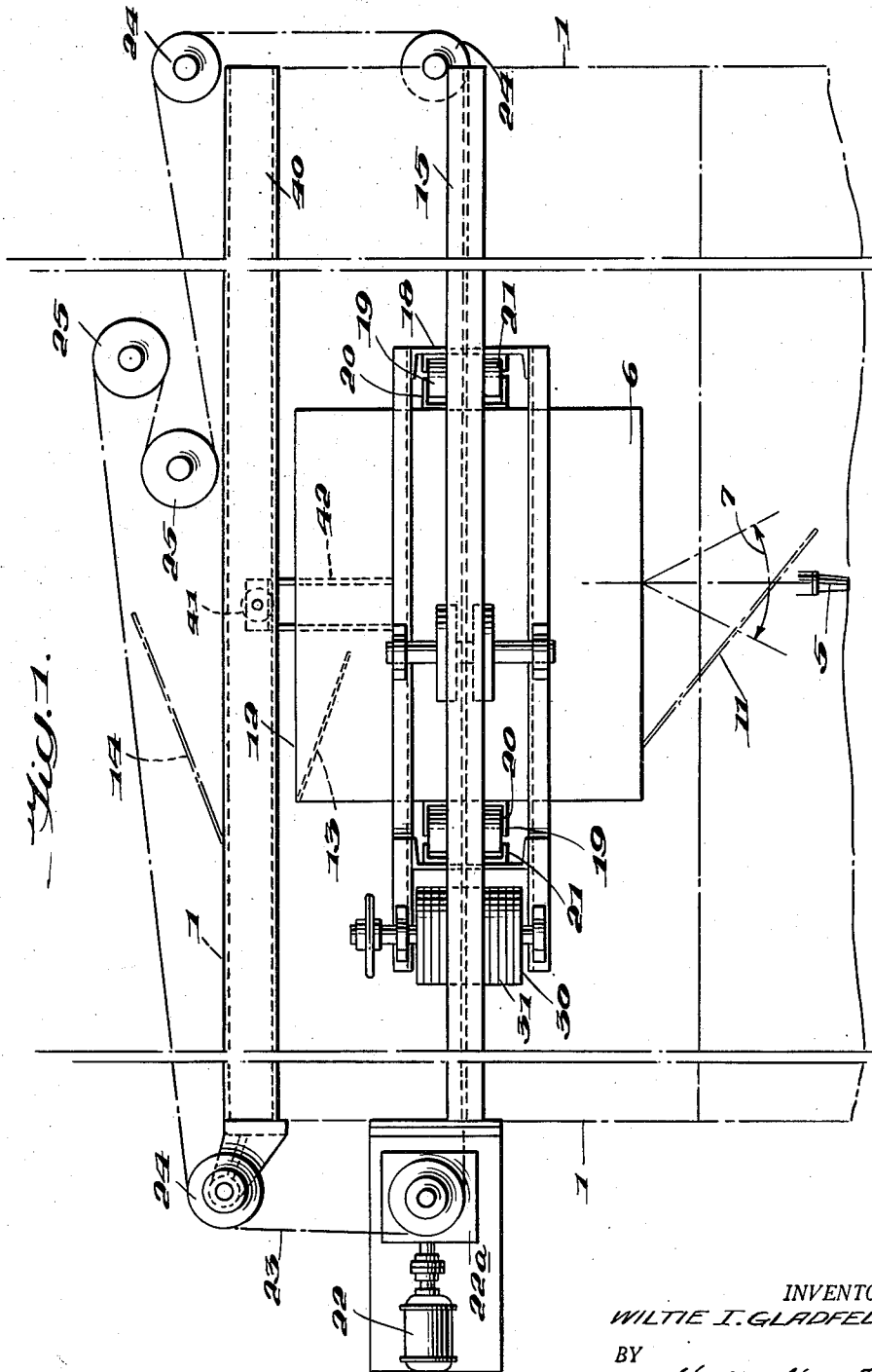
W. I. GLADFELTER

2,611,219

WORK BLASTING EQUIPMENT

Filed May 26, 1951

8 Sheets-Sheet 1



INVENTOR.  
WILTIE I. GLADFELTER,  
BY  
*Hull + Houghton*  
ATTORNEYS

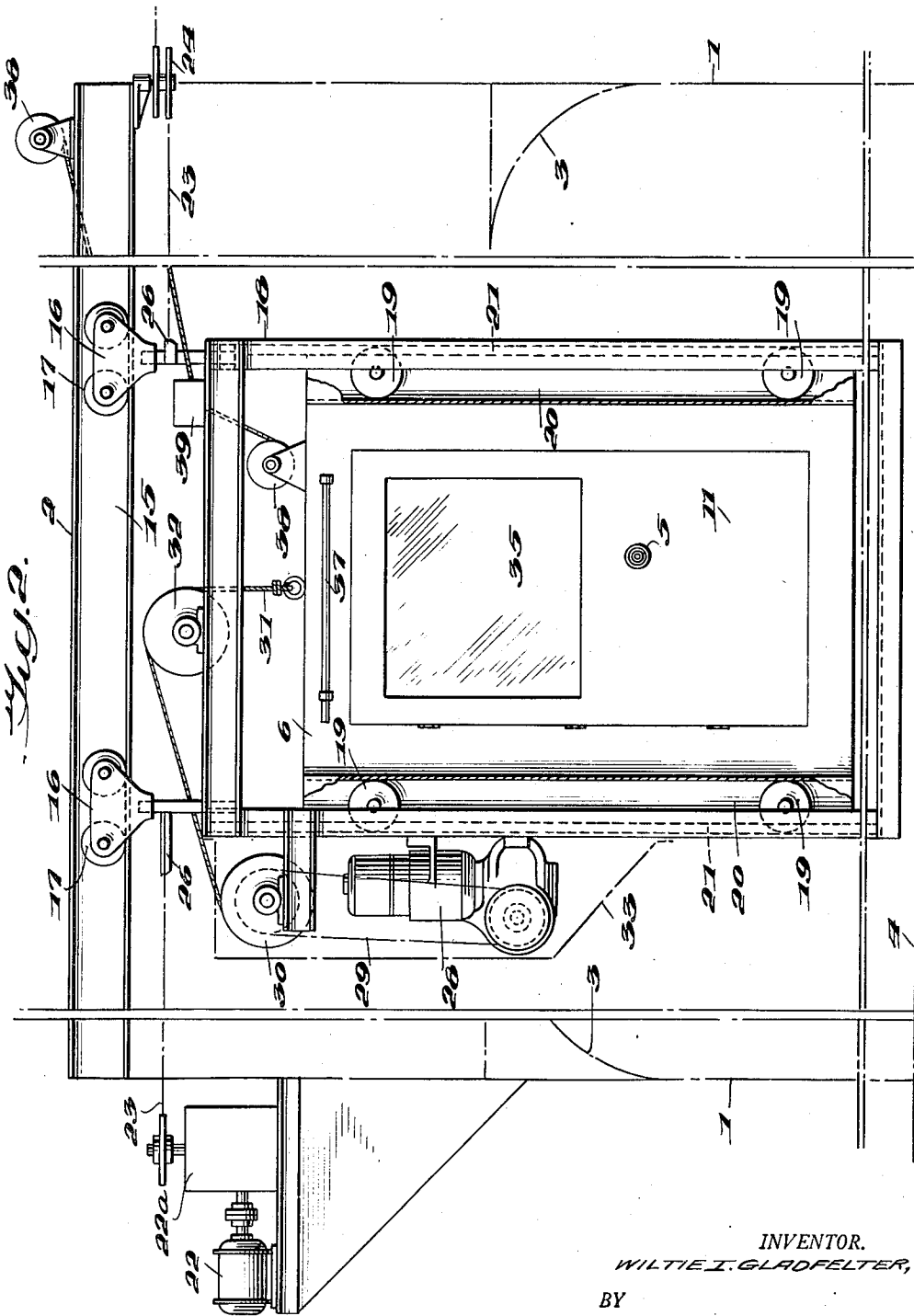
Sept. 23, 1952

W. I. GLADFELTER  
WORK BLASTING EQUIPMENT

2,611,219

Filed May 26, 1951

8 Sheets-Sheet 2



*Fig. 2.*

