March 14, 1944. D. C. TURNBULL 2,344,475

ABRADING APPARATUS

Filed Dec. 31, 1941 5 Sheets-Sheet 1

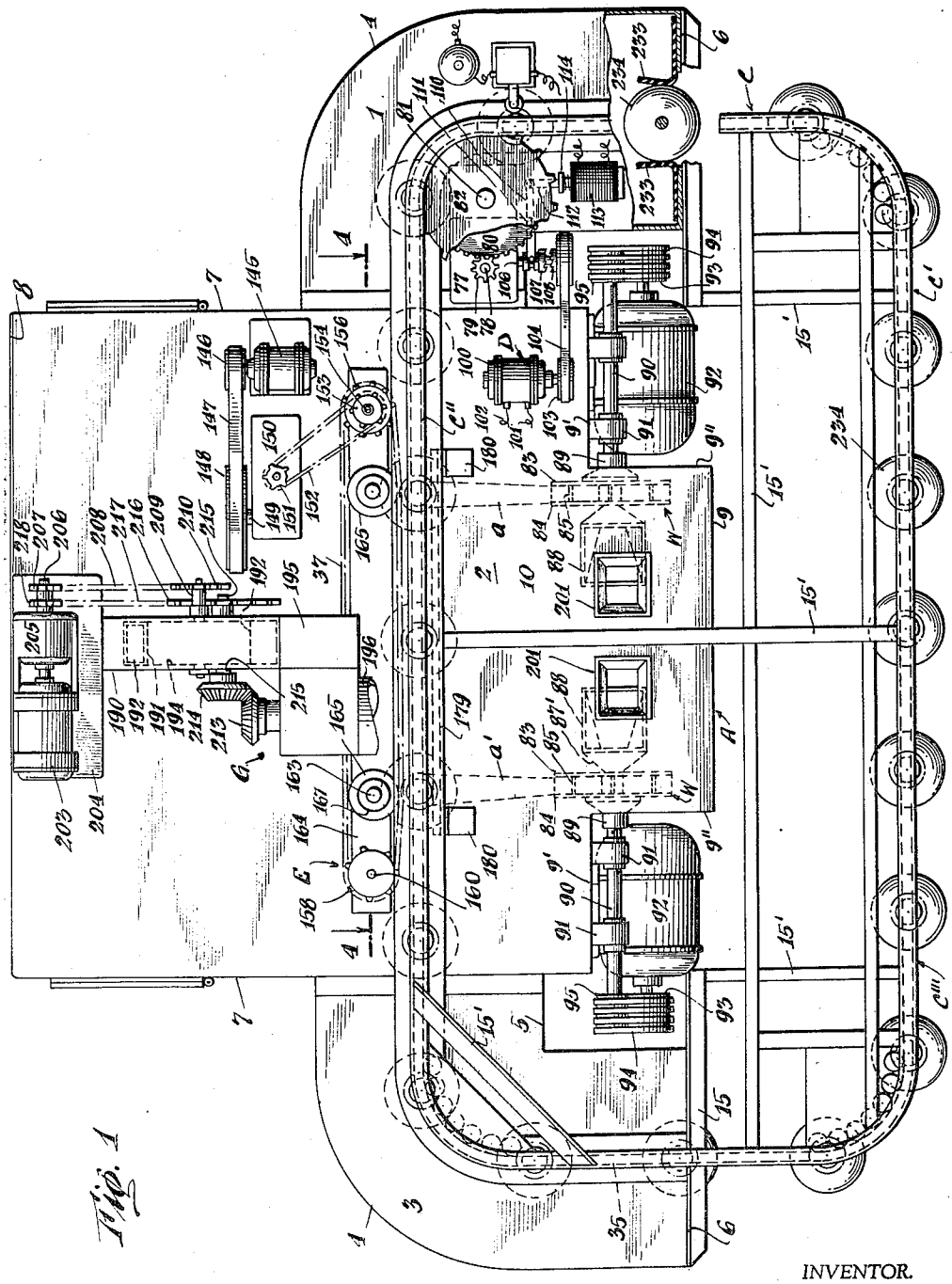

Fig. 1

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Fig. 2

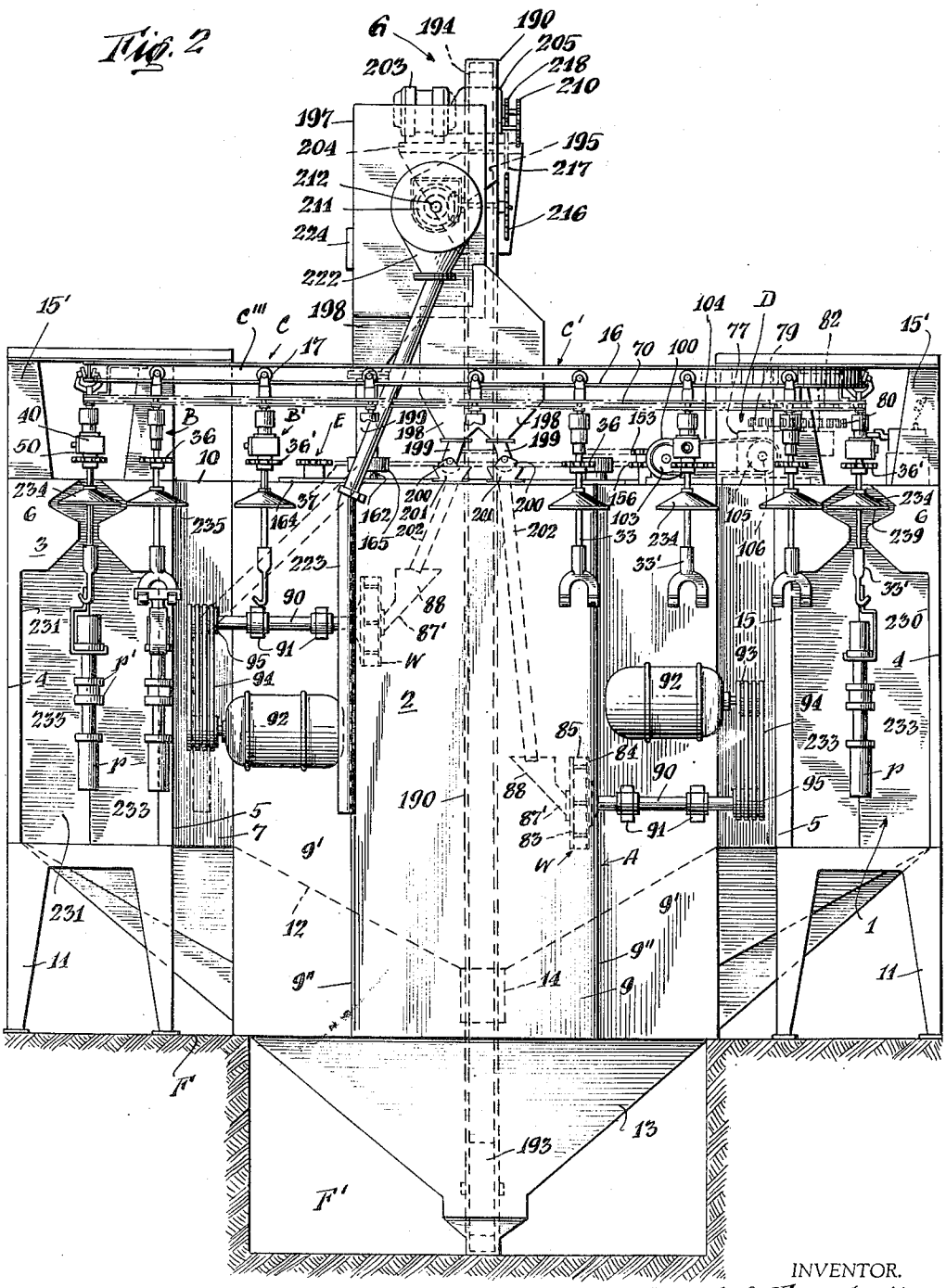

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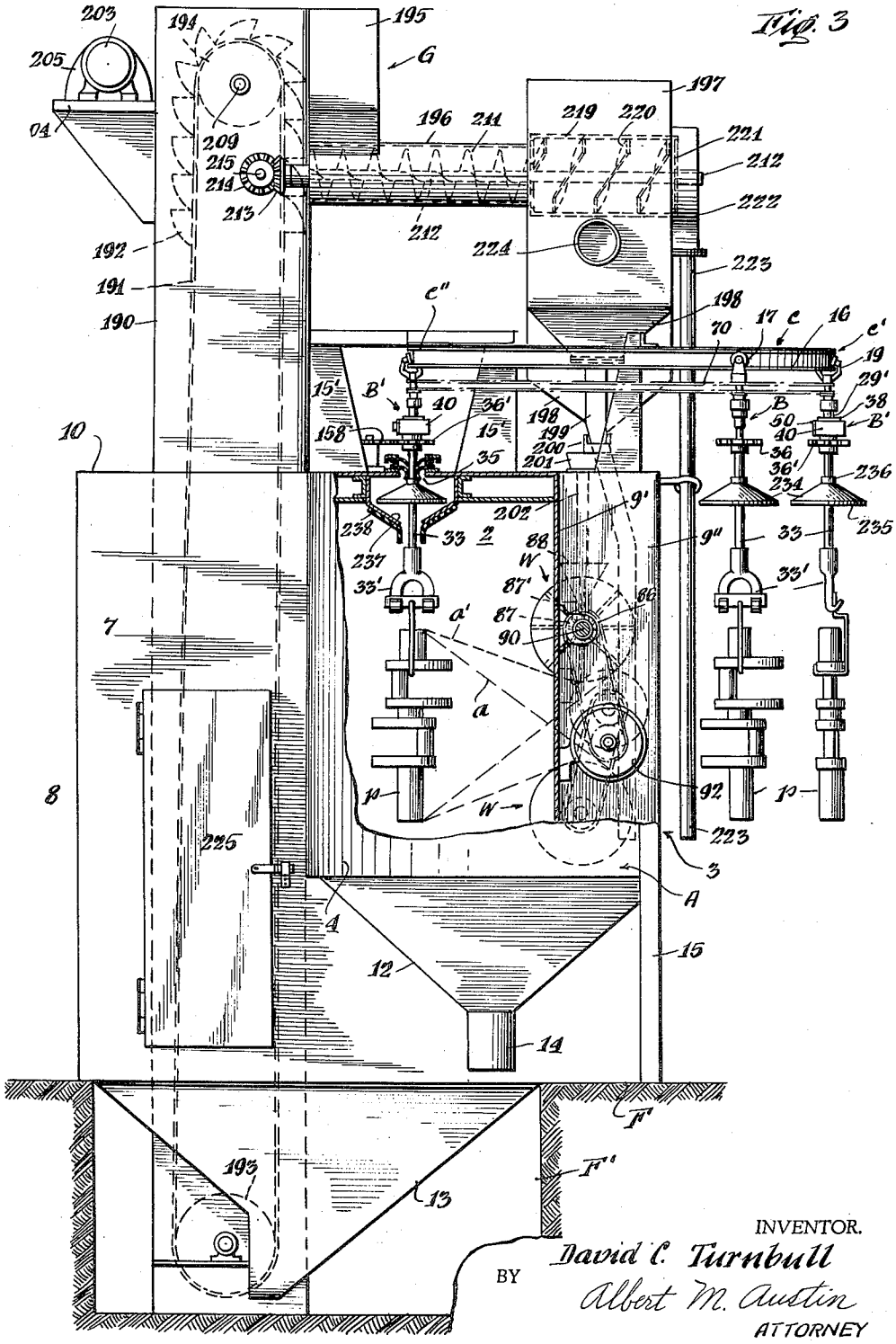
