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APPARATUS FOR TREATING METAL

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This invention relates to apparatus for treating metal and more particularly to apparatus for cleaning, polishing, hardening or otherwise treating the surfaces of castings, forgings and similar metallic articles.

In cleaning, polishing, hardening or otherwise treating the surfaces of metallic articles it is desirable to so manipulate the articles in the stream of treating particles that the articles will be uniformly and satisfactorily cleaned or treated. Where the articles are small, rugged and so shaped that they can be tumbled about, they can generally be effectively treated in a tumbling mill. However, where the articles are large, irregularly shaped, brittle or fragile they cannot be so cleaned and treated and other methods and apparatus must be employed.

An object of this invention is to provide an imroved apparatus for uniformly treating or cleaning the surfaces of irregularly shaped, or large, brittle or fragile articles by continuous operation.

Other objects of this invention will become apparent from the disclosure.

According to the present invention, the articles to be treated are deposited on a conveyor and advanced through the stream of treating material in such a way that all portions, or predetermined selected portions, of each article are exposed for treatment by the stream. Each article is advanced along a predetermined path through the stream and is turned about an axis extending transversely to the direction of advance movement of the article. Preferably the treating material is projected against the articles from two opposite directions in fan-like streams so that the treating material will strike all selected surface portions of the articles including the surfaces of cavities and projections.

The apparatus for carrying out the invention preferably includes a conveyor having a plurality of spaced and generally parallel supporting elements adapted to support the articles to be treated and to advance them along a predetermined lineal path and at the same time turn them about to expose all surfaces or selected surfaces of the article to the abrasive stream. The supporting elements may comprise belts actuated at different relative speeds, thereby to effect a turning movement of the articles during forward movement as they are being treated. Preferably the abrasive throwing wheels or projectors are arranged so that one or more of them projects a stream of treating material from above and one or more projects the treating material from below, thereby treating both upper and lower surfaces of the articles substantially simultaneously.

The present invention provides apparatus whereby relatively large, heavy or irregularly shaped articles such as castings, forgings and other machine and structural parts of various shapes can be quickly and easily cleaned or treated. The apparatus permits the cleaning operation to be carried out continuously and substantially automatically. If desired, automatic apparatus may be provided for supplying the articles to the treating apparatus and conveying them therefrom.

The apparatus is simple and rugged and is easy to construct and operate. There is a minimum of the apparatus exposed to the wearing action of the treating material and the parts thus exposed can be quickly and easily repaired or replaced. The principal bearing portions of the apparatus all are effectively sealed against entry of abrasive particles and thus are assured life and minimum of injury.

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 side elevational view of one form of apparatus suitable for carrying out the invention, certain parts being shown in section to expose the interior construction, this view being taken along line 1—1 of Fig. 5;

Fig. 2 is an enlarged transverse cross sectional view taken along line 2—2 of Fig. 1;

Fig. 3 is a top plan view of the complete apparatus;

Fig. 4 is a cross sectional view taken along line 4—4 of Fig. 1;

Fig. 5 is an end elevational view of the apparatus viewed from the discharge end thereof; and

Fig. 6 is a somewhat diagrammatic sectional view of a throwing wheel used to project the abrasive stream.

In the following description and in the claims, various details will be identified by specific names for convenience, but they are intended to be as generic in their application as the art will per-

mit. Like reference characters denote like parts in the several figures of the drawings.

In the drawings accompanying and forming part of this specification, certain specific disclosures of the invention are made for purposes of explanation, but it will be understood that the details may be modified in various respects without departure from the broad aspect of the invention.

Referring to the drawings, the apparatus includes a housing structure 1 having a treating chamber 2. The housing 1 is provided with an inlet or charging opening 3 and an outlet or discharge opening 4. Adjacent the charging opening 3 is a charging vestibule 5, closed by one or more flexible curtains 6. Adjacent the discharge opening 4 is also a discharge vestibule 7, closed by one or more flexible curtains 8. Extending between the charging opening 3 and discharge opening 4 is a conveyor 9 (described more in detail hereinafter), adapted to support articles to be treated and convey them through the treating chamber 2.