INVENTOR.  
WILTIE I. GLADFELTER,  
BY  
*Hally Houghton*  
ATTORNEYS

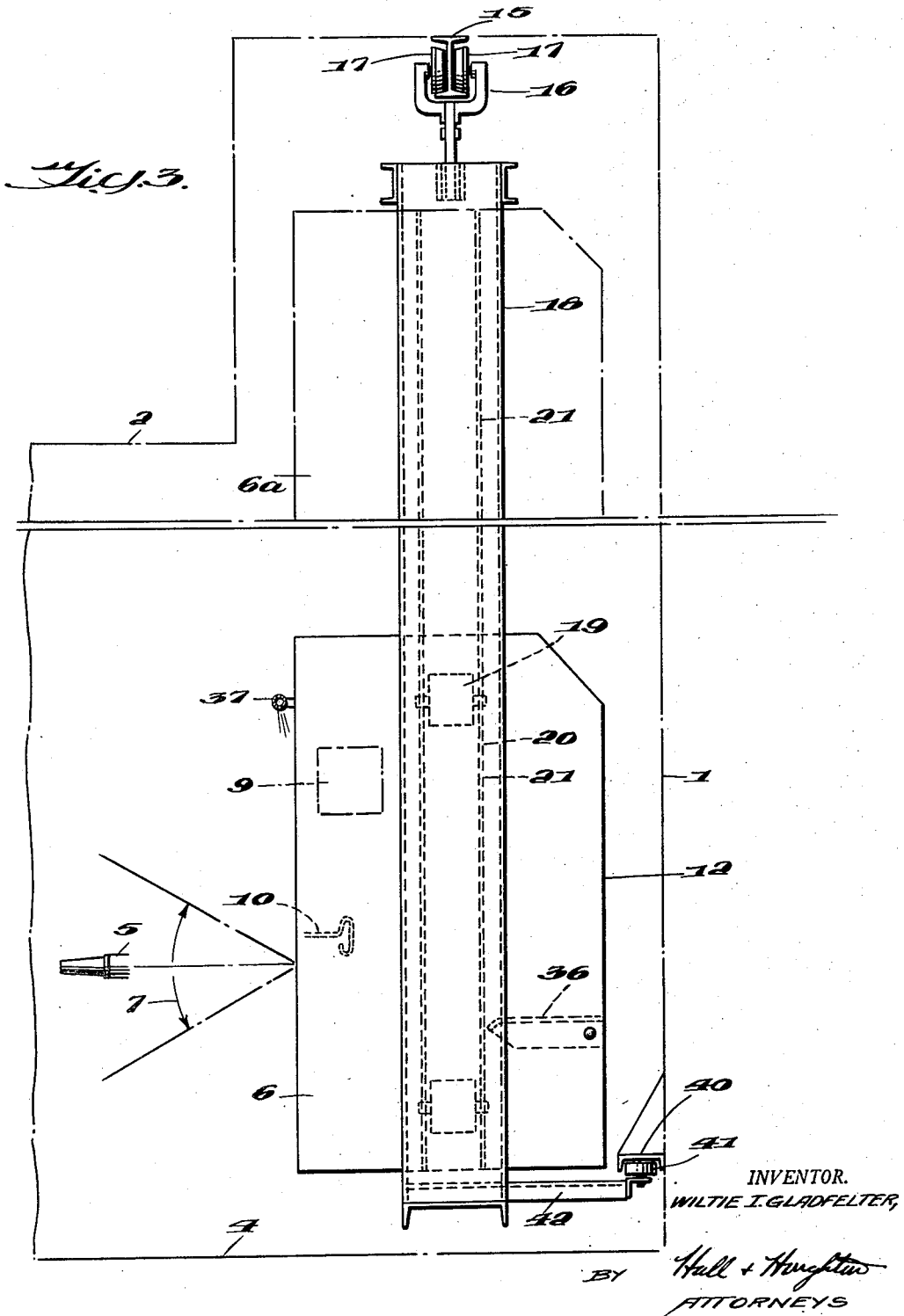
Sept. 23, 1952

W. I. GLADFELTER  
WORK BLASTING EQUIPMENT

2,611,219

Filed May 26, 1951

8 Sheets-Sheet 3



Sept. 23, 1952

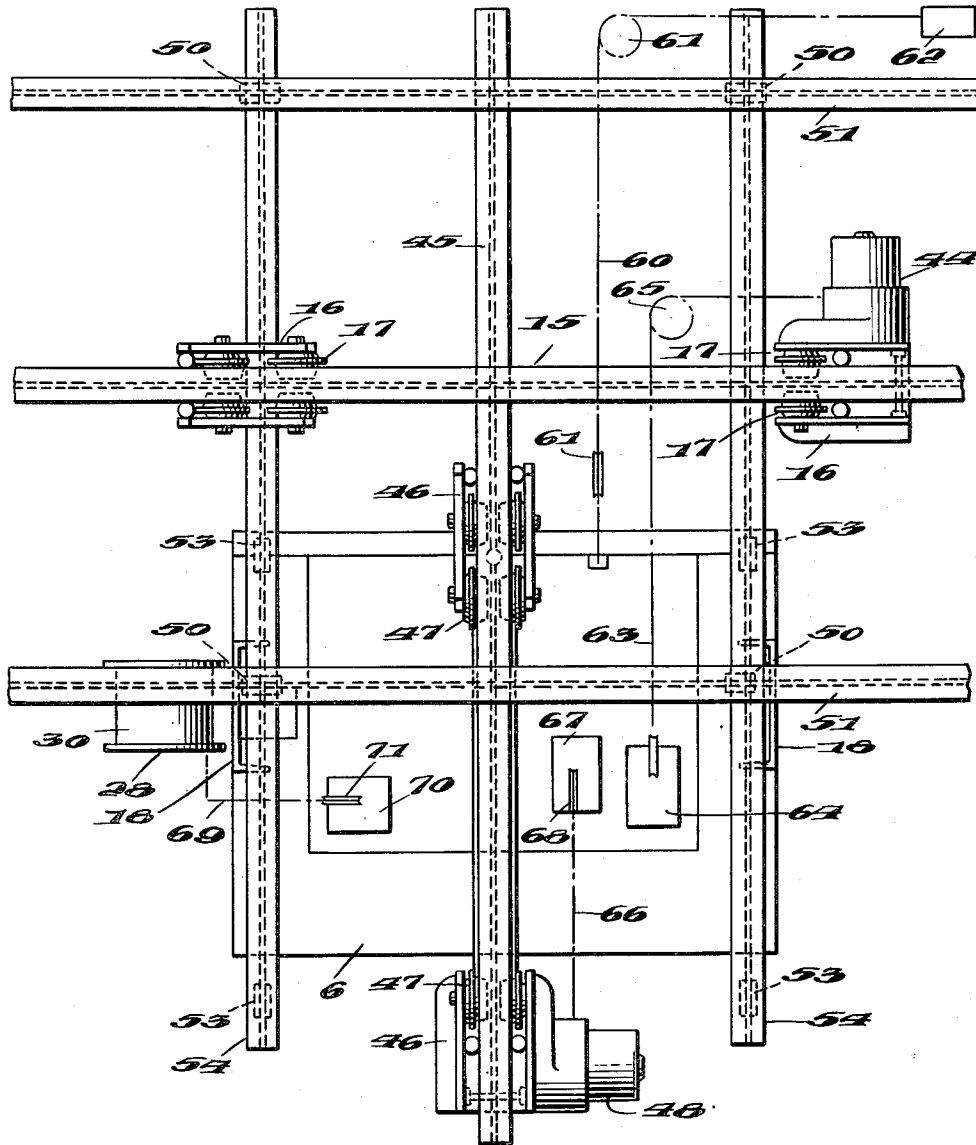
W. I. GLADFELTER  
WORK BLASTING EQUIPMENT

2,611,219

Filed May 26, 1951

8 Sheets-Sheet 4