Fig. 3



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ABRADING APPARATUS

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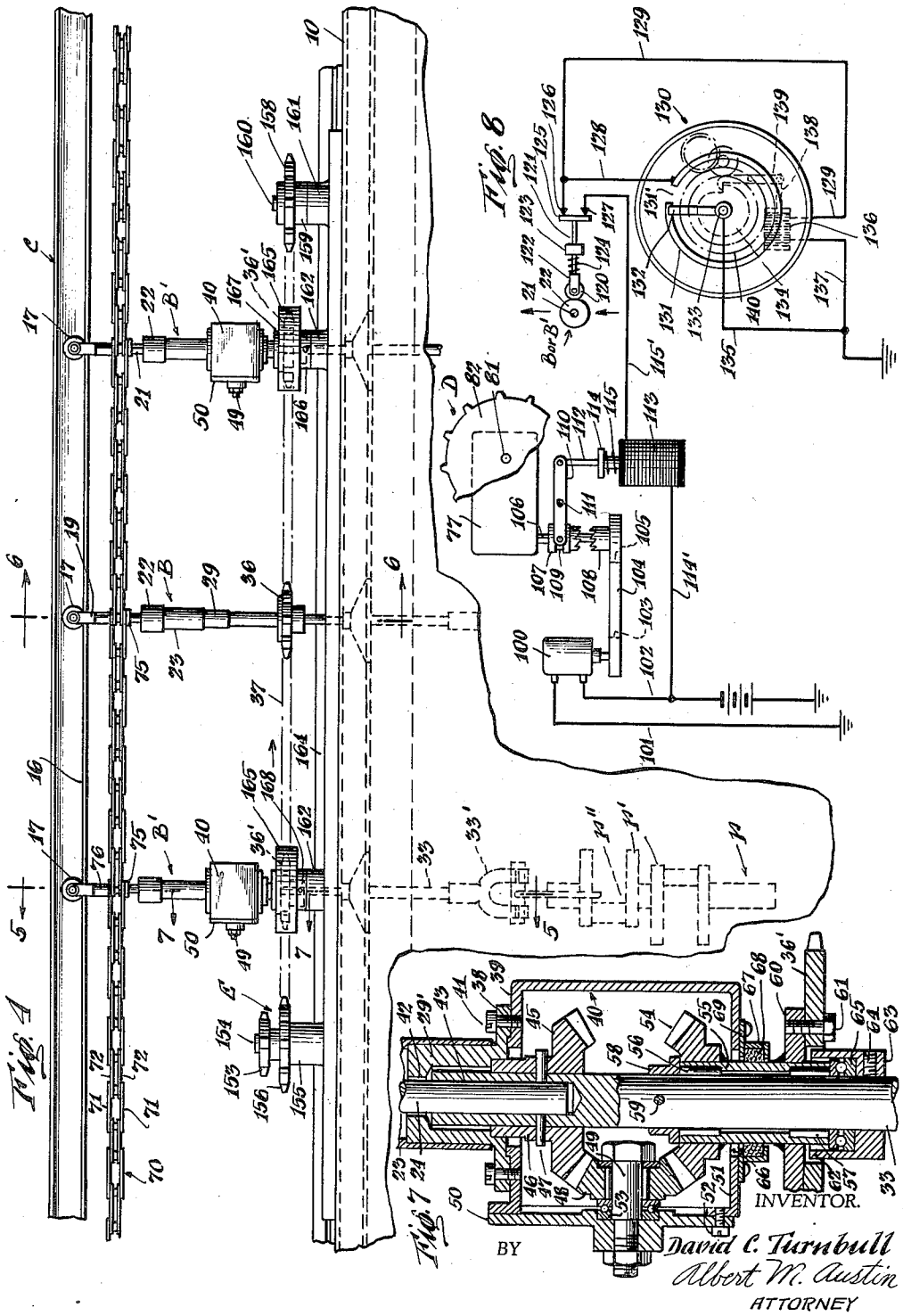

Fig. 4

Fig. 8

Fig. 7

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Fig. 5

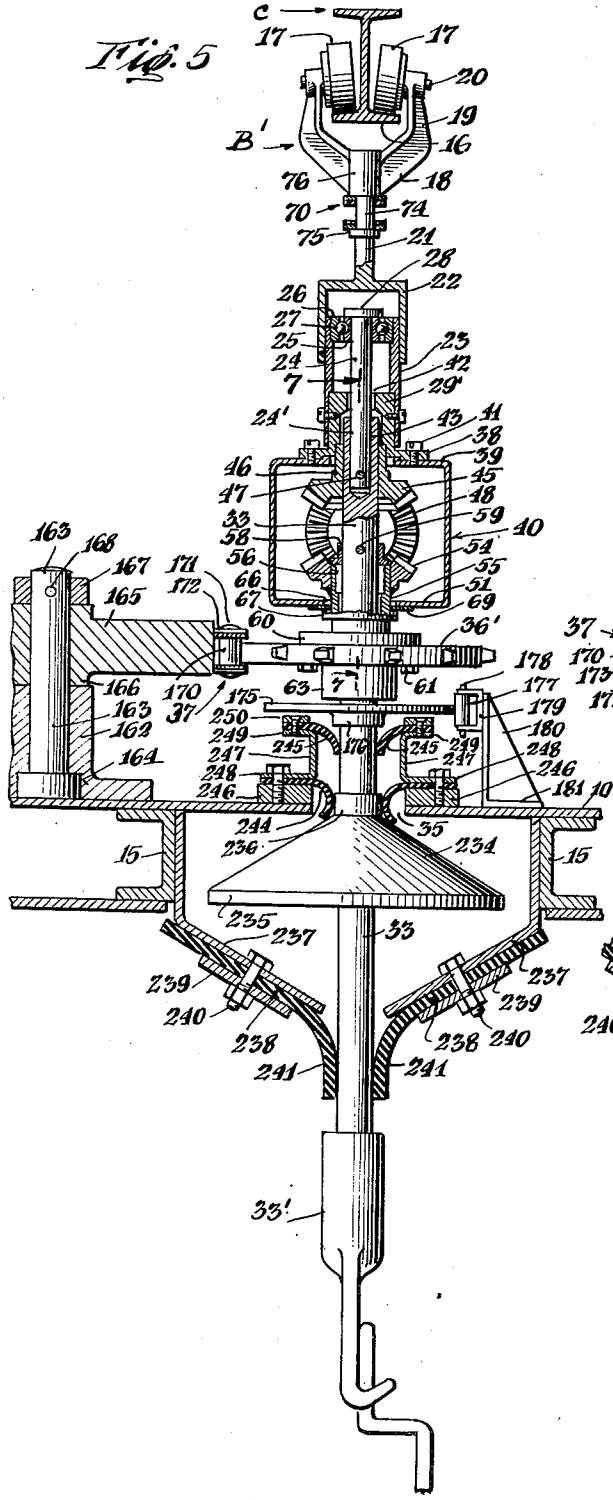
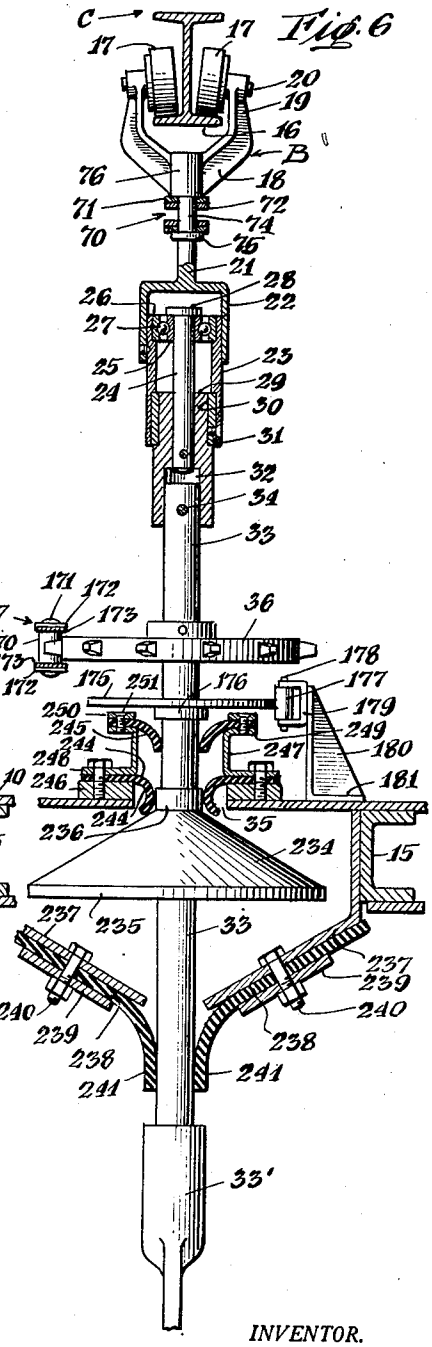