Suitably mounted on the top wall of the housing 1 and adapted to project a stream of abrasive *a* against articles *d* on the conveyor 9 is an abrasive projector 10, which preferably is of the centrifugal throwing wheel type. Although the abrasive projector may take other suitable forms, preferably it comprises a plurality of spaced throwing blades 12 extending from adjacent the periphery of the wheel inwardly and terminating short of the center of the wheel to define a generally central opening 14. The blades may be supported upon a frame such as one or more side plates 11. The hub portion 13 of the wheel is connected to a rotatable shaft 25 mounted in suitable bearings 15. Disposed in the circular space 14 between the inner ends of the blades 12 is an impeller 16 having a plurality of radially extending vanes 17 which preferably rotates with the throwing blades 12. An independently mounted normally stationary control member 18 may be interposed between the impeller 16 and the inner ends of the blades 12 and may be provided with a discharge opening 19. The treating material is supplied to the impeller 16 by a feed pipe 20. The wheel 10 is driven by a motor 22 which is connected as by a belt drive 23 to the rotatable shaft 25 on which the wheel is mounted.

When treating material is supplied to the rotating impeller and wheel it is hurled by the impeller vanes 17 through the opening 19 in the control member and into the path of the rotating throwing blades 12. The material is urged outwardly along the blades 12 by centrifugal force and is projected from the blades 12 adjacent the periphery of the wheel by combined centrifugal and rotational force.

The treating material is projected from the wheel in the form of a fan-like stream which diverges from its point of emergence and impinges the articles in the form of an elongated impingement pattern. The direction of flight of the stream *a* relative to the wheel can be regulated and determined by a proper adjustment of the clock dial position of the opening 19.

The wheel is preferably arranged so that the articles carried by the conveyor 9 pass through the stream *a* in a direction extending substantially along the longer axis of the impingement pattern and are struck by treating particles from angles varying throughout sixty degrees or more. The range of angularity may vary considerably but generally will be selected so that it approaches 90°.

A suitable opening 24 may be provided in the top wall of the housing 2 to permit the passage of the abrasive *a* into the treating chamber. Preferably a portion of the wheel 10 projects through this opening and into the treating chamber. A suitable protective housing 26 may be disposed over the wheel to enclose the major portion thereof.

Disposed below the conveyor 9, and preferably in substantially the same vertical plane, is a second abrasive projector 30 which may be similar in all respects to the wheel 10 and may be rotatably carried on a shaft 31 extending through an opening 32 in the housing wall and journalled in bearings 33. The wheel 30 may be driven from a motor 34 in a manner similar to the projector 10. The projector 30 may be disposed directly below the projector 10 or it may be offset longitudinally as shown in Fig. 1 in the illustrative drawings.

A hopper 35 containing treating material is disposed in a suitable position preferably above the projectors 10 and 30. The hopper is connected to a main conduit 36 leading into branch conduits 37 and 38, which supply treating material to the feed pipes 20 leading to the projectors 10 and 30, respectively. The conduits 37 and 38 and feed pipes 20 may be suitably supported by brackets 21 and 39 connected to the adjacent structure.

The treating material used will depend upon the work to be performed. It is understood that the terms "treating metal" or "abrasive" is intended to refer to any suitable granular material ranging from relatively large to relatively small particles and from smooth non-cutting particles such as hard steel shot, to highly abrasive particles such as cracked steel grits or sharp quartz sand. Where a relatively smooth surface is desired the particles may be fine and relatively smooth and non-abrasive, and where a roughened or stippled surface is desired, particles having abrading characteristics are selected.

The bottom wall of the housing is inclined to provide a hopper 45, which may be disposed if desired in a pit 46 below the surface of the floor. The hopper 45 leads to and communicates with an open trough 47 provided with a screw conveyor 48, adapted to conduct spent abrasive toward the center of the trough 47. Communicating with the trough 47 and leading to an elevator 50 is a second trough 49 having a screw conveyor 51. The elevator 50 may include an endless belt 52 trained over drums 54 and 55 and carrying a plurality of buckets 53. The conveyor 48 is driven from a motor and reducer set 60 connected as by the belt drive 62 to a pulley 63 attached to the conveyor 48. The conveyor 51 may be driven in a similar way from the motor and reducer set 60' through a belt drive 66, and a pulley 67. The conveyors cooperate to carry the spent abrasive from the hoper 45 to the elevator 50. The elevator 50 is driven by a motor 70 driving a speed reducer 71 which in turn drives a suitable belt drive 72 which rotates the upper drum 55. The abrasive is elevated from the bottom of the elevator 50 to the top thereof and discharged into the hopper 35 from whence it can flow by gravity to the projectors 10 and 30.