*Fig. 4.*



INVENTOR.  
WILTIE I. GLADFELTER,

BY

*Hall + Houghton*

ATTORNEYS

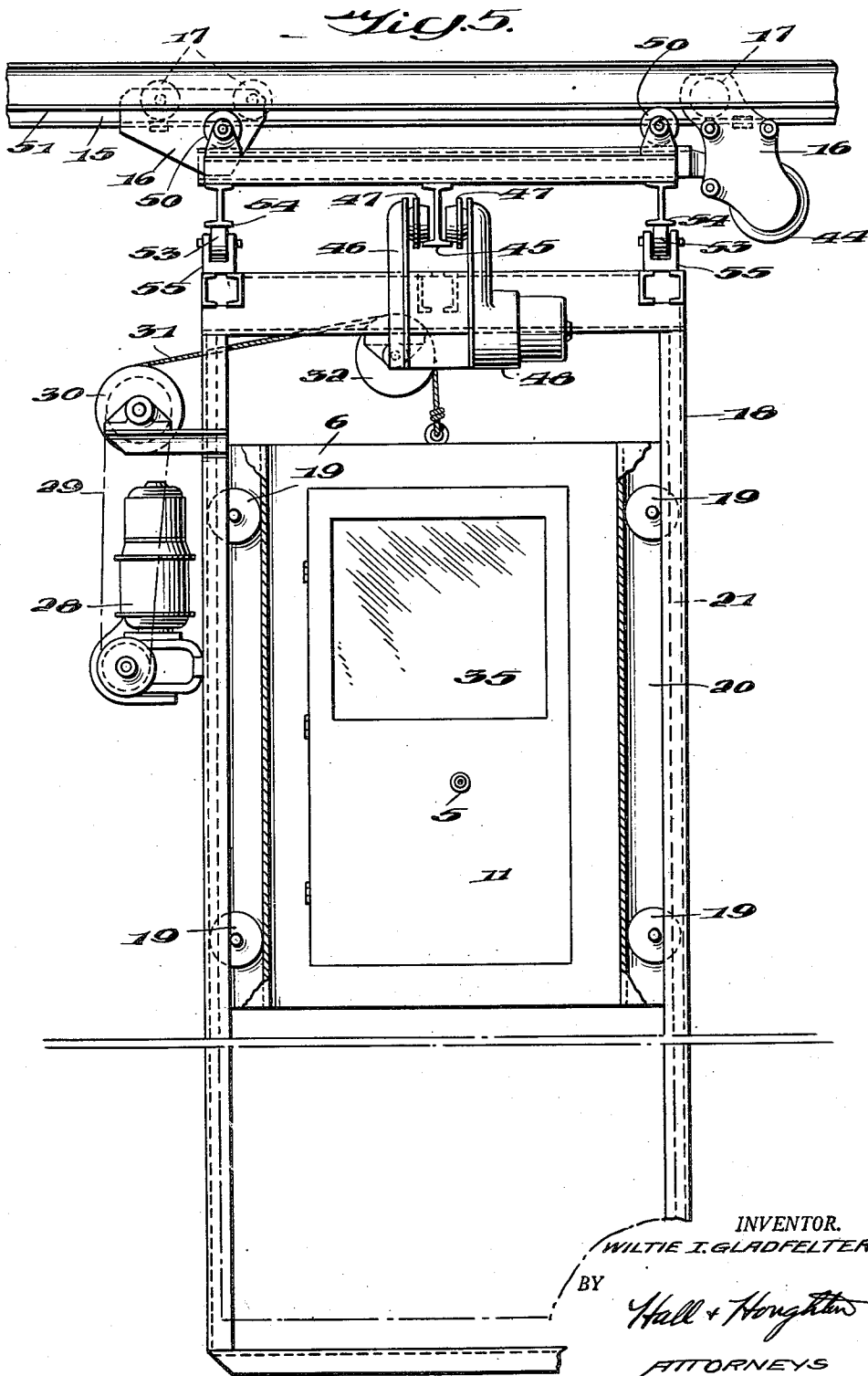
Sept. 23, 1952

W. I. GLADFELTER  
WORK BLASTING EQUIPMENT

2,611,219

Filed May 26, 1951

8 Sheets-Sheet 5



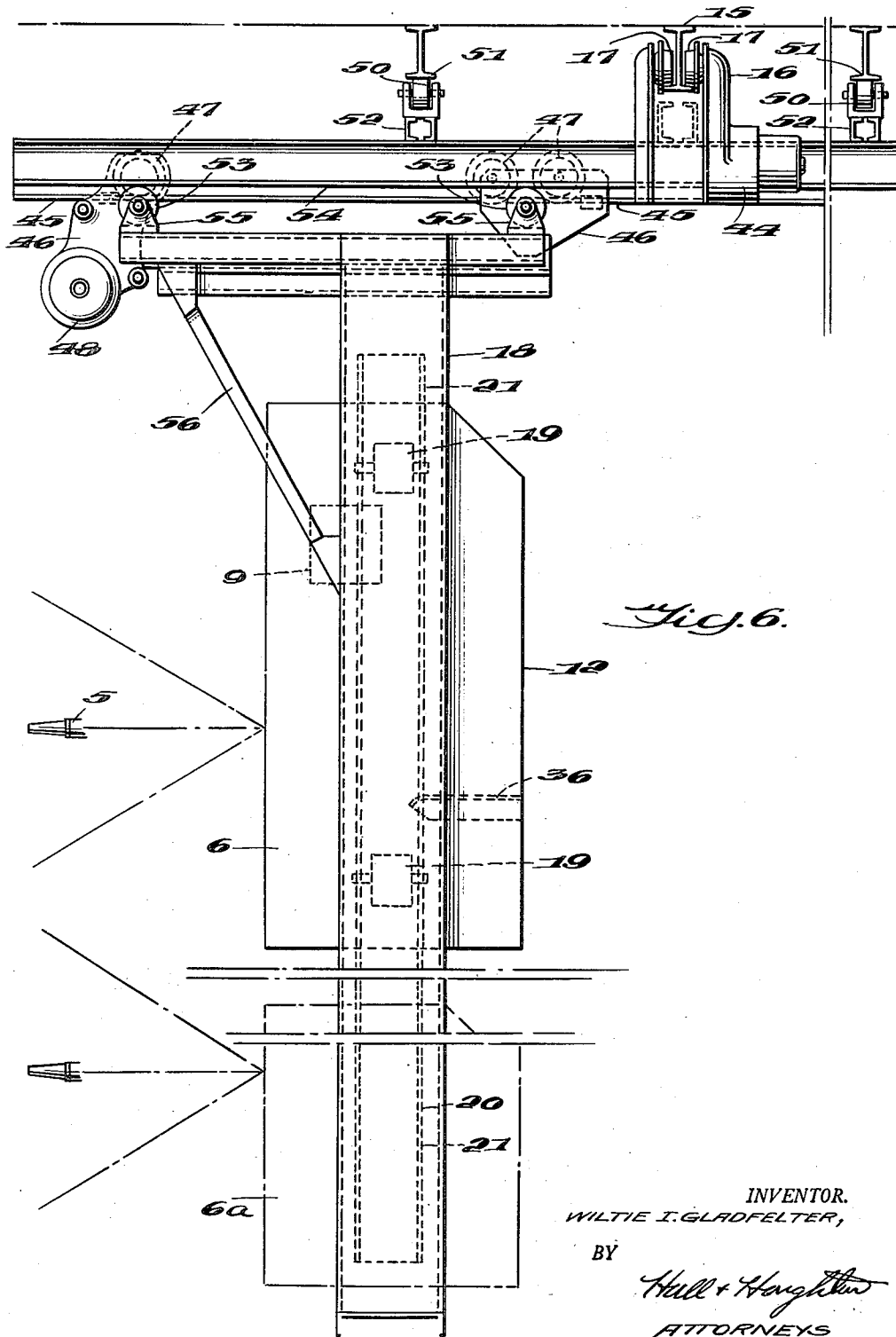
Sept. 23, 1952

W. I. GLADFELTER  
WORK BLASTING EQUIPMENT

2,611,219

Filed May 26, 1951