Fig. 6



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Patented Mar. 14, 1944

2,344,475

UNITED STATES PATENT OFFICE

2,344,475

ABRADING APPARATUS

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Application December 31, 1941, Serial No. 425,082

19 Claims. (Cl. 51—9)

This invention relates to abrading apparatus, and more particularly to blast cleaning apparatus whereby relatively large and irregularly shaped castings and metal objects may be subjected to the cleaning or treating action of any desired number of centrifugally projected abrasive streams.

In the blast cleaning and treating of numerous relatively large and cumbersome or irregularly shaped metal objects the problem is presented of conveying and manipulating the metal objects in successive centrifugally projected abrasive streams so as to thoroughly clean to the desired degree all irregular projections and cavities which the surfaces of the objects present. To effect this result the objects should be advanced into each of the successive blasting streams with the least possible delay and yet be permitted to dwell in each of the blast streams for a carefully controlled period.

Abrasive blasting wheels having means associated therewith for accurately controlling the direction of fire of the abrasive blast, as illustrated and described in Peik Pat. No. 1,953,566, are highly effective in the blast cleaning and treating of numerous metal objects. Since such abrasive throwing wheels, each throwing many hundreds of pounds of abrasive per minute, are relatively heavy and must be rotated at very high speeds, it is generally most convenient to maintain the wheels in a relatively stationary position and manipulate the workpieces in each of the blast streams. This requires that all the projections and cavities on the surfaces of the workpieces to be cleaned must be manipulated in the fan-shaped stream projected from each wheel, and further requires that the surface areas to be cleaned reside in the blasting streams for a controlled period of time so that all surfaces will be thoroughly and adequately cleaned and yet not over-abraded or damaged by the blasting stream, which may quickly result from relatively short over-exposure due to the large volume and terrific speed of the abrasive projected by abrasive throwing wheels of the type above-referred to.

An object of this invention is to provide improved blasting apparatus having means associated therewith for accurately controlling the period of exposure of the workpieces in centrifugally projected abrasive streams.

Another object of this invention is to provide improved mechanism for assuring positive and accurate indexing of the advancing workpieces in one or more abrasive blasting streams so that the maximum quantity of projected abrasive will be employed in doing useful work.

Another object of this invention is to provide improved mechanism for rotating the workpieces at controlled speed in one or more centrifugally projected abrasive streams.

A further object of this invention is to provide improved blasting apparatus which is substantially automatic, smooth and efficient, foolproof in operation, sturdy and lasting in construction, simple and relatively inexpensive in design, and which achieves high speed production output at relatively lower costs than apparatus of this type heretofore provided.

Other objects of this invention will become apparent as the disclosure proceeds.

Various other features and advantages of the invention will be apparent from the following particular description and from an inspection of the accompanying drawings.

Although the novel features which are believed to be characteristic of this invention will be particularly pointed out in the claims appended hereto, the invention itself, as to its objects and advantages and the manner in which it may be carried out, may be better understood by referring to the following description taken in connection with the accompanying drawings forming a part thereof, in which:

Fig. 1 is a top plan view of the apparatus;

Fig. 2 is a front elevational view of the apparatus shown in Fig. 1;

Fig. 3 is an end elevational view of the apparatus, certain parts being broken away to illustrate structural details;

Fig. 4 is an enlarged fragmentary elevational view of the work-supporting hangers and spinner mechanism as the same appears when one looks along line 4—4 of Fig. 1;

Fig. 5 is an enlarged vertical cross-sectional view through one of the intermediate work-supporting hangers and adjacent spinner chain guiding or supporting devices, as the same appears when looking along line 5—5 of Fig. 4;

Fig. 6 is an enlarged vertical cross-sectional view through one of the alternate work-supporting hangers and adjacent spinner chain supporting device, as the same appears when viewed along line 6—6 of Fig. 4;

Fig. 7 is a fragmentary vertical cross-sectional view showing the driving parts of the intermediate work-supporting hanger as the same appears when viewed along line 7—7 of Fig. 5; and

Fig. 8 is a diagrammatic illustration of the wiring diagram and electric control mechanism for regulating the advance movement of the work-supporting hangers through the blasting streams.

Similar reference characters refer to similar parts throughout the several views of the drawings and the specification.

Referring to the drawings, the blasting ap-

paratus comprises generally a blast cabinet A into which the workpieces *p* are conveyed by alternate and intermediate workpiece suspension hangers B and B' which are adapted to roll along a circuitous track C. The surfaces of the workpieces *p* are blasted with abrasive during their residence in the cabinet A by means of a plurality of centrifugal throwing wheels W which operate to project controlled streams of abrasive *a* and *a'* against the workpieces. The workpiece-supporting hangers B and B' are advanced into the blasting zone by means of hanger-advancing mechanism D which operates to advance the workpieces into each of the successive blasting streams where they are permitted to dwell for a predetermined time period before they are advanced out of the blasting streams. Mechanism E is also provided for rotating the workpiece-supporting hangers during their residence in the blasting streams, so that all surfaces, including projections and cavities in the workpieces, are fully blasted and cleaned to the desired degree.

As shown more particularly in Figs. 1, 2 and 3, the blast cabinet A comprises generally an entrance vestibule section 1, a blasting zone section 2, and an exit vestibule section 3. The entrance and exit vestibule sections provide hallways through which the work-supporting hangers move in entering and leaving the main blasting section 2 disposed therebetween. Each of the vestibule sections 1 and 3 is defined by an outer side wall 4, an inner side wall 5 and a front entrance wall 6. The main blasting section is defined by spaced side walls 7, a rear wall 8 and a front wall 9. The entire top of the cabinet is enclosed by a top wall 10, which extends over the entrance vestibule 1, main blasting section 2, and exit vestibule 3. The walls of the cabinet are held together in rigid assembly by suitable framework 15. The entrance vestibule section 1 and the exit vestibule section 3 may rest upon a sturdy raised base or table 11, while the main blasting section 2 may rest directly upon the building floor F.

An abrasive-receiving hopper 12, as illustrated more particularly in Figs. 2 and 3, may be provided to form the bottom wall of the blasting section 2 of the cabinet. If the distance between the front wall 9 and the rear wall 8 of the blasting section of the cabinet is made of substantial depth as indicated, it may be desirable to provide a second abrasive-receiving hopper 13 which sets into a pit F' in the floor to receive the abrasive from the funnel 14 of the hopper 12. Abrasive-elevating and screening mechanism G may be provided for cleaning and cycling the abrasive from the hopper 13 to the abrasive throwing wheels W.

The conveyor track C is positioned above the top wall 10 of the cabinet and may be of any desired shape most convenient for plant operations to carry the workpieces *p* to the blasting cabinet, through the blast cabinet, and away from the blast cabinet to an unloading zone. The conveyor track C, as illustrated in Figs. 1, 2 and 3, is shown as comprising a closed circuitous track having the loading section C' thereof positioned outside of the cabinet, a section C'' which extends over the top wall 10 of the cabinet, and an unloading section C''' extending beyond the top wall area of the blast cabinet. The conveyor track C may be formed as an I-beam section having a bottom flange 16 along which the work-supporting carriers B and B' are adapted to roll. The track C is braced and supported by suitable framing 15' suitably secured to the cabinet framework 15 or to the ceiling of the plant, as found most convenient.

In order that all surfaces of the workpieces *p* be fully cleaned to the desired extent during residence of the workpieces in the abrasive streams *a* and *a'*, it is desirable to rotate the workpieces *p* in each blasting stream for a predetermined period. The workpieces *p* should also obviously be arranged as close together as possible in order that the abrasive streams may be utilized to the maximum in cleaning the workpieces and not be projected between the spaced workpieces without cleaning the surfaces thereof. It is also obvious that where the workpieces *p* have projections *p'* of substantial length and cavities *p''* of substantial depth, the workpieces can be suspended closer together if alternate workpieces are rotated in opposite directions. While it is an old expedient to rotate the workpieces in opposite directions in the blasting zone so that the blasting streams may be utilized to their maximum usefulness, I have provided improved mechanism for rotating the workpieces in the blasting streams with alternate workpieces rotating in the same direction and intermediate workpieces rotating in the opposite direction, which is simple in design, sturdy and lasting in construction, and positive in operation.