The conveyor 9 may include a pair of spaced and generally parallel endless flexible belts 80, each of which is trained around drums 81 disposed outside the front and rear end walls of

the housing 1. Each drum 81 is mounted on shaft 82 rotatable in bearings 83 carried on a bracket or shelf 84 extending from the housing 2. Each belt 80 is adapted to ride on a belt guide or support 90, mounted on brackets 91 which are suitably secured to the housing 1. Each support 90 has a flat web portion 92 preferably inclined downwardly and inwardly and an upstanding guide flange 93 at its outer edge and a depending stiffening flange 94 at its inner edge. The supports 90 are suitably spaced and constitute with the belts 80 means for supporting and advancing articles *d* to be treated through the treating chamber.

The lower flight of each belt 80 may be trained over one or more rollers 95 rotatably mounted by shafts 96 suitably journalled in the housing 1. It will be seen that the upper flight of each continuous belt 80 enters the housing 1 through the charging opening 3, moves through the treating chamber 2 and leaves the housing through the discharge opening 4. Suitable lower openings (not shown) are provided in the end walls of the housing 1 for permitting the passage of the lower flight. A flexible curtain or brush 97 may be provided adjacent the last supporting roll 95 and similar brushes 98 may be disposed adjacent the belt opening in the housing for removing spent abrasive from each belt 80 before it passes from the treating chamber 2.

Preferably, each belt 80 is driven by a motor 100, driving a speed reducer 101, which is connected as by a chain drive 102, to a sprocket 103 carried on the drum shaft 82 at one end of the apparatus. Energization of the motor 100 effects rotation of the corresponding drum 81 and causes the belt 80 to travel along its path. The belts 80 may be driven from a single source of power but it is desirable that the speed of each belt 80 be individually controllable.

Preferably, the belts are driven at different forward speeds so that the articles carried thereon are caused to roll or rotate. If desired, one of the belts may be driven in a reverse direction but in this event, the other belt should have a forward speed in excess of the rearward speed of the first belt.

If desired, suitable charging and discharging apparatus may be provided adjacent the charging and discharging ends of the apparatus, respectively. The articles to be treated may be transported to the conveyor and removed therefrom automatically if desired. However, the specific structure of such automatic conveyors forms no part of the present invention and any suitable automatic conveyor may be employed.

For the purposes of illustration, there is shown a loading chute 105 supported by bracket 106, which chute is inclined toward and extends to the loading end of the upper flight of the belts 80. A discharge chute 107 may extend from the discharge end of the upper flight and may be suitably supported by bracket 108.

The present apparatus is suitable for treating various shapes and sizes of articles and is admirably adapted for treating articles having a substantially circular or cylindrical body portion as, for example, wheels, brake drums, receptacles and various other articles. For the purpose of illustration, there is shown a plurality of brake drums *d* each of which has a cylindrical rim portion *w* and a projecting hub *h*.

The operation of the apparatus is as follows: The abrasive projectors 10 and 30 are driven by the motors 32 and 34, respectively, and are supplied with abrasive from the hopper 35 in the manner above described and project abrasive streams *a* and *b* respectively, into the treating chamber. The articles *d* to be treated are successively placed upon the loading chute 105 and slide by gravity or are otherwise urged on to the belts 80, each of which supports an edge portion of the rim *w*. The motors 100 are energized and drive the belts 80, thereby advancing the drums *d* through the charging vestibule and into the treating chamber.

The articles *d* advance forwardly within the chamber and enter the abrasive stream *a* which impinges against the top surface of the rim *w* and the leading surface of the hub *h*. Preferably the belts 80 are driven at different speeds, thus effecting rotation of each article *d* about its vertical axis. This rotation brings successive portions of the horizontal top surfaces and the vertical surfaces into the stream *a*, where they are suitably treated. As each article *d* advances through the stream, it is struck by abrasive approaching from angles which vary as the articles advance. Thus, the surfaces of the cavities and projections are effectively subjected to the effect of the stream.

As the article *d* is advanced further, it leaves the stream *a* and enters the stream *b* which treats the lower surfaces of each article *d* in a manner equivalent to the treatment of the upper surfaces by the stream *a*. Each article then passes out through the discharge vestibule 7 and is deposited on the discharge chute 107 by which it can be transported away from the treating apparatus.