8 Sheets-Sheet 6



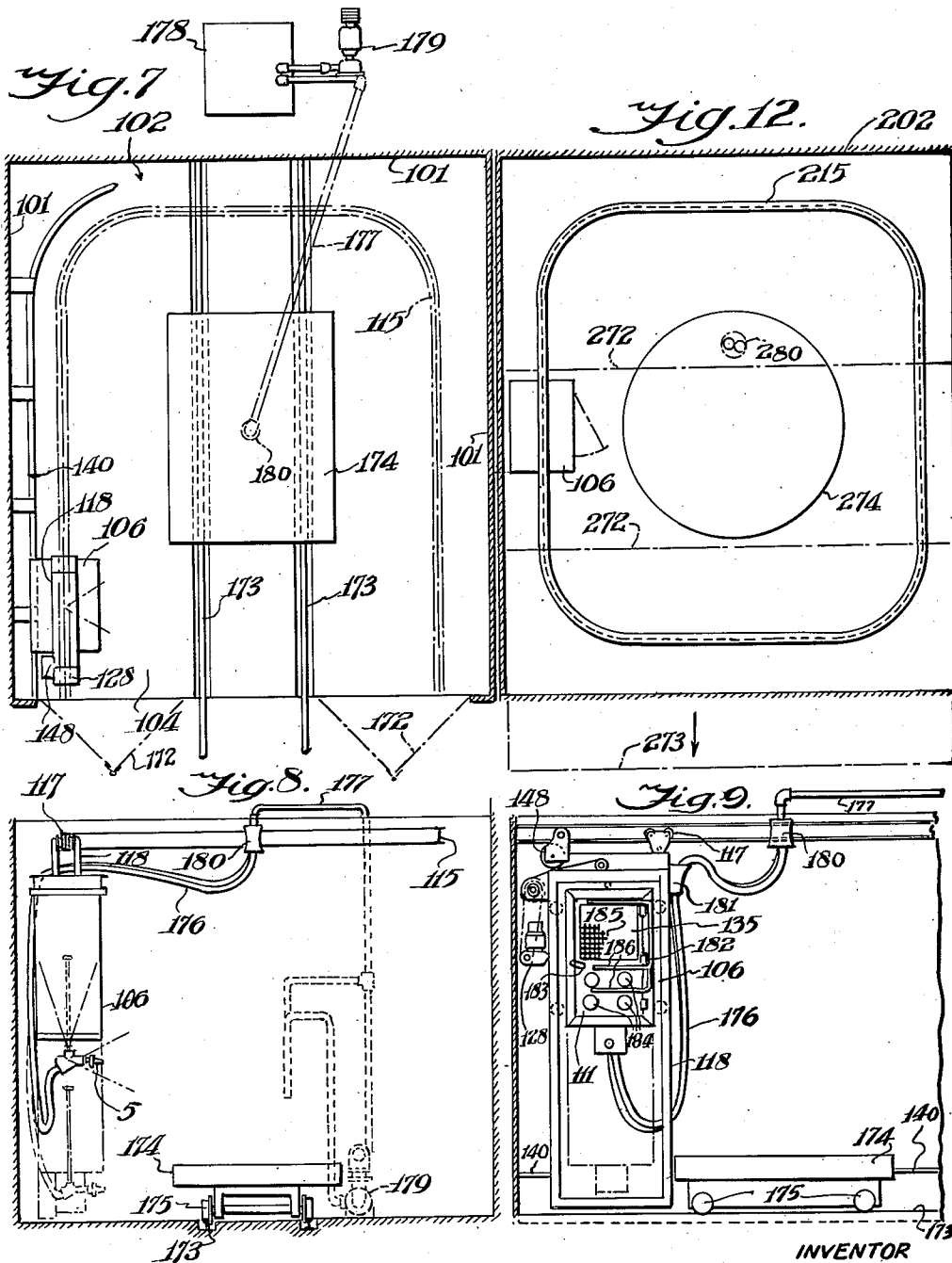
Sept. 23, 1952

W. I. GLADFELTER  
WORK BLASTING EQUIPMENT

2,611,219

Filed May 26, 1951

8 Sheets-Sheet 7



INVENTOR  
WILTIE I. GLADFELTER,  
BY  
*Dithard G. Connolly*  
HIS ATTORNEY

Sept. 23, 1952

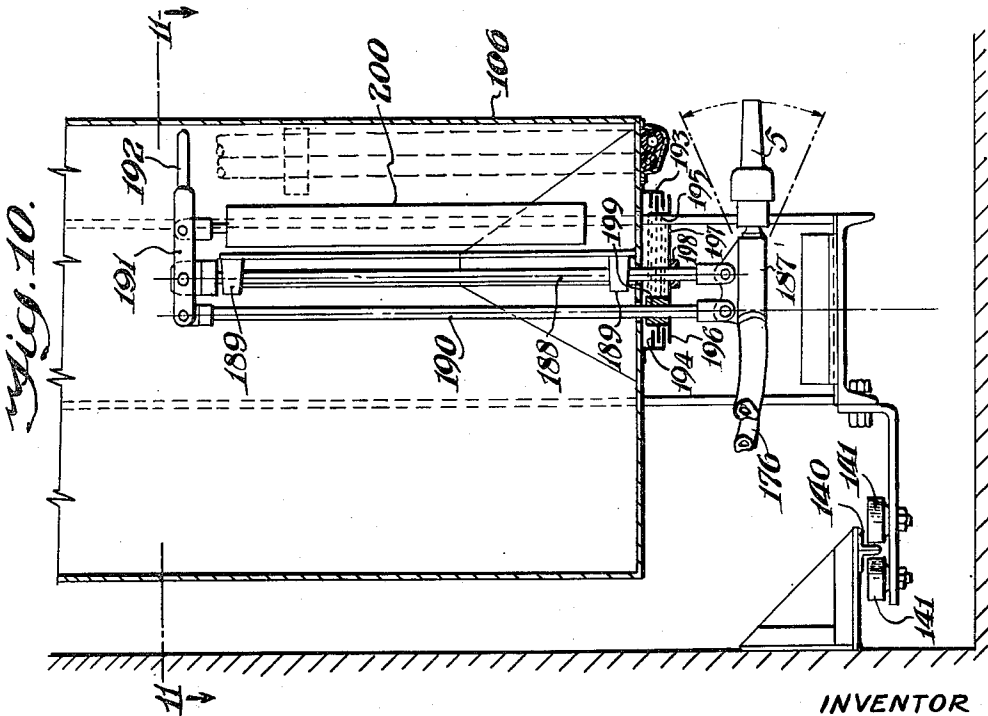
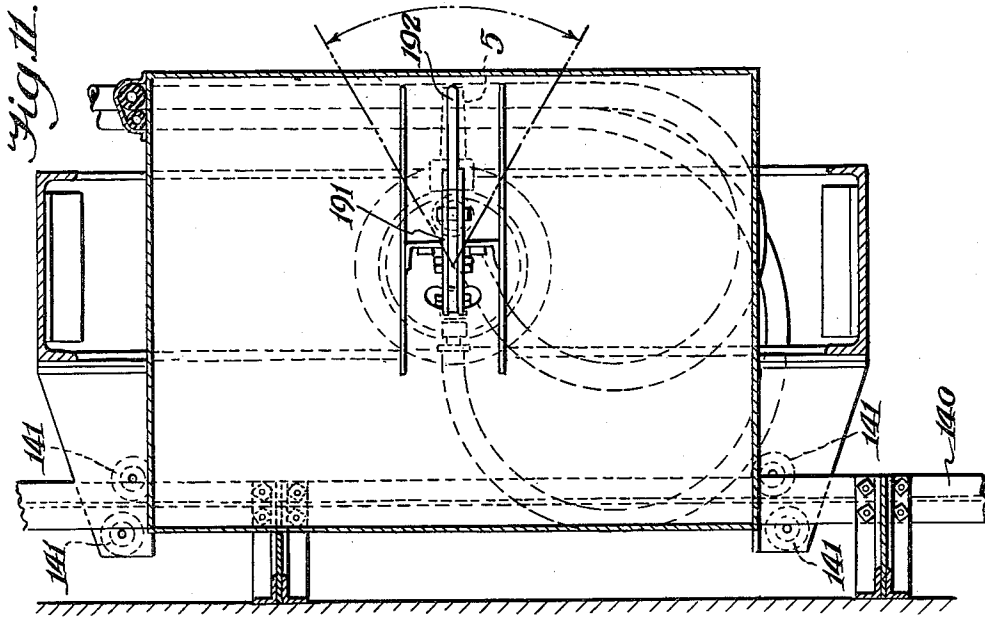
W. I. GLADFELTER