This desirable objective is achieved by so constructing the alternate work-supporting hangers B and the intermediate work-supporting hangers B' that the workpieces on all the alternate hangers may be rotated in one direction and the workpieces on all the intermediate hangers may be rotated in the opposite direction by a single drive chain. While the alternate hangers B and the intermediate hangers B' have been illustrated in Figs. 1, 2, 3 and 4 as being some distance apart, this has been done for the sake of clearness as it will be understood that the hangers can be positioned as close together as the shape and size of the workpieces *p* to be cleaned will permit.

Both the alternate and intermediate work-supporting carriers B and B', as illustrated more particularly in Figs. 4, 5 and 6, comprise a pair of rollers 17 which roll on the flange 16 of the I-beam shaped track C. The rollers 17 are secured to the arms 19 of the U-shaped yoke 18, each arm carrying a stub shaft 20 on which the rollers 17 are journaled. Each yoke 18 is provided with a downwardly extending leg 21 which terminates in a cup-shaped receiver 22. A tubular sleeve 23 has the upper end thereof projecting into the cup 22 and is firmly secured to the cylindrical wall of the cup. A spindle 24 is rotatably mounted within the sleeve 23 by a thrust bearing comprising bearing part 25 fixed to the upper end of the sleeve 23 and bearing part 26 fixed to the upper end of the spindle 24, the bearing parts 25 and 26 having a raceway therebetween for ball bearings 27. The spindle 24 may be provided with a flattened head 28 which rests on the bearing part 25.

Both the alternate and intermediate hangers B and B' are each provided with a work-supporting spindle 33 which is connected to the carriage spindle 24. The spindles 33 are of sufficient length to extend through a slot 35 in the top wall 10 of the cabinet, the slot 35 being directly below cabinet section C'' of the track C. The lower end of each hanger spindle 33 is provided with a hook element 33' to which the workpiece *p* may be conveniently attached.

Each of the work-supporting spindles 33 and the workpiece which it supports may be freely rotated from the thrust bearing contained within the stationary sleeve 23 of the hanger carriage.

As shown more particularly in Figs. 4 and 6, the spindle 33 of each alternate hanger extends into a socket 32 which is formed in the lower end of a heavy collar member 29. The upper end of the work-supporting spindle 33 is removably secured within the socket 32 by means of a suitable key 34. The heavy collar member 29 is provided with a bearing collar 30 secured to the upper end thereof which is positioned adjacent a bearing collar 31 secured to the lower end of the sleeve 23, thus permitting the heavy collar member 29 to freely rotate within the sleeve 23. Each alternate work-supporting spindle has fixed thereto a sprocket 36 designed to mesh with a continuous spinner chain 37 described in more detail hereinafter.

The work-supporting spindle 33 of each intermediate hanger B' is also provided with a sprocket 36' of the same diameter as the alternate sprockets 36, and is designed to be driven by the same spinner chain 37 which drives the spinner sprockets 36 of the alternate hangers. The spinner sprocket 36' associated with the intermediate hangers B' is, however, connected to its carrier spindle 24 in such a manner that its work-supporting spindle 33 is rotated in a direction opposite to the direction of rotation of the work-supporting spindles 33 associated with the alternate hangers.

As illustrated more particularly in Figs. 4, 5 and 7, each intermediate hanger is provided with a heavy collar member 29' which is fixedly secured to its sleeve 23. The lower end of each collar 29' is provided with a laterally extending flange 38 which is secured as by removable bolts 41 to the upper wall 39 of gear box 40. The spindle 24 of each intermediate hanger is free to rotate in a bore 42 provided in the collar member 29' and is provided with an end portion 24' which projects beyond the flange 38 of its collar member 29'. The upper end of each intermediate hanger spindle 33 is also provided with a bore 43 into which the lower end portion 24' of intermediate hanger spindle 24 extends.

A bevel gear 45 having a hub portion 46 telescopes over and snugly embraces the upper end of each intermediate work-supporting spindle 33. The bevel gear 45 and work-supporting spindle 33 are secured to the end 24' of intermediate hanger spindle 24 by a key or pin 47 which extends through the hub portion 46, spindle 33 and end portion 24' of spindle 24.

Bevel gear 45 meshes with a bevel transfer gear 48 which is supported upon the shank portion of a bolt 49 fixed to a plate 50 removably secured to the top wall 39 and bottom wall 51 of gear box 40 by means of removable screw bolts 52. To permit the bevel transfer gear 48 to rotate on the shank of its supporting bolt 49 without friction, a suitable ball bearing assembly 53 may be provided between the hub of the bevel gear 48 and its supporting bolt 49.

The bevel transfer gear 48 meshes with a bevel driving gear 54 secured to the upper end of a driving sleeve 55 which surrounds the work-supporting spindle 33. The sleeve 55 rotates about the work-supporting spindle 33 substantially without friction by the provision of an upper roller bearing 56 and a lower roller bearing 57 positioned between the sleeve 55 and the work-supporting spindle 33. The gear sleeve 55 is prevented from sliding upwardly on the work-supporting spindle 33 by a collar 58 which is fixed to the spindle 33 as by pin 59 and which abuts the upper end of the sleeve 55. The lower end of the sleeve 55 projects through the bottom wall 51 of the gear box 40 and has secured to its outer periphery a heavy disc member 60. The driving sprocket 36' is firmly secured to the heavy disc 60 by spaced bolts 61. The sprocket 36' is provided with a large circular opening 62 through which the work-supporting spindle 33 projects. A thrust bearing cup 63 is secured to work-supporting spindle 33 at a point below the sprocket 36', as by a set screw 64. A thrust bearing 65 is positioned within the cup 63 and provides a support for the driving sleeve 55.

The gear box 40 may be packed with grease which may be prevented from dripping out through the aperture 66 in the bottom wall 51 of gear box 40 through which the driving sleeve 55 extends, by a suitable sealing gasket which may comprise a gasket cup 67 fixed to the driving sleeve 55 and within which suitable packing material 68 may be placed. A sealing ring 69 secured to the bottom wall 51 of gear box 40 provides a further seal between the bottom wall 51 and the gasket cup 67.

The spinner sprocket 36' driven by spinner chain 37 rotates the driving sleeve 55 to which the driving bevel gear 54 is attached. Driving bevel gear 54 rotates bevel transfer gear 48 which has a driving connection with the gear 45 attached to the upper end of the work-supporting spindle 33 of the intermediate hanger. In this arrangement it will be appreciated that bevel gear 45 attached to the spindle 33 is rotated in a direction opposite to the driving bevel gear 54 attached to the driving sleeve 55 so that the intermediate work-supporting spindle 33 will rotate in a direction opposite to its associated spinner sprocket 36'. All moving parts are maintained in well greased driving condition since all driving parts are lubricated from the grease that may be packed in gear box 40. By means of the driving device above described, the work-supporting spindle 33 of each intermediate hanger B' may be rotated in a direction opposite to the rotation of the work-supporting spindles 33 associated with the alternate hangers B, even though the spinner sprocket 36' associated with each intermediate hanger is rotated in the same direction as the spinner sprocket 36 associated with each alternate hanger by the same spinner chain 37.

All the hangers B and B' are connected together by means of a continuous conveyor chain 70 which is positioned directly beneath the track C. The conveyor chain 70 may be in the form of a heavy link chain comprising paired links 71 pivotally connected to intermediate links by heavy studs 73 which extend through aligned openings therein. The leg portion 21 of each hanger bracket 18 is provided with a reduced neck portion 74 which extends through aligned apertures in the paired links 71 and 72 so that the reduced neck portion 74 is substituted for the stud 73 at that point. The ends of adjacent paired links 71 seat between an enlarged collar portion 75 and an enlarged head portion 76 provided on each leg 21. Thus connected, the work-supporting hangers B and B' can be arranged in uniform spaced relationship with the rollers 17 thereof free to roll on the flanges 16 of the track C.

The work-supporting hangers B are caused to travel along the track C by driving mechanism D which engages the conveyor chain 70, and com-

prises a conveyor driving motor 100 mounted on the top wall 10 of the cabinet supplied with power from the primary power lines 101 and 102 so that the motor 100 operates continuously. A pulley wheel 103 is fixed to the motor shaft and carries a drive belt 104 trained around pulley 105 which normally idles on shaft 106 of reduction gearing housed within gear box 77. The reduction gearing in gear box 77 drives shaft 78 which carries a gear wheel 79. Gear wheel 79 meshes with a larger gear wheel 80 fixed to stub shaft 81. Stub shaft 81 carries a large sprocket wheel 82 which meshes with the conveyor chain 70. The hanger-advancing mechanism D has also incorporated therewith devices for periodically advancing and indexing the workpieces in the abrasive streams *a* and *a'* projected from the abrasive throwing wheels W. These indexing devices will be more particularly described hereinafter.