It will be noted from an inspection of the drawings that articles having a diameter considerably greater than the width of the abrasive streams *a* and *b* may be effectively cleaned by the apparatus disclosed due to the fact that the articles *d* are rotated about an axis lying in a vertical plane passing substantially midway between the supporting elements and approximately medially of the streams *a* and *b*. Thus, the articles *d* are continuously in the streams and the several portions are carried through each stream preferably a number of times during the course of a single trip through the apparatus. The speed of the articles *d* through the treating chamber is controlled so that the articles are exposed to the abrasive for the desired time and the relative speeds of the belts 80 are adjusted so that the articles rotate the desired number of times in passing through the treating chamber.

The provision of the required number of projectors both above and below the conveyor so arranged as to treat both the upper and lower surfaces of articles on the conveyor permits the articles to be fully treated in the course of a single trip through the apparatus. It is understood that any number of wheels or projectors placed in staggered relationship or otherwise arranged may be used as conditions require. The articles to be treated may be supplied at one end of the apparatus and removed at the other, and the apparatus operated continuously so the apparatus need be shut down only for repairs.

Preferably the belts 80 are so arranged that the rim portions of the articles only bear on the belts, thus permitting the articles to roll relatively freely on the belts. This insures a relatively smooth, even rotation of the articles on the conveyor. Also, the inclination of the belts 80 causes the articles to assume a central posi-

tion relative to the conveyor and thus uniform treatment of the articles is insured.

In certain cases, one of the belts may be omitted and the remaining belt driven in the manner above described. In that case, the single belt imparts a rotary movement to each article and causes the article to roll along while supported by the support 90 at one side and the belt 80 at the other side.

It will be noted that substantially no portion of the apparatus is directly in the path of the abrasive fired by the throwing wheels, the articles *d* to be cleaned being juxtaposed as shown in Fig. 1 to receive the full force of the abrasive fired by the wheels. The flexible curtains 5 and 8 bear upon the belts 80 and prevent the escape of spent abrasive and the brushes 97 and 98 brush the abrasive off from the conveyor. Substantially all of the bearing portions of the apparatus are disposed outside of the housing and thus there is little opportunity for abrasive working into the bearings. In this connection, it will be noted that the supporting rolls 95 for the belts preferably are spaced sufficiently to permit the abrasive streams to pass therebetween. The supports 90 preferably are also spaced sufficiently to be out of the path of the abrasive.

The apparatus may be suitably modified to handle various types of articles, and thus it is apparent that various modifications may be made in the apparatus without departing from the spirit of the invention. Preferably, the supports 90 and belts 80 are of sufficient width to accommodate a considerable range of sizes of articles. The belts may be made of various materials having suitable strength and wearing qualities and of sufficient flexibility to assume the shape required to properly support and manipulate the articles supported thereon. The belts may be formed of rubber, fabric, connected metal bars, interconnected links or various other suitable materials.

The apparatus is adapted to convey articles of various shapes and sizes and the articles may be positioned so that they are substantially supported by and extend above the supports or alternatively the article may be mounted on the supports in an inverted position from that shown in the drawings so that the articles are suspended downwardly between the supports. This inverted arrangement may be advantageous in certain cases where the article is so shaped that it might otherwise tip over.

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. Apparatus for abrasively treating metal articles including, a plurality of endless conveyor belts, means mounting said belts in spaced and generally parallel relation to support the articles to be treated therebetween, an abrasive throwing wheel operative to project a stream of abrasive and means for driving said belts at different relative speeds thereby to turn said article about an axis transverse to its forward movement simultaneously with its forward movement through said streams.

2. Apparatus for treating metal articles including, means for projecting a stream of abrasive particles, a pair of spaced article-supporting belts, article guiding means associated with said spaced belts, means for driving said belts at differential speeds so as to cause the articles supported thereon to rotate while advancing through the stream, and means for supporting the upper run of said belts transversely inclined toward one another.

3. Apparatus for blast cleaning metal articles including, a housing, an abrasive throwing wheel operative to project a controlled fan-shaped stream of abrasive into said housing, and conveyor means extending through said housing and adapted to advance articles to be treated through said stream, said conveyor means including a pair of spaced and generally parallel supporting elements, endless belts having portions riding on said supporting elements, drums disposed outside of said housing and having driving engagement with said endless belts, and means for driving said drums to selectively advance said endless belts at desired differential speeds.