2,611,219

WORK BLASTING EQUIPMENT

Filed May 26, 1951

8 Sheets-Sheet 8



INVENTOR  
WILTIE I. GLADFELTER,  
BY

*Arthur J. Connolly*  
HIS ATTORNEY

# UNITED STATES PATENT OFFICE

2,611,219

## WORK BLASTING EQUIPMENT

Wittie I. Gladfelter, Hagerstown, Md., assignor  
to Pangborn Corporation, Hagerstown, Md., a  
corporation of Maryland

Application May 26, 1951, Serial No. 228,501

20 Claims. (Cl. 51—8)

1

This invention relates to work blasting equipment and more especially to blasting rooms for cleaning of castings and the like, and aims generally to improve the same. The present application is in part a continuation of prior application, Serial No. 141,315, filed January 30, 1950, and now abandoned.

The invention is particularly, but not exclusively, applicable to core knockout rooms in which a jet of water, or preferably of water and abrasant, is employed to break down and blast away molding cores used in the founding of large hollow castings, as well as to clean the dirt and scale from the surface of castings.

In particular it provides flexible means for transporting an orientable blast gun and the operator controlling the same in at least two dimensions to enable blasting of the work from many different positions or vantage points.

Particular objects of the invention, severally and interdependently, reside in the provision of a structure, and more particularly a suspended structure, associable with a blasting room and mounting a gun-carrying operator's car for lateral and vertical traverse with respect to the blasting room to facilitate blasting of the work from different horizontal and vertical angles; in the provision of such a structure adapted for further traverse to move the blasting means and car about or toward and from the work; in the provision in such a structure of means controllable by the operator in the car for effecting the traverse and for effecting the blasting operation from any selected position in said traverse; in the provision of stabilizing means particularly in the suspended structures; in the provision of novel and effective access means for use of the operator; and in the provision of various new and useful features, arrangements, and sub-combinations thereof contributing to the attainment of the aforesaid main objects.

The invention resides in the new features, combinations, and arrangements of parts hereinafter described with reference to illustrative examples, and is particularly pointed out in the appended claims.

In the accompanying drawings of illustrative embodiments of the invention

Figs. 1 to 3 are somewhat diagrammatic plan, front elevation and side elevation views of one embodiment;

Figs. 4 to 6 are similar views of a second embodiment;

Figs. 7 and 8 are plan and side views of a third embodiment;

2

Fig. 9 is a fragmentary view of the interior of the room in the embodiment of Figs. 7 and 8;

Fig. 10 is an enlarged detail view of a portion of the nozzle mechanism in the construction of Figs. 7, 8 and 9;

Fig. 11 is a sectional view of the car of Figs. 8 and 9 taken along the line II—II; and

Fig. 12 is a plan view similar to Fig. 7, of a further embodiment of the present invention.

In the hydraulic blasting of castings and the like, it is customary to place the casting in an enclosure and project upon it a high pressure stream of water and abrasant from nozzles or blast guns carried by operators within the room, or positioned adjacent to a wall of the enclosure. In the latter case, the direction of projection of each jet gun relative to its mounting has been variable and it has been customary to provide two jet guns, one to project a stream generally horizontally toward the work, and another located at a high elevation to project a stream generally downward toward the work. The provision of two guns at different levels has required the inclusion of two operating stations at different angles and with their respective platforms, stairways, piping, valves, etc. with accompanying disadvantages.

A later improvement over the lower and upper stationary operator positions is exemplified in the patent to Keefer No. 2,440,222, in which a section of the blast room wall or enclosure is replaced by a vertically slideable wall section which carries a blast gun. The slideable wall section comprises the inner face of an operator's vestibule or car with one high pressure blast gun and controls so that the operator can simultaneously move up and down the sliding wall section and the blast gun and operator's car carried thereby, with obvious advantages over the former two level arrangements.

By the present invention still greater flexibility and ease of operation, and still greater effectiveness of blasting is accomplished, since with the present invention, the gun and operator's car are traversable, not simply in one dimensional direction, but in two or three dimensions, all under control of the operator in the car, and the gun or blasting means being mounted for at least limited universal movement under direct control of the operator, and without his having to resist the reactive thrust thereof, the combination greatly improves the ability of the operator to quickly and easily orient the gun to obtain maximum effectiveness for core removal or surface blasting of the work.

In addition, the suspension of the equipment as aforesaid, while it enables the operator to effect better blasting of work located at a distance from the room wall, maintains a clear floor area, and the ability to move the suspended equipment away from any particular part of the room affords more clearance for manipulating large castings or quantities of castings. Furthermore, the new access provisions herein enable the operator's car to mask and act as an entrance lock for a mandoor of the enclosure, so that an operator may enter and leave the car and the enclosure without interfering with the work of other operators thereby contributing to efficiency in the over-all operation of the blast room.

In the form of the invention shown in Figs. 1 to 3, the blast room comprises a suitable enclosure or housing having enclosing walls 1, supported by suitable structural members (not shown) which may be of conventional form. As is conventional, the blast room 1 may be provided with large swinging or sliding doors and fixed or openable roof sections 2 (or may even be open topped if desired) to facilitate the transportation to and from the room of the castings or other work pieces being blasted. Especially when the room is open topped or has openable roof sections 2 apt to be left open during a blasting operation, the side walls of the room at least above the areas apt to be struck by the blast stream, may be provided near the upper parts of the walls with inwardly curved splash-return guards 3 (Fig. 2) to return toward the interior of the room water and abradant directed upwardly along the walls 1.

The floor of the room, indicated at 4, may be of the usual grating construction, and underlying hoppers (not shown) may be provided to receive the spent blastant. Other usual appurtenances of blast rooms, such as work supporting cars, tracks therefor, work supporting turntables, and the like (not shown), may also be provided. When work orienting appurtenances such as turntables are included, controls therefor are preferably arranged inside the operator's car so that the work may be moved at will by the operator to present its cavities or surfaces to best advantage for blasting and with a minimum of delay.

In accordance with the present invention, the blast gun or blasting means diagrammatically indicated at 5 is preferably carried by the operator's car 6 and mounted thereon for at least limited universal movement relative thereto as indicated at 7 (Figs. 1 and 3). The gun may be of any suitable form such as the turret nozzle type shown in the patent to Keefer No. 2,440,222, above mentioned. As shown in said Keefer patent the abradant and propellant fluid lines can hang from the turret nozzle in loops having their remote ends connected to supply piping at or adjacent the room walls, and having sufficient loop slack to enable movement of the car 6 throughout the range of traverse provided. For very long blasting rooms, providing for very extended lateral travel of the car 6 the room may be provided with several blastant and propellant hoses spaced along the zone of traverse, and alternatively connectable to the gun couplings. Any suitable means is provided, preferably in the operator's car 6 to enable control of the supply of abradant and propellant to the gun 5, and to enable orientation of the gun relative to the car, as exemplified (Fig. 3) by the electrical remote control panel 9 and the gun orienting handle 10,

which may be similar to that shown in the aforesaid Keefer patent.

In the form shown in Figs. 1 and 2, the gun 5 is mounted on a door 11 hinged in one wall, the front wall, of the operator's car 6, and another wall of the car 6, such as the rear wall thereof, is provided with a second door 13. A part of the enclosure wall 1, to which the car 6 may be juxtaposed as hereinafter described, is provided with a personnel access door or mandoor 14 adapted to align with the car door 13. Preferably the door 14 is of less area than the wall area masked by the car 6 when brought into registry therewith, so that flying blastant in the enclosure will, for at least the most part, be prevented from passing out through the door 14 when changing operators, for example. With the car slightly misaligned with door 14, as shown in Fig. 1, and not more than 9 inches or so of clearance between the car and the enclosure wall, personnel may directly enter the blast room between the car corner and the wall, with very little, if any, escape of the blastant therethrough.