Any desired number of abrasive throwing wheels W may be provided as may be necessary or desirable to effectively clean the surfaces of the workpieces *p* under treatment at the desired production speeds. While I have illustrated two such abrasive throwing wheels in Figs. 1, 2 and 3, it will be appreciated that this invention is in no wise limited to the use of only two abrasive throwing wheels but any desired number thereof may be provided. The abrasive throwing wheels preferably used are control cage and impeller type wheels, such as disclosed in Peik Pat. No. 1,953,566 having certaitn refinements in design as illustrated in Unger Pat. No. 2,162,139. Each wheel W comprises generally a pair of side wall forming discs 83 and 84 having channel-shaped abrasive throwing blades 85 mounted therebetween which extend inwardly short of the axis of rotation of the wheel to provide a central space. A tubular control cage 86 extends into the central space of the wheel and is normally stationary during operation of the wheel but is so mounted that it may be adjusted to place the discharge outlet in the cage in any desired clock-dial position to regulate the direction of fire of the abrasive stream projected therefrom. The wheel is equipped with a vaned impeller 87 positioned within the control cage 86 and fixed to the rear side wall disc 84 of the wheel to rotate with the blades 85 thereof. Abrasive is supplied to the interior of the impeller by means of a feed spout 87 having a funnel formation 88 at the upper end thereof.

Each wheel W may be positioned entirely within the blasting section 2 of the cabinet and has a hub 89 secured to the rear side wall disc 84 thereof. The wheel shaft 90 fixed to the hub 89 is preferably positioned on the outside of the cabinet and is rotatably mounted in suitable spaced bearings 91 which may be secured to the front wall of the cabinet. The wheel shaft 90 is driven by a motor 92 having a drive pulley 93 over which V-belts 94 are trained, the V-belts 94 also being trained around the pulley 95 secured to the end of the wheel shaft 90.

The front wall 9 of the cabinet may be recessed in the manner illustrated in Fig. 1 so as to provide an offset from wall portion 9' upon which the motor 92 and bearings 91 are mounted, and a side wall portion 9'' having an opening therein through which a portion of the hub 89 of the wheel projects. In this arrangement the driving motor 92, V-belts 94, wheel shafting 90 and shaft bearings 91 are fully protected from flying abrasive, while the abrasive throwing wheels W are free to operate within the blasting section 2 of the cabinet. It will be noted, by referring more particularly to Figs. 1 and 3, that the rear wall 8 of the blasting section 2 of the cabinet 1 is spaced a substantial distance rearwardly of the blasting position of the workpieces *p* moving along the section C'' of the track C. In this construction of the cabinet the side walls 7 and rear wall 8 of the blasting section 2 of the cabinet are spaced so far away from the workpieces *p* that any abrasive which may fail to strike the workpieces *p* advancing through the blasting zone has lost much of its abrading force before it contacts the cabinet walls.

It will be noted by referring more particularly to Figs. 2 and 3, that the wheels W may be arranged at different elevations and may be rotated in opposite directions so as to project their fan-shaped streams *a* and *a'* in a manner to most effectively and thoroughly clean all surface areas of the workpieces *p* operated upon. The workpieces *p* are moved into the successive blast streams *a* and *a'*, dwell therein for a predetermined period, and then successively advanced out of the blast streams by indexing devices associated with the hanger-advancing mechanism B.

The indexing devices asociated with the hanger-advancing mechanism D operate to halt the work-supporting hangers B and B' in the blasting zone for a predetermined period of time and thereafter to automatically advance the work-supporting hangers B and B' into the next treating zone for a predetermined dwell, without halting the driving motor 100 which advances the hangers. Thus the loss of power and efficiency resulting from halting the driving motor is obviated and exact indexing of the workpieces in the blasting zone is effected.

The mechanism for advancing and indexing the workpieces *p* in the blasting zone is illustrated more particularly in Figs. 1 and 8. The conveyor-driving motor 100 drives motor belt 104 trained around pulley 105 which normally idles on shaft 106 of reduction gearing housed in gear box 77 and when idling does not rotate the conveyor chain sprocket wheel 82. The idler pulley 105, however, has a clutch 108 attached thereto which also idles on shaft 106. A companion clutch 107 is fixed to rotate with the shaft 106 but is free to slide thereon, as shown in Fig. 8. The companion clutch 107 has a groove 109 therein which receives a roller fixed to the end of a rocking lever 110 which is pivoted on pivot 111. The other end of rocking lever 110 is connected to the end of a solenoid shaft 112, so that when the solenoid 113 is energized the companion clutch 107 is held out of engagement with the clutch 108 so that the conveyor chain sprocket 82 does not rotate. When the solenoid 113 is de-energized, a coil spring 115 which surrounds the solenoid shaft 112 presses against a collar 114 on solenoid shaft 112 to pivot rocking lever 110, so as to move the companion clutch 107 into driving engagement with the clutch 108 thus causing the motor 100 to drive main conveyor chain sprocket 82.

The solenoid 113 has one end of its coil connected to a secondary circuit 114' attached to the primary motor circuit 102. The other end of the solenoid coil is connected to lead wire 115' which is connected to contact point 127 arranged to contact a movable switch block 125. Movable switch block 125 is arranged to contact terminal 126 of lead wire 129 which is connected by wire 128 to a time clock 130.

The movable switch block 125 is fixed to the end of a shaft 121 which is provided with a pair of legs 122 for supporting a contact roller 120. The block shaft 121 extends through a stationary collar 123 against which a coil spring 124 seats. The coil spring 124 seats against the legs 122 of the switch block shaft 121 to normally retain the switch block 125 out of contact with the terminals 126 and 127.

It will be noted that when the switch block 125 is out of contact with the switch terminals 126 and 127, the solenoid circuit is open and the solenoid 113 remains de-energized, so that the driving motor 100 will continue to rotate the main chain conveyor sprocket 82 and advance the work-supporting hangers B and B'. When the cylindrical wall of cup 22 of the work-supporting hanger B or B' strikes the contact roller 120, however, switch block 125 is pushed into contact with the contact points 126 and 127 so as to close the solenoid circuit, energizing the solenoid 113 which operates to withdraw the companion clutch 107 out of meshing contact with the idler clutch 108, thus halting the advance of the main conveyor chain. When this occurs current will flow through the switch blocks 125 and into the branch wire 128 which is connected to the gap contact ring 131 of the time clock 130. When this occurs the contact hand 132 begins to swing counter-clockwise about its shaft 133 around the contact ring 131, the hand 132 being connected to ground wire 135. When the time clock hand 132 has made substantially a complete revolution, its end rides into the gap 131' between the ends of the contact ring 131 so as to break the circuit and de-energize the solenoid 113. Companion clutch 107 will then slide into engagement with the idler clutch 108 so as to cause the driving motor 100 to again rotate the main conveyor chain sprocket 82. When this occurs cup 22 of the work-supporting hanger B and B' will move out of contact with the contact roller 120 which operates the switch block 125 so as to also break the circuit at this point.

In order to bring the time clock into proper starting position, the time clock is provided with a suitable coil spring 140 which mechanically carries the clock hand 132 over the gap between the ends of the arcuate contact ring 131 so that the contact hand 132 of the clock is again in contact with the contact ring 131 when the next work-supporting spindle 20 has advanced to the point where it will engage the contact roller 120.

To prevent the clock spring 140 from rotating the clock hand 132 beyond the contact ring gap 131', there is provided a locking device which prevents rotation of the hand 132 except when the contact block 125 is in electrical contact with contact point 126. It will be noted that the hand shaft 133 has fixed thereto a cam 134 which is engaged by a hook lever 139 to prevent further counter-clockwise rotation of the hand 132. The hook lever 139 is moved out of contact with the cam 134 by means of a solenoid 136 connected to the hook lever 139 by solenoid shaft 138. Solenoid 136 has one of its termini connected to contact point 126 by lead wire 129 and its other terminus connected to ground wire 137. Thus it will be appreciated that when contact block 125 contacts terminal point 126 current will flow through solenoid wire 129 and into the solenoid 136 which operates to pivot hook lever 139 and release the cam 134 so that current flowing into the time block through lead wire 128 will drive the hand 132 counter-clockwise until it again reaches the gap 131' in contact ring 131. Thus the coil spring 140 will rotate the hand 132 over the gap in ring 131 after the clock circuit has been broken. Upon breaking of the clock circuit the solenoid 136 will be deenergized, permitting the hook lever 139 to move into engagement with the shoulder 134' on the cam 134 and prevent the coil spring 140 from rotating the hand 132 beyond its proper contact starting position shown in Fig. 8.

Since electrical time clocks are well-known, its construction has been only diagrammatically illustrated. The contact roller 120 and its associated contact block 125 and terminal contacts 126 and 126 encased in a suitable switch box, may be suitably suspended from track section C'' directly above the initial blast stream *a*, with the contact roller 120 positioned in the line of travel of cups 22 of the work-supporting hangers B. Thus when the cup 22 of the hanger strikes the contact roller 120, the workpiece *p* will be indexed directly in the blasting stream *a* to receive the full force of the abrasive blast. The abrasive throwing wheel which projects the blast stream *a'* and the wheels which project further blast streams are so relatively and uniformly spaced that other hangers B and B' will accurately index their suspended workpieces in each of the respective blast streams when a workpiece is indexed in blast stream *a*. This is made possible by reason of the uniform spacing of the hangers B all of which are connected by conveyor chain 70.

The indexing mechanism herein illustrated permits continuous operation of the main driving motor 100 and thus eliminates power wastage in starting torque on the motor. This control device also insures positive and accurate indexing of the work-supporting hangers so that their workpieces are accurately suspended directly in all of the blasting streams. The contact block 125 and its associated contact roller 120 may be positioned directly above one of the blasting zones or it may be positioned considerably to one side of the blasting zone since all hangers B are uniformly spaced along the main conveyor chain 70.