Preferably the doors 11 and 14, when both are used, are located in the front and rear walls of the car 6, with the gun carried by the door 11. This arrangement has various advantages, and in particular allows the car to be made of minimum depth from front to back, thus minimizing the space occupied by it in the blast room.

In the form shown in Figs. 1 to 3 the car 6 is suspended to be movable within the room in two directions. To this end there is provided a trackway 15 shown of I-beam form, extending across the top of the room, and carried by suitable structural supports (not shown). The operator's car 6, in the form of an elevator, is suspended from and traversable along this trackway 15, and is raisable and lowerable relative thereto. The traversable suspending means, best shown in Figs. 2 and 3, comprises wheeled means 16 having track rollers 17, from which is suspended a vertical elevator runway 18. The car is arranged in any suitable way for vertical traverse in the runway 18, as by providing it with guide means of any form shown as rollers 19 suitably journaled, as in the flanges of car carried channels 20 (partially broken away in Fig. 2) and running in guide channels 21 carried by the elevator runway 18.

As shown in Fig. 3, the trackway 15 may be located at an elevation considerably higher than the normal top level of a blast room, so that in its vertical traverse the elevator 6, and gun 5 carried thereby, may be carried to a high elevation 6a relative to the work. As indicated by the broken out portions in the drawings, the blast room itself, and the height of the elevator runway, may be relatively great, heights up to 18 feet or more being very effective.

Still referring to Figs. 1 to 3, in the form there shown, suitable means is provided for traversing the elevator along the trackway 15 and vertically relative thereto, so that the gun may be aimed at the work from any desired position within the lateral and vertical range of adjustment. As exemplifying such means, the traverse along the trackway may be effected by a reversible drive motor 22 (Figs. 1 and 2) operating through a reducer 22a, a chain loop 23 trained around guide sprockets 24 and take up sprockets 25, and having its ends connected to the wheeled means 16, as at 26 (Fig. 2); and the vertical motion of the elevator between its lowest and highest positions 6 and 6a (Fig. 3) may be ef-

fectured by a gear head motor drive with brake, indicated at 28 (Fig. 2), carried by the elevator runway assembly 18, chain drive connected at 29 to a cable drum 30 carried thereby, on which is wound the elevator cable 31, after the latter passes over a conventional supporting and guiding sheave 32, also carried by the wheeled elevator supporting means 16—18.

The motors and primary drives are protected from water and abradant, herein by mounting the elements 22, 22a, 23 outside the blasting room and enclosing the elements 28—30 in a suitable housing 33 (Fig. 2).

As is shown in Figs. 1 and 3, the blast-gun or nozzle 5 can be located somewhat to one side of the center of the door 11, and this door is provided with a vision window 35 of substantial extent. The off-center arrangement of the nozzle facilitates manipulation thereof by the operator as it places the operating handle 10 more conveniently for an operator viewing the work from a position at the center of the window than would a centered arrangement.

Still referring to the operator's car, as shown in Fig. 3, this car may be equipped with an operator's seat 36 and with a window wash off spray pipe 37. The controls available to the operator within the car 6 in general should include manual and/or automatic controls for the supply of liquid to the wash-pipe 37, as well as manual controls for the supply of fluid or abradant or both to the gun 5, for driving turntables or other manipulating supports for the work to be blasted from the car, and for traversing the car vertically and horizontally as aforesaid. As above mentioned some or all of these controls may be centralized in the electrical control panel 9, the leads from which may be carried in any suitable way, as through one or more commutator ring type cable reels 38 and junction boxes 39 (Fig. 2) to the instrumentalities or appurtenances to be controlled.

Especially in hydraulic blasting for core knock-out and the like, heavy reactive forces occur at the nozzle. To resist these forces, the nozzle can be firmly mounted turretwise on the car 6, in a manner similar to the mounting employed in the above mentioned Keefer patent. When the nozzle 5 is mounted on the door 11, this door is preferably outwardly opening and closes against a sturdy jamb strip to sustain the reactive forces. With this construction the door is held against opening when the nozzle is in operation. In addition suitable stabilizing means is provided to prevent swinging of the suspended elevator and gun relative to the trackway, herein shown as a horizontal downwardly opening guide channel 40 (Figs. 1 and 3) in which runs guiding means, comprising one or more guide rollers 41, suitably braced to the suspended runway frame 18.

In the second illustrative embodiment of the invention, Figs. 4 to 6, the structure is modified to enable the car 6 and gun 5 to be moved toward and away from the work as well as laterally and horizontally relative thereto. For brevity, some of the parts corresponding generally to those shown in Figs. 1 to 3 are similarly numbered, and will not be again described in detail. In this form of the invention, the elevator runway 18 and parts carried thereby are suspended for sideways movement on the first trackway 15, by wheeled means 16 comprising the rollers 17. In this instance, in lieu of the traversing chain drive 22—23 of Figs. 1—3, one of the supporting

wheels means 17 is itself motor driven by geared reversing motor 44 power for which is controlled in any suitable way, preferably from control panel 9 in the blasting car 6.

The wheeled means 16—17 in this instance supports a second trackway or rollerway 45 extending transversely of the first trackway 15, and from which is suspended a second wheeled means 46 having traversing rollers 47 engaging the trackway 45. The second wheeled means 46 is suitably traversable on the second trackway 45, as by a geared head reversible motor 48, similar to the motor 44 and similarly controlled. The elevator runway 18 is in turn suspended from the second wheeled means 46.

The stabilizing means, to prevent swinging of the elevator and gun under the reaction of the nozzle or otherwise, in this arrangement comprises stabilizing rollers 50 running on stabilizing trackways or rollerways 51, and braced to the wheeled means 16 or the second or transverse trackway carried thereby as shown at 52. The first wheeled means and second trackway 45 and wheeled means 46 carried thereby are thus prevented from tilting relative to the first trackway. To prevent the elevator runway from swinging relative to the wheeled means 46, the stabilizing means further includes stabilizing rollers 53 running on stabilizing trackways or rollerways 54, and braced to the elevator runway 18, as by suitable supports 55. Additional bracing 56 (shown in Fig. 6) may be employed if desired, to further rigidify the traversable structure.

As in the form of Figs. 1—3, the power leads for the control panel 9 may be carried in any suitable way to the instrumentalities to be controlled, as exemplified in Fig. 4 by the main power cable 60, pulleys 61 and cable reel 62; the cable 63, reel 64 and pulley 65 for the horizontal bridge travel motor 44; the cable 66, reel 67 and pulley 68 for the horizontal fore-and-aft, or trolley travel motor 48; and the cable 69, reel 70 and pulley 71 for the elevator drive motor 28.

With this arrangement the advantages of the structure of Figs. 1 to 3 are realized, and in addition, the gun car 6 may be moved not only sideways and vertically relative to the work, but also to-and-fro relative thereto, which is especially advantageous when blasting very irregular castings or castings having deep cavities difficult to reach with the blast stream.

The construction of Figs. 7 to 11 inclusive shows a preferred type of blasting apparatus exemplifying the present invention. In this construction a track 115 is generally U-shaped in plan view and extends along three generally rectangularly disposed walls 101 of a blasting room 102. The fourth wall is shown as provided by retractable door panels 112 which can be double-hinged for example to fold in either direction as they are opened to permit the introduction and removal of the work articles to be blasted. For convenience in handling the work the floor 104 of the room is provided with a pair of tracks or rails 173 on which can be mounted a flat car 174 equipped with one or more sets of rail-fitting wheel trucks 175. If desired, the work articles can be directly supported on such trucks without using an intervening car body.

A blasting car 106 is suspended in a vertically extending framework 118, and the framework in turn has rollers 117 by which it is secured to the track 115. Raising and lowering mechanism 128 is shown as connected to move the car 106 vertically in the framework 118 and suitably ad-

just its position as desired. Additional driving means 148 is connected to propel the car-carrying framework 118 along track 115 so as to bring the car 106 to the desired vantage point for blasting. A blasting nozzle 5, here shown as mounted underneath car 106, is supplied with liquid and solid blastant by means of flexible hoses indicated collectively at 176 and extending to approximately the center of the room where they connect with supply conduits, one of which is shown at 177 leading to an abradant supply tank 178 and pumping mechanism 179. The abradant in this tank can conveniently be a thick slurry of sand in liquid such as water, with the pumping mechanism 179 connected to agitate and circulate this slurry thereby keeping the abraded particles in suitable suspension for movement through the lines to the nozzle.