All of the spindle-driving sprockets 36 and 36' are rotated during their residence in the blasting streams *a* and *a'* by a continuously driven motor 145 which carries a drive pulley 146. A drive belt 147 is trained around motor pulley 146 and around a pulley 148 attached to the shaft 149 of reduction gearing 150, as illustrated more particularly in Fig. 1. Reduction gearing 150 is provided with a driven sprocket 151 over which is trained a continuous drive chain 152 also trained around a sprocket 153 fixed to a stub shaft 154 adjacent the path of travel of the work-supporting hangers when moving through the blasting section 2 of the cabinet. The stub shaft 154 rotates in a bearing collar 155 suitably secured to the top wall 10 of the cabinet. Stub shaft 154 has fixed thereto a spinner chain sprocket 156 around which is trained one end of the continuous spinner chain 37 designed to mesh with spinner sprockets 36 and 36' attached to the spindles 33 of work-supporting hangers B and B', as previously explained. The other end of the continuous spinner chain 37 is trained around a sprocket 158 having a hub 159 which rotates on a stationary stub shaft 160 fixed to a socket 161 supported on the top wall 10 of the cabinet. The sprocket-engaging run of the spinner chain 37 moves in the direction indicated by the arrow in Fig. 4.

To insure positive driving engagement between spinner chain 37 and spinner sprockets 36 and 36', it is desirable to provide chain backing means directly above blasting streams *a* and *a'*. I have

provided a backing means for this purpose which is simple in construction and highly efficient in operation. As illustrated more particularly in Figs. 1, 4 and 5, a chain backing pedestal 162 is positioned directly above each blasting stream, rests upon the top wall 10 of the cabinet and is positioned between the inner and outer runs of spinner chain 37. Each backing pedestal comprises a stub shaft 163 whose lower end is fixed to a base 164 rigidly supported on the top wall 10 of the cabinet. A heavy chain contacting disc 165 provided with a hub portion 166 is free to idle on stub shaft 163 and is positioned between the inner and outer runs of spinner chain 37 with its periphery positioned to bulge the sprocket-engaging run of the chain, as illustrated more particularly in Fig. 1. The contact disc 165 may be removably mounted on the stub shaft 163 by means of a collar 167 removably secured to the upper end of stub shaft 163 by a removable key or set screw 168.

To reduce friction and permit the spinner chain 37 to smoothly roll over the peripheries of the contact discs 165, the spinner chain 37 is provided with roller sleeves 170 which are free to roll on the pins 171 which connect the paired outer links 172 to the paired inner links 173 of the chain. The chain rollers 170 roll over or with the peripheries of the contact discs 165 substantially without friction and yet serve to bulge the inner run of the spinner chain 37 so that it positively engages the spinner sprockets 36 and 36'. It will be noted that each chain pedestal 162 is positioned directly above each blasting stream a and a' so that the hanger sprockets 36 and 36' will be positively engaged and rotated by the spinner chain. The contact discs 165 also serve to maintain the spinner chain 37 taut.

Means are provided to further insure positive engagement between the spinner chain 37 and the spindle sprockets 36 and 36' and to prevent the spindles 33 from swaying or swinging while traveling through the blasting streams. By referring more particularly to Figs. 1, 4, 5 and 6, it will be noted that each work-supporting spindle 33 carries a contact disc 175 having a hub portion 176 which is secured to the spindle 33 and rotates therewith. The periphery of each contact disc 175 is arranged to roll in contact with a series of free rollers 177 which extend along the path of travel of the hangers as they move through the blasting zone. Each roller 177 is free to rotate on a pin 178 fixed at each end to the legs of a U-shaped bar 179 which extends along the path of travel of the hangers. The U-shaped bar 179 may be secured to a plurality of spaced brackets 180 having their foot portions 181 secured to the top wall of the cabinet, as more particularly illustrated in Figs. 1 and 5. The U-shaped roller-supporting bar 179 carrying the closely spaced contact rollers 177 may extend the full distance between and slightly beyond the spaced abrasive streams a and a' so that each hanger spindle 33 is prevented from swinging on the track section C'' as it advances through the blasting zone.

It will also be noted that the chain-engaging peripheries of the contact discs 165 bulge the driving run of the spinner chain 37 to the point where the spinner sprockets 36 and 36' will not interfere with the rotative movement of the chain-supporting sprockets 156 and 158. The spinner sprockets 36 and 36' will engage the driving run of the spinner chain 37 at a point somewhere between the idling sprocket 158 and the adjacent pedestal 162, and the spinner sprockets 36 and 36' will disengage themselves from the driving run of the spinner chain 37 somewhere between the other pedestal 162 and the driving sprocket 156. Thus the spinner sprockets 36 and 36' freely move into and out of engagement with the spinner driving chain 37 to rotate all of the work-supporting spindles 33 during their advance along the blasting section 2 of the cabinet.

Abrasive cycling mechanism G is provided for transporting abrasive from the abrasive receiving hopper 13 contained in the floor pit F' to the abrasive throwing wheels W. As illustrated more particularly in Figs. 1, 2 and 3, the abrasive cycling mechanism may comprise an enclosed elevator housing 190 which extends through the rear portion of the blasting section 2 of the cabinet and into the floor pit F'. The elevating housing 190 contains a continuous elevator belt 191 carrying abrasive buckets 192. The lower end of the elevator belt 191 is trained around a suitable pulley 193 in the boot of the elevator housing 190 into which the reduced lower end of the abrasive hopper 13 extends. The upper end of the elevator belt 191 is trained around a belt pulley 194 within the top end of the elevator housing 190.

A spillway chute 195 is provided at the upper end of the elevator housing 190, into which the abrasive cycling buckets 192 dump their loads of abrasive. The spillway chute 195 empties the abrasive into an abrasive receiving tube or conduit 196, whence the abrasive moves into an overhead abrasive receiving tank 197 suitably supported from the top wall 10 of the cabinet. The abrasive receiving tank 197 is provided with a plurality of abrasive receiving hoppers 198 in the bottom thereof which lead to abrasive discharge spouts 199. The lower end of each abrasive discharge spout 199 is provided with a control valve 200 to control the volume of abrasive discharge from the spout 199. The abrasive is conducted from each of the spouts 199 into the funnel 201 of an abrasive feed pipe 202 of suitable length which conducts the abrasive to the funnel portion of the feed spout associated with each wheel.

The abrasive cycling mechanism is driven by a motor 203 supported upon a suitable platform 204 fixed to the elevator housing 190. The motor 203 is connected to a speed reducer 205 whose drive shaft 206 carries a sprocket wheel 207 over which drive chain 208 is trained. The bucket belt pulley 194 is fixed to a shaft 209 which carries a sprocket 210 over which drive chain 208 is trained and provides a driving connection between the motor 203 and the elevator belt 191.

To convey the abrasive through the abrasive conduit 196, a screw or flight conveyor 211 is contained within the tube 196, the flight conveyor 211 being fixed to a suitable shaft 212 one end of which is journaled in a bearing supported by the elevator housing 190 and the other end of which is journaled in a bearing fixed to the side wall of the abrasive-receiving tank 197. The shaft 212 of the flight conveyor 211 is driven by means of a bevel gear 213 fixed to the end thereof, bevel gear 213 meshing with bevel gear 214 fixed to a shaft 215 which may extend through and be journaled in bearings mounted on the side walls of the elevator housing 190. Shaft 215 has a sprocket 216 fixed thereto over which is trained a drive chain 217 which is also trained over a sprocket 218 fixed to the shaft 206 of the gear reducer 205. Thus, the elevator motor 203 also operates to drive the shaft 212 of the flight conveyor.

A tubular screen 219 is supported in stationary position within the tank 197 and is arranged to receive the abrasive from the discharge end of the abrasive trough or conduit 196. The tubular screen 219 contains a spiral abrasive agitator 220 fixed to the conveyor shaft 212 to rotate therewith. The spiral agitator 220 rolls the abrasive material within the tubular screen 219 so as to cause the usable abrasive to escape through the tubular screen 219 and fall into the abrasive-receiving tank 197. The stationary screen 219 has an opening 221 in its end through which clinkers and other coarse material removed from the castings during the blasting operation may discharge into a receiver 222 which leads into a gravity discharge pipe 223. A dust collector (not shown) may be connected to a dust discharge port 224 of the abrasive-receiving tank 197. The tank 197 may also contain mechanism (not shown) for removing dust, broken unusable abrasive, and other undesirable material from the abrasive cycled into the tank 197, so that only clean and usable abrasive is supplied to the abrasive blasting wheels W. One of the side walls 7 of the blasting section 2 of the cabinet may be provided with an inspection door 225 so that the operating mechanism contained within the cabinet may be conveniently inspected and repaired.

The front wall 6 of the entrance vestibule 1 may be provided with an entrance opening 230 and the front wall 6 of the exit vestibule 3 may be provided with an exit opening 231 through which the suspended workpieces may enter the entrance vestibule and leave the exit vestibule. Each of the door openings 230 and 231 is normally closed by paired doors 233 which may be made of either flexible rubber or steel. Each of the hangers is provided with a cone-shaped member 234 which is fixed to the rotatable spindle 33 of each of the hangers B and B'. Each cone-shaped shield 234 is of such diameter and so arranged that the peripheral portion 235 thereof will engage the paired doors 233 during advance movement of the hangers to swing the doors open so that the workpieces p need not strike the doors.

The cone-shaped shields 234 have their reduced ends 236 arranged to extend into the slot 35 in the top wall 10 of the cabinet, as illustrated more particularly in Figs. 5 and 6, so as to partially close the slot and prevent abrasive from escaping from the cabinet and damaging the mechanism mounted on the top wall of the cabinet. To further prevent the escape of abrasive through the slot 35 in the top wall of the cabinet, a pair of downwardly inclined baffle plates 237 are provided whose upper ends are secured to the framing 15 which extends along and on each side of the slot 35. A flexible rubber baffle 238 is secured to each of the downwardly inclined baffle plates 237 as by means of a clamping plate 239 and bolt 240. A downwardly inclined end portion 241 of each flexible baffle 238 is free to flex around the hanger spindles 33 as they move therebetween.

Abrasive sealing means is also provided above the path of travel of the cone-shaped shields 234, as illustrated more particularly in Fig. 5. This further sealing means comprises a pair of lower flexible rubber flaps 244 and a pair of upper flexible rubber flaps 245. Each of the lower flaps 244 rests on a bar 246 seated on the top wall 10 of the cabinet closely adjacent to the slot 35. A U-shaped spacing member 247 has the lower leg 248 thereof resting on one of the bars 246 with the lower flaps 244 clamped therebetween. The upper flaps 245 rest on the upper leg 249 of the U-shaped member 247 and is held in place by a clamping bar or member 250 held in place by screws 251.

By this novel sealing arrangement a triple seal is provided along the path of travel of the spinner spindles 33 which positively prevents any escape of abrasive from within the cabinet through the slot 35 in the top wall of the cabinet. The flexible flaps 238 provide an initial seal within the cabinet. The cone-shaped shields 234 fixed to each of the spinner spindles 33 provide a further and secondary seal. Finally, the paired flexible flaps 244 and 245 provide a tertiary seal which absolutely prevents any dust or other particles that may have escaped through the flexible baffle 238 and the cone-shaped shields 234 from escaping into the atmosphere.

My improved blasting apparatus permits convenient loading of the workpieces p at the loading station adjacent the loading section C' of the track C. The loading can be easily and conveniently done during the interval in which the hangers remain stationary. The hangers B with their suspended workpieces p are successively advanced into the entrance vestibule 1 and thence proceed into the main blasting section 2 of the cabinet. Each hanger halts directly in each of the successive blasting streams a and a' and resides in each of these blasting streams for a period which is determined by the setting of the time clock 130 which is associated with the conveyor-advancing mechanism D.

During the progress of the hangers and suspended workpieces through the blasting section of the cabinet, they are rotated by the spinner drive chain 37 with the spindles 33 of alternate hangers B rotating in one direction and the spindles 33 of intermediate hangers B' rotating in the opposite direction, so that substantially all of the projected abrasive performs useful work in cleaning the workpiece surfaces. The walls 7 and 8 of the blasting section of the cabinet are so spaced and arranged that any abrasive fired from the wheels W that does not strike the workpieces loses substantially all of its abrading velocity before it strikes the cabinet walls 7 and 8.

The spinner-rotating mechanism is so constructed and arranged as to smoothly engage the spinner sprockets 36 and 36' substantially without shock or strain on the parts. The hangers B and B' are prevented from swinging movement during their travel through the blasting section by the contact discs 165 of pedestals 162 and guide rollers 177. The workpiece-supporting spindles 33 may be rotated at any desired speed of rotation by a proper adjustment of the reduction gearing 150.

The conveyor advancing mechanism is so arranged and constructed that the workpieces are quickly advanced from one blasting stage to the next blasting stage with a minimum loss of time but yet permit the workpieces to dwell in each blasting stream for any desired cleaning period, which may be regulated and controlled to a fraction of a second by the time clock 130. Since the spinner speed reducer 150 is completely independent of the hanger speed reducer 77, each may be adjusted and controlled as desired independently of the other. By equally spacing the hangers B and B' along the conveyor chain 37 positive registry of each of the workpieces in the successive blasting streams is assured. Any de-

sired number of abrasive throwing wheels W may be provided, arranged at any desired elevation for rotation clockwise or counterclockwise. The workpieces emerging from the exit vestibule 3 of the cabinet may be conveyed to any desired location in the shop before being removed from the hangers adjacent the unloading section C''' of track C.

While certain novel features of the invention have been disclosed and are pointed out in the annexed claims, it will be understood that various omissions, substitutions and changes may be made by those skilled in the art without departing from the spirit of the invention.

What is claimed is:

1. In blast cleaning apparatus including a blasting station, a work-supporting carrier, means for transporting said carrier along a predetermined path, said work-supporting carrier including a carriage portion, a work-supporting spindle, means rotatably connecting said spindle to said carriage, and a sprocket operatively connected to said spindle, a continuous drive chain having an outer run and an inner run positioned along the path of travel of said spindle sprocket, means for driving said drive chain to rotate said work-supporting spindle during its advance movement, and means including a freely rotating contact disc positioned between the inner and outer runs of said drive chain substantially in line with the blasting station to receive side thrust exerted on the carrier at the blasting station, said disc being arranged to bulge the inner sprocket engaging run of said chain to facilitate engagement of said spindle sprocket with said chain.

2. In blast cleaning apparatus including a pair of blasting stations, a work-supporting carrier, means for transporting said carrier along a predetermined path, said work-supporting carrier including a carriage portion, a work-supporting spindle, means rotatably connecting said spindle to said carriage, and a sprocket operatively connected to said spindle, a continuous drive chain having an outer run and an inner run positioned along the path of travel of said spindle sprocket, means for driving said drive chain to rotate said work-supporting spindle during its advance movement including, a chain supporting sprocket at each end of said drive chain, reduction gearing operatively connected to one of said chain sprockets, a driving motor operatively connected to said reduction gearing, and means including a pair of freely rotating contact discs positioned between the inner and outer runs of said chains substantially in line with said blasting stations to receive side thrust exerted on the carrier at the blasting stations, said discs having their peripheries positioned to bulge the inner sprocket engaging run of said chain to facilitate engagement of said spindle sprocket with said chain.

3. In blast cleaning apparatus, a work-supporting carrier, means for transporting said carrier along a predetermined path, said work-supporting carrier including, a carriage portion, a work-supporting spindle, means rotatably connecting said spindle to said carriage, and a sprocket operatively connected to said spindle, a drive chain having a run thereof positioned along the path of travel of said sprocket, means for driving said drive chain to rotate the work-supporting spindle during its advance movement, a contact disc fixed to and concentric with said spindle, a guide member positioned along the path of travel of said contact disc opposite to the sprocket engaging run of said drive chain, and a plurality of rollers rotatably supported by said guide member against which the periphery of said contact disc may roll during advance movement of the hanger to retain the sprocket in driving engagement with the sprocket-engaging run of said drive chain.

4. In blast cleaning apparatus, a work-supporting carrier, means for transporting said carrier along a predetermined path, said work-supporting carrier inlcuding, a carriage portion, a work-supporting spindle, means rotatably connecting said spindle to said carriage, and a sprocket operatively connected to said spindle, a continuous drive chain having an outer run and an inner run positioned along the path of travel of said sprocket, means for driving said drive chain to rotate the work-supporting spindle during its advance movement, means including a freely rotating contact disc positioned between the inner and outer runs of said drive chain and having its periphery positioned to bulge the inner sprocket engaging run of said chain to facilitate engagement of said spindle sprocket with said chain, a contact disc fixed to said spindle, a guide member positioned along the path of travel of said spinner contact disc opposite the sprocket engaging run of said drive chain, and a plurality of rollers rotatably supported by said guide member against which the periphery of said spinner contact disc may roll during advance movement of the hanger to retain the sprocket in driving engagement with the sprocket engaging run of said drive chain.

5. In blast cleaning apparatus, a track, a work-supporting hanger movable along said track, said hanger including, a roller carriage supported by and movable along said track having a downwardly extending leg portion, a tubular receiver fixed to said leg, a bearing sleeve fixed to said tubular receiver, a thrust bearing positioned within and supported by said sleeve, a collar member having one end thereof rotatably mounted in said sleeve, a hanger spindle supported in said thrust bearing and connected to said collar member, a work-supporting spindle fixed to said collar member, and a sprocket fixed to said work-supporting spindle, a drive chain having a run thereof positioned along the path of travel of said sprocket, a conveyor chain connected to said leg portion, means for driving said conveyor chain to advance the carriage along said track, and means for driving said sprocket chain to rotate said work supporting spindle during its advance movement.

6. In blast cleaning apparatus, a track, a work-supporting hanger movable along said track, said hanger including, a carriage supported by said track, a tubular sleeve fixed to said carriage, a thrust bearing positioned within said sleeve, a work-supporting spindle rotatably supported from said thrust bearing, a sprocket, and mechanism operatively connecting said sprocket to said spindle whereby said spindle will be rotated in a direction opposite to the direction of rotation of said sprocket, a drive chain having a run thereof positioned along the path of travel of said sprocket, and means for driving said drive chain to rotate said work-supporting spindle during its advance movement.

7. In blast cleaning apparatus, a track, a carriage supported by and movable along said track, a tubular sleeve fixed to said carriage, a thrust bearing positioned within said sleeve, a work-supporting spindle rotatably supported by said

thrust bearing, a sprocket mounted on said spindle, a drive chain having a run thereof positioned along the path of travel of said sprocket, means for driving said drive chain to rotate said sprocket during its advance movement, and means for rotating said work-supporting spindle in a direction opposite to the direction of rotation of said sprocket.