The hoses 176 can also include electric power supply lines as well as an air supply hose that can be connected with the interior of car 106 for the purpose of providing positive ventilation for the operator. Downwardly flaring protecting collar 180 encircles the hoses adjacent their fixed connection at the center of the room to prevent kinking and excessive flexing of these hoses at this location. A second flared sheath 181 can be mounted on car 106 as shown in Fig. 9 for the same reason. Additional protection for the hoses can be provided in the form of a rotatable boom (not shown) swiveled adjacent collar 180 or sheath 181 and having a free end secured to the hoses 176 to keep them from sagging unduly. An anti-tilt rail 140, against which the car is journaled as by rollers 141, counteracts the blasting thrust of the nozzle.

As shown in Fig. 9 substantially the entire front of the car 106 can be in the form of a door 111 hinged as indicated at 182 and having a locking handle or knob 183. One or more lights 184 mounted in a portion of the door is arranged to illuminate the work to be blasted while transparent panel 135, which can be protected by bars as indicated at 185, acts as a viewing window for the operator in the car. Clearing mechanism such as the water spray lines 186 are arranged to wash the surfaces of panel 135 and lights 184 to keep them clear.

As indicated above, the floor 104 of the blasting room is preferably in the form of a grating to permit abradant and detritus to fall through into a conveniently provided pit. The detritus can be delivered from the pit, as by means of a hopper outlet, to be discarded. Inasmuch as a considerable amount of suitable blastant particles such as molding sand is usually contained in or on the work articles and dropped through with the detritus, reclaiming structure such as a sand classifier can be supplied for receiving the materials collecting in the pit, removing sand particles of selected size and delivering these selected particles to the tank 178. Floor 104 can also be sloped downwardly toward rails 173 as for example at about a 10° inclination so that larger articles, core rods and the like, blasted from the work articles on to the floor will collect where they can be easily removed either manually or with the help of instruments such as lifting magnets.

As shown in Figs. 10 and 11, the nozzle 5 can advantageously have an extensive range of universal movement. For this purpose this form of the invention has the nozzle supported by its body 187 which is pinned to a shaft 188 projecting through the floor into the interior of car 106

where it is journaled on fixed bearings 189. Shaft 188 is prevented from appreciable movement in its longitudinal direction as by shoulders, not shown, cooperating with the sides of the bearings 189. A rod 190 is also pinned to the nozzle body 187 at a point spaced from the attachment of shaft 188, and both rod 190 and shaft 188 extend upwardly and are pivoted to a control lever 191 having a handle portion 192 for operation by the operator in the car.

By manipulating a handle 192 up or down it will be noted the nozzle body 187 can be pivoted about its pin attachment to shaft 188 to move the nozzle 5 in a manner corresponding to the movement of the handle. At the same time the handle 192 can be deflected sideways so that lever 191 pivots about shaft 188 and correspondingly rotates the nozzle.

For sealing the openings in the floor of car 106 through which shaft 188 and rod 190 move, and particularly the arcuate slot through which rod 190 pivots around shaft 188, the arrangement shown in Fig. 10 is quite effective. An outer ring 193 fixed to the car floor encircles the floor openings and has inwardly directed flanges 194. An inner ring 195 has spaced outwardly directed flanges 196 positioned to mesh with flanges 194, and is held by a cap 197 and collar 198 in fixed position on shaft 188. The cap 197 is imperforate except for the passageways through which the rod 190 must move longitudinally. A washer or gasket 199 snugly fitted around rod 190 reduces leakage at this point. The intermeshed flanges 194 and 196 act as a series of baffles which permit rotation of shaft 188 and rod 190 and at the same time prevent any splashing abradant from entering the car 106 through the above floor openings. A small amount of fresh air led to the car interior as indicated above, is permitted to escape between the flanges and thereby also reduces the ingress of floating particles of abradant which, during the blasting, may form in clouds in the blasting room.

For the convenience of the operator a ballast 200 can be provided for control lever 191 to assure that the nozzle 5 is easily controlled notwithstanding its powerful thrust recoil as well as the shifting tendencies of the looped hoses. The ballast 200 can be in the form of an open container in which weights can be added and from which weights can be removed to effect a fine adjustment for the balancing action. Suitable weights are in the form of a small supply of sand which can be kept within the car 106.

A feature of the above construction is that although quite simple the track 115 provides an exceptionally large latitude of blasting positions. Furthermore, this track arrangement in combination with the vertical adjustment travel of the car provides a range of blasting positions which covers substantially any vantage point likely to be desirable. Moreover, the flexible portions of the blasting lines, and their companion air and electric lines where used, need only a small amount of adjustment with respect to span. Thus, for example, it will be noted that the maximum distance of the car from the center of the blasting room in Fig. 7 is not much larger than the minimum distance. Most of the flexibility of these lines is accordingly used to provide swivel action rather than expansion and contraction, and the possibility of having sagging contracted lines interfere with the blasting is greatly reduced.

In general, the highly desirable blasting of the construction of Figs. 7 to 11 can be provided with blasting rooms that need not be rectangular or square in plan view. Circular, elliptical or polygonal room outlines are also useable. For best results, the continuous car carrying trackway should extend at least about 270° around the periphery of the room regardless of its outline.

Fig. 12 shows an embodiment of the present invention in which a blasting room 202 has an endless car-holding track 215 which extends in a more or less endless manner along all the side walls. In this form of the invention the work articles can be held on a stationary table 274 for example and introduced and removed as by means of a crane or similar lifting device operating through the top of the chamber. Where it is desired to keep the blasting chamber closed, the top may have a retractable roof as indicated by the sliding section panels 272 which can be arranged to slide away from over the table 274 and also off to one side of the room as indicated at 273. The blastant and other lines can be introduced as shown at 280 through a fixed portion of the chamber's roof.

As indicated above, the endless track 215 can be used with blasting chambers having any convenient plan outline. If desired, auxiliary limit switches can be provided to keep the blasting car from running along the endless track to an extent that would kink or tangle the lines. For convenience, these limit switches can be positioned along a portion of the track to automatically shut off power to the track driving mechanism when the car reaches a desired position from either direction. A small amount of overlap can be provided to reduce the requirement to travel the entire length of track in order to make a small shift near the limit zone.

The above described features of the invention need not all be used simultaneously. Moreover, the individual features can be combined in different groupings. By way of example, the construction of Figs. 7 to 11 inclusive can be used with a work loading and unloading passageway at the top of the blasting chamber, as by using a movable roof or by omitting the roof completely. Correspondingly, the endless track construction of Fig. 12 can be used with the wall door loading and unloading features of Fig. 7.

The blasting car guiding mechanism of the present invention need not be mounted overhead at the top of the room, but can also be provided at lower levels as in the usual form of car-carrying rails. In addition, the blasting car can be directly held on the floor of the blasting room as by means of wheels that are not located in a track but can roll along the floor after the manner of conventional rubber tired vehicle constructions.

According to a further phase of the present invention, the adjustable blasting nozzle can have an additional range of adjustment extending vertically of the car on which it is carried. Thus, by arranging for the nozzle to project out from one side of the car and to be vertically moveable from the top to the bottom of the car, the nozzle need not be confined to the vertical travel of the car itself. Advantageously, such extra nozzle travel can be correlated to automatically follow the vertical movements of the car. In other words, the nozzle can be adjusted so that it is at the top of the car when the car is at its highest position and automatically moves down with the car so that it reaches the bottom

of the car when the car goes to its lowest position.

As many apparently widely different embodiments of this invention may be made without departing from the spirit and scope hereof, it is to be understood that the invention is not limited to the specific embodiments hereof except as defined in the appended claims.