8. In blast cleaning apparatus, a track, a carriage supported by and movable along said track, a tubular sleeve fixed to said carriage, a thrust bearing positioned within said sleeve, a work-supporting spindle rotatably supported by said thrust bearing, a sprocket mounted on said spindle, a drive chain having a run thereof positioned along the path of travel of said sprocket, means for driving said drive chain to rotate said sprocket during its advance movement, and means associated with said sprocket and work-supporting spindle for rotating said spindle in a direction opposite to the direction of rotation of said sprocket, said means including a sleeve fixed to said sprocket and rotatable on said spindle, a driving gear fixed to said sleeve, a transfer gear meshing with said driving gear, and a gear fixed to said spindle in meshing engagement with said transfer gear.

9. In blast cleaning apparatus, a track, a roller carriage supported by and movable along said track, a tubular sleeve fixed to said carriage, a thrust bearing positioned within said sleeve, a work-supporting spindle rotatably supported by said thrust bearing, a gear box fixed to said sleeve and enclosing a portion of said work-supporting spindle, a sprocket sleeve rotatably mounted on said spindle and having the end portion thereof extending into said gear box, a sprocket fixed to said sleeve exterior to said gear box, a driving gear within said gear box fixed to said sleeve, a transfer gear meshing with said driving gear rotatably supported within said gear box, a gear fixed to said work-supporting spindle within said gear box meshing with said transfer gear, and means for rotating said sprocket to rotate said work-supporting spindle in a direction opposite to the direction of rotation of said sprocket.

10. In blast cleaning apparatus, a track, a roller carriage supported by and movable along said track, a tubular sleeve fixed to said carriage, a thrust bearing positioned within said sleeve, a carriage spindle rotatably supported by said thrust bearing, a work-supporting spindle fixed to said carriage spindle, a collar member fixed to said sleeve, a gear box fixed to said collar member and enclosing the upper end portion of said work-supporting spindle, a sprocket sleeve rotatably mounted on said spindle and having a portion thereof extending into said gear box, a sprocket fixed to said sprocket sleeve exterior to said gear box, means for rotating said sprocket, and a device for rotating said work-supporting spindle in a direction opposite to the direction of rotation of said sprocket including a driving gear within said gear box fixed to said sprocket sleeve, a transfer gear meshing with said driving gear rotatably supported within said gear box, and a gear fixed to said work-supporting spindle within said gear box meshing with said transfer gear.

11. In blast cleaning apparatus, a stationary track, alternate and intermediate work-supporting hangers movable along said track, a conveyor chain for advancing the workpieces suspended from said hangers through a blasting zone, means for driving said conveyor chain to advance the workpieces suspended from said hangers through said blasting zone, and mechanism for rotating the spindles of alternate hangers in one direction during their travel through the blasting zone and the spindles of intermediate hangers in the opposite direction during their travel through the blasting zone, said spindle rotating mechanism including a single spinner chain, means for driving said spinner chain in one direction only, a spinner sprocket directly fixed to each of the work-supporting spindles of alternate hangers and a spinner sprocket associated with each of the work-supporting spindles of intermediate hangers, the sprockets of said alternate hangers and the sprockets of said intermediate hangers being positioned to be driven in the same direction by said single drive chain, and means for operatively connecting the sprocket and spindle of each intermediate hanger so that its spindle will be rotated in a direction opposite to the direction of rotation of its associated sprocket.

12. In blasting cleaning apparatus, a stationary track, alternate and intermediate work-supporting hangers movable along said track, a conveyor chain for advancing the workpieces suspended from said hangers through a blasting zone, a continuously operated driving motor, cooperating mechanical and electrical mechanism for detachably connecting and disconnecting said motor to said conveyor chain to periodically advance the workpieces suspended from said hangers into, through and out of said blasting zone, to index the workpieces in said blasting zone and to selectively control the period of exposure of the workpieces in said blasting zone, and mechanism for rotating the spindles of alternate hangers in one direction during their travel through the blasting zone and the spindles of intermediate hangers in the opposite direction during their travel through the blasting zone.

13. In blast cleaning apparatus, a stationary track, a work-supporting hanger movable along said track, a conveyor chain fixed to said hanger, a continuously operated driving motor for periodically driving said conveyor chain to advance said hanger along said track, an abrasive projector for projecting a stream of abrasive into a predetermined blasting zone positioned along the path of travel of the work supported on said hanger, and mechanism for controlling the period of exposure of the work supported on said hanger in said blasting zone, said mechanism including a time clock, a switch device having an element positioned to be engaged by said hanger during its advance to operate said switch, a clutch operatively connected to said conveyor chain and adapted to be moved into and out of driving relation with said motor, an electrical device operatively connected to said clutch to throw said conveyor chain into and out of driven relation with said motor, and an electric circuit electrically connecting said conveyor driving motor, electrical clutch operating device, contact switch and time clock whereby said electrical clutch operating device is retained out of driven relation with said motor during a predetermined time period established by the setting of said time clock.

14. In blast cleaning apparatus, a stationary track, a plurality of work-supporting hangers movable along said track, a conveyor chain fixed to and uniformly spacing said hangers along said track, a continuously operated driving motor for periodically driving said conveyor chain to advance said hangers along said track, an abrasive projector for projecting a stream of abrasive into

a predetermined blasting zone positioned along the path of travel of the workpieces supported on said hangers, and mechanism for controlling the period of exposure of the workpieces and indexing the workpieces supported on said hangers in said blasting zone, said mechanism including a time clock, a switch device having an element positioned to be engaged by successive hangers during their advance movement to close said switch when contacted by said hanger, a clutch operatively connected to said conveyor chain and adapted to be moved into and out of driven relation with said motor, an electrical device operatively connected to said clutch to throw said conveyor chain into and out of driven relation with said motor, and an electric circuit electrically connecting said conveyor driving motor, electrical clutch operating device, contact switch and time clock whereby said electrical clutch operating device is retained out of driven relation with said motor during a predetermined time period established by the setting of said time clock.

15. In blast cleaning apparatus, a stationary track, a work-supporting hanger movable along said track, a continuous conveyor chain fixed to said hanger, a continuously operated driving motor, a driving sprocket having a driving connection with said conveyor chain, means including a clutch device for operatively conecting said motor to said sprocket, said clutch device having a clutch part driven by said motor and a movable clutch part connected to said sprocket, an electrically operated device operative to move said movable clutch part into and out of driving engagement with said motor driven idling clutch part, a contact element positioned in the path of travel of said hanger, a switch associated with and adapted to be opened and closed by said contact element, an electrically driven time clock, and an electric circuit electrically connected to said motor, clutch part operating device, contact switch, and time clock whereby said time clock operates to control the time period in which said movable clutch part is retained out of operative engagement with said motor driven clutch part.

16. In blast cleaning apparatus, a stationary track, a plurality of work-supporting hangers movable along said track, a continuous conveyor chain fixed to and uniformly spacing said hangers, a continuously operated driving motor, a driving sprocket having a driving connection with said conveyor chain, reduction gearing having a driving connection with said sprocket, a drive shaft associated with said reduction gearing, a clutch device having a clutch part normally idling on said shaft and a movable clutch part normally fixed to rotate with said shaft, driving means connecting said motor to said idling clutch part, an electrically operated device operative to move said movable clutch part into and out of driving engagement with said motor driven idling clutch part, a contact element positioned in the path of travel of said hangers, a switch associated with and adapted to be opened and closed by said contact element, an electrically driven time clock, and an electrical circuit electrically connected to said motor, clutch part operating device, contact switch and time clock whereby said time clock operates to control the time period in which said movable clutch part is retained out of operative engagement with said motor driven clutch part.

17. In blast cleaning apparatus, a blast cabinet, a plurality of work-supporting carriers, a work-supporting spindle suspended from each of said carriers and extending through a slot in the top wall of said cabinet, means for transporting said carriers and associated spindles along a predetermined path defined by said slot, abrasive projectors projecting a plurality of streams of abrasive into said cabinet along the path of travel of the work-pieces supported by said spindles, and sealing means for preventing escape of abrasive through said slot, said sealing means including a pair of spaced trough forming baffle plates projecting into the cabinet from the top wall thereof with said slot positioned between said plates, a pair of flexible baffle members fixed to the lower ends of said baffle plates and forming with said baffle plates a substantially closed trough but adapted to be flexed by the advance movement of said spindles, a pair of flexible sealing members exterior to said cabinet arranged to substantially seal said slot but adapted to be flexed by the advance movement of said spindles, and a cone-shaped shield fixed to each of said spindles and movable between said paired flexible baffle members and within said trough.

18. In blast cleaning apparatus, a stationary track, work supporting hangers movable along said track, a conveyor chain connecting said hangers, means including a clutch for advancing said conveyor chain to advance workpieces suspended from said hangers through a blasting zone, and cooperating electrical and mechanical mechanism for indexing the workpieces in said blasting zone and for selectively controlling the period of exposure of the workpieces in said blasting zone, said mechanism including contact means operable by said hangers and time controlled switching means actuated by said contact means for operating said clutch during a predetermined length of time.

19. In blast cleaning apparatus, a track, a work supporting carriage movable along said track, a work supporting spindle rotatably supported from said carriage, a sprocket rotatably mounted on said spindle, a drive chain having a run thereof positioned along the path of travel of said sprocket, means for driving said drive chain to rotate said sprocket, and means for rotating said work supporting spindle in a direction opposite to the direction of rotation of said sprocket.

DAVID C. TURNBULL.

CERTIFICATE OF CORRECTION.

Patent No. 2,344,475. March 14, 1944.

DAVID C. TURNBULL.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 4, first column, line 67, for "from" read --front--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 16th day of May, A. D. 1944.

Leslie Frazer

(Seal) Acting Commissioner of Patents.