What is claimed is:

1. In a blast room, a walled enclosure, a trackway extending across the upper part of the enclosure, an elevator car suspended from said trackway, means for traversing said suspended car along said trackway, means for raising and lowering said car relative to said trackway, and blasting means carried by said car and mounted for at least limited universal movement relative thereto.

2. In a blast room, a walled enclosure, a trackway extending across the upper part of the enclosure, an elevator car suspended from said trackway, means for traversing said suspended car along said trackway, means for raising and lowering said car relative to said trackway, blasting means carried by said car and mounted for at least limited universal movement relative thereto, and means under control of an operator within the car for controlling said traversing, elevating, and blasting means.

3. In a blast room, a walled enclosure, a trackway extending across the upper part of the enclosure, an elevator car suspended from said trackway, means for traversing said suspended car along said trackway, means for raising and lowering said car relative to said trackway, a blasting gun carried by said car and mounted for at least limited universal movement relative thereto, and means under control of an operator within the car for controlling said traversing and elevating means and the operation and orientation of said gun.

4. In a blast room, a walled enclosure, a trackway extending across the upper part of the enclosure, an elevator car suspended from said trackway, means for traversing said suspended car along said trackway, means for raising and lowering said car relative to said trackway, a high pressure hydraulic blasting gun carried by said car and mounted for at least limited universal movement relative thereto, and means under control of an operator within the car for controlling said traversing and elevating means and the operation and orientation of said gun.

5. In a blast room, a walled enclosure, a trackway extending across the upper part of the enclosure, an elevator car suspended from said trackway, means for traversing said suspended car along said trackway, means for raising and lowering said car relative to said trackway, a high pressure hydraulic blasting gun carried by said car and mounted for at least limited universal movement relative thereto, means for stabilizing said elevator car against swinging under the reactive force of said hydraulic gun, and means under control of an operator within the car for controlling said traversing and elevating means and the operation and orientation of said gun.

6. In a blast room, a walled enclosure, a trackway extending across the upper part of the enclosure, an elevator car suspended from said trackway, means for traversing said suspended car along said trackway, means for raising and lowering said car relative to said trackway, a high pressure hydraulic blasting gun carried by

11

said car and mounted for at least limited universal movement relative thereto, means for stabilizing said elevator car against swinging under the reactive force of said hydraulic gun comprising at least one rollerway lying out of the plane of suspension of said car from said trackway.

7. In a blast room, a walled enclosure, a trackway extending across the upper part of the enclosure, an elevator car suspended from said trackway, means for traversing said suspended car along said trackway, means for raising and lowering said car relative to said trackway, a high pressure hydraulic blasting gun carried by said car and mounted for at least limited universal movement relative thereto, means for stabilizing said elevator car against swinging under the reactive force of said hydraulic gun comprising a downwardly facing channel and a thrust roller running therein, and means under control of an operator within the car for controlling said traversing and elevating means and the operation and orientation of said gun.

8. In a blast room, a walled enclosure, a trackway extending across the upper part of the enclosure, and elevator runway suspended from said trackway and traversable therealong, an elevator vertically movable in said runway, blasting means carried by said elevator and mounted for at least limited universal movement relative thereto, means for traversing said runway along said trackway, and means for traversing said elevator along said runway.

9. In a blast room, a walled enclosure, a first trackway extending thereacross, wheeled means running thereon, a second trackway carried by said wheeled means and extending transversely of said first trackway, an elevator supported on said second trackway and traversable therealong, blasting means carried by said elevator, means for traversing said wheeled means along said first trackway, means for traversing said elevator along said second trackway, and means for raising and lowering said elevator and gun relative to said trackway.

10. In a blast room, a walled enclosure, a first trackway extending thereacross, wheeled means running thereon, a second trackway carried by said wheeled means and extending transversely of said first trackway, an elevator supported on said second trackway and traversable therealong, a high pressure blast gun carried by said elevator and mounted for at least limited universal movement relative thereto, means for traversing said wheeled means along said first trackway, means for traversing said elevator along said second trackway, and means for raising and lowering said elevator and gun relative to said trackway.

11. In a blast room, a walled enclosure, a first trackway extending thereacross, wheeled means running thereon, a second trackway carried by said wheeled means and extending transversely of said first trackway, an elevator supported on said second trackway and traversable therealong, a high pressure blast gun carried by said elevator and mounted for at least limited universal movement relative thereto, means for traversing said wheeled means along said first trackway, means for controlling the orientation of said gun, means for traversing said elevator along said second trackway, and means for raising and lowering said elevator and gun relative to said trackway.

12. In a blast room, a walled enclosure, a first trackway extending across the upper part thereof, wheeled means running thereon, a second

12

trackway suspended from said wheeled means and extending transversely of said first trackway, means for stabilizing said second trackway against tilting, relative to said first trackway, an elevator runway suspended from said second trackway and traversable therealong, means for stabilizing said runway against swinging relative to said second trackway, an elevator vertically movable in said runway, and blast jetting means mounted on said elevator.

13. In a blast room, a walled enclosure, a first trackway extending across the upper part thereof, wheeled means running thereon, a second trackway suspended from said wheeled means and extending transversely of said first trackway, means for stabilizing said second trackway against tilting relative to said first trackway, an elevator runway suspended from said second trackway and traversable therealong, means for stabilizing said runway against swinging relative to said second trackway, an elevator vertically movable in said runway, blast jetting means mounted on said elevator and power driven means controllable by an operator in said elevator for traversing said wheeled means along said first trackway, for traversing said runway along said second trackway, and for traversing said elevator along said runway.

14. In a blast room, a walled enclosure, an elevator car mounted for horizontal and vertical traverse within said enclosure and adapted to be brought into a position with one of its car walls juxtaposed to a particular area of said enclosure wall, a door in said car wall, a door in said particular area of said enclosure wall, and blasting means carried by said car.

15. In a blast room, a walled enclosure, a movable operator's car within said enclosure and movable to position its rear wall in juxtaposition to an area of said enclosure wall, a door in the rear wall of said car, a door in said area of enclosure wall of less extent than the area of the rear wall of said car, a door in another wall of said car, and blasting means carried by said car, whereby said car not only supports said blasting means but also serves as an entrance lock for said enclosure.

16. In a blast room, a walled enclosure, a movable operator's car within said enclosure and movable to position its rear wall in juxtaposition to an area of said enclosure wall, a door in the rear wall of said car, a door in said area of enclosure wall of less extent than the area of the rear wall of said car, and blasting means carried by said car.

17. Work blasting equipment comprising an enclosed movable operator-carrying car having substantially impervious outer walls, a door hinged to one of said walls and opening outwardly, a door stop defining the closed position of the door, and an outwardly directed blast gun mounted on said door for projecting its blast outwardly therefrom and applying a blast recoil that automatically keeps the door closed.

18. Blasting apparatus for subjecting articles to the action of a directable stream of blastant while shielding a direction-controlling operator from exposure to the stream, said apparatus including an enclosed blasting room, trackway structure extending in different directions across the upper portion of the room, an operator-housing car carried by the trackway structure, impelling means connected for moving the car with respect to the trackway structure and including control elements within the car for manipulation

13

by an operator housed therein to selectably bring the car to appropriate vantage points for blasting, said car also carrying projecting means for projecting a stream of blastant, and directive mechanism within said car and connected to the projecting means for orientation of the stream by the operator.

19. The combination as defined by claim 18 in which the trackway structure includes a length of track extending continuously at least about 270° around the walls of the blasting room to very simply give the operator in the car a wide range of vantage points.

20. The combination as defined by claim 18 in which the blasting room has four generally rectangularly positioned side walls, the trackway structure includes a continuous U-shaped rail fixed in place adjacent the tops of three of the

14

walls, and the control elements include vertically adjusting mechanism connected to the rail and supporting the car in vertically adjustable position with respect to the walls.

WILTIE I. GLADFELTER.

## REFERENCES CITED

The following references are of record in the file of this patent:

## UNITED STATES PATENTS

Number	Name	Date
1,628,317	Hoevel	May 10, 1927
1,655,767	Hoevel	Jan. 10, 1928
1,656,238	Ruemelin	Jan. 17, 1928
1,977,386	Holes	Oct. 16, 1934
2,440,222	Keefer	Apr. 20, 1948