4. Apparatus for treating metal articles including, a housing, a plurality of spaced and generally parallel endless belts extending through said housing, a driving drum for each of said endless belts disposed outside of said housing, means for driving said belts at differential speeds, guide members extending through said housing and adapted to support and guide the upper flights of said endless belts, spaced supporting and guiding rolls adapted to support the lower flights of said endless belts, an abrasive throwing wheel operative to project a fan-shaped stream of abrasive having an elongated impingement pattern, said wheel being arranged so as to place said elongated pattern between said spaced belts, and sealing means for the upper and lower flights of said belts respectively for preventing the escape of treating material from said housing.

5. Apparatus for blast cleaning and removing scale and other foreign undesirable materials from the surface of metallic objects including, an abrasive throwing wheel operative to project a fan-shaped stream of abrasive having an elongated impingement pattern, spaced conveyor elements positioned on opposite sides of said wheel, means for advancing said conveyor elements at differential speeds and in the general direction of the longitudinal axis of the impingement pattern, thereby to turn an object about an axis transverse to its forward movement simultaneously with its forward movement through said stream.

6. Apparatus for blast cleaning metal articles including, an abrasive throwing wheel operative to project a fan-shaped stream of abrasive having an elongated impingement pattern, a plurality of spaced guiding elements for the articles to be treated positioned outside of the path of the projected abrasive stream, means for advancing the articles to be treated along said guiding elements through said stream in the same general direction as the longitudinal axis of said impingement pattern, and means for imparting a higher velocity in a forward direction to an article along one of said guiding elements than along another of said guiding elements whereby to rotate each article about an axis transverse to its direction of forwaro movement.

7. Apparatus for abrasively cleaning metal articles including, an abrasive throwing wheel operative to project a stream of abrasive, a plurality of spaced and generally parallel conveyor members adapted to support an article to be treated, and means for driving said conveyors at selected differential speeds to carry the article

through said stream and simultaneously rotate the same in said stream.

8. Apparatus for blast cleaning metallic articles including, a plurality of spaced supporting elements, an abrasive throwing wheel operative to project a fan-shaped stream of abrasive having an elongated impingement pattern, said wheel being arranged so as to direct said abrasive stream between said spaced supporting elements, means for guiding the article to be cleaned through the abrasive stream, and means for imparting a higher velocity in a forward direction to the article to be cleaned along one of said supporting elements than another of said supporting elements whereby to rotate said article in said stream.

9. Apparatus for blast cleaning metallic articles including, an abrasive throwing wheel operative to project a fan-shaped stream of abrasive at blasting velocities, a pair of spaced and generally parallel supporting elements, conveyor means extending along said supporting elements for carrying the articles to be treated, means for driving said conveyor means at differential speeds to simultaneously rotate and advance the articles to be treated through said stream thereby to subject the sides faces as well as the advancing and following faces of said articels to the impinging action of the fan-shaped abrasive stream.

10. In an abrading apparatus, a pair of spaced and generally parallel conveyor members adapted to support therebetween a metal work piece to be treated, an abrasive throwing wheel mounted above and an abrasive throwing wheel mounted below said conveyor members and in such a manner as to project their respective abrasive streams generally between said conveyor members, and means for driving said conveyor members at selected differential speeds to convey the work piece through said streams and rotate the work piece in said streams whereby both upper and lower surfaces of the work piece supported on said conveyor members are subjected to abrasive treatment.

11. In an abrading machine, a pair of endless conveyor belts, means mounting said belts in spaced and generally parallel relation with the supporting surfaces thereof positioned to support and confine a work piece to be treated therebetween, an abrasive throwing wheel operative to project a stream of abrasive at abrading velocities against the work piece supported on said belts, and means for driving one of said belts at a higher velocity in a forward direction than the other belt whereby to rotate the work piece under treatment in the abrasive stream and advance the work piece through said stream.

12. Apparatus for blast cleaning and removing scale and other foreign undesirable materials from the surface of metallic objects including, an abrasive throwing wheel operated to project a fan-shaped stream of abrasive having an elongated impingement pattern, spaced conveyor elements positioned on opposite sides of said wheel, means for advancing said conveyor elements at differential speeds and in the general direction of the longitudinal axis of the impingement pattern thereby to turn the object under treatment about an axis transverse to its forward movement, said conveyor elements having their respective supporting surfaces transversely inclined toward one another whereby the object supported thereon has a limited area of contact therewith.

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APPARATUS FOR TREATING METAL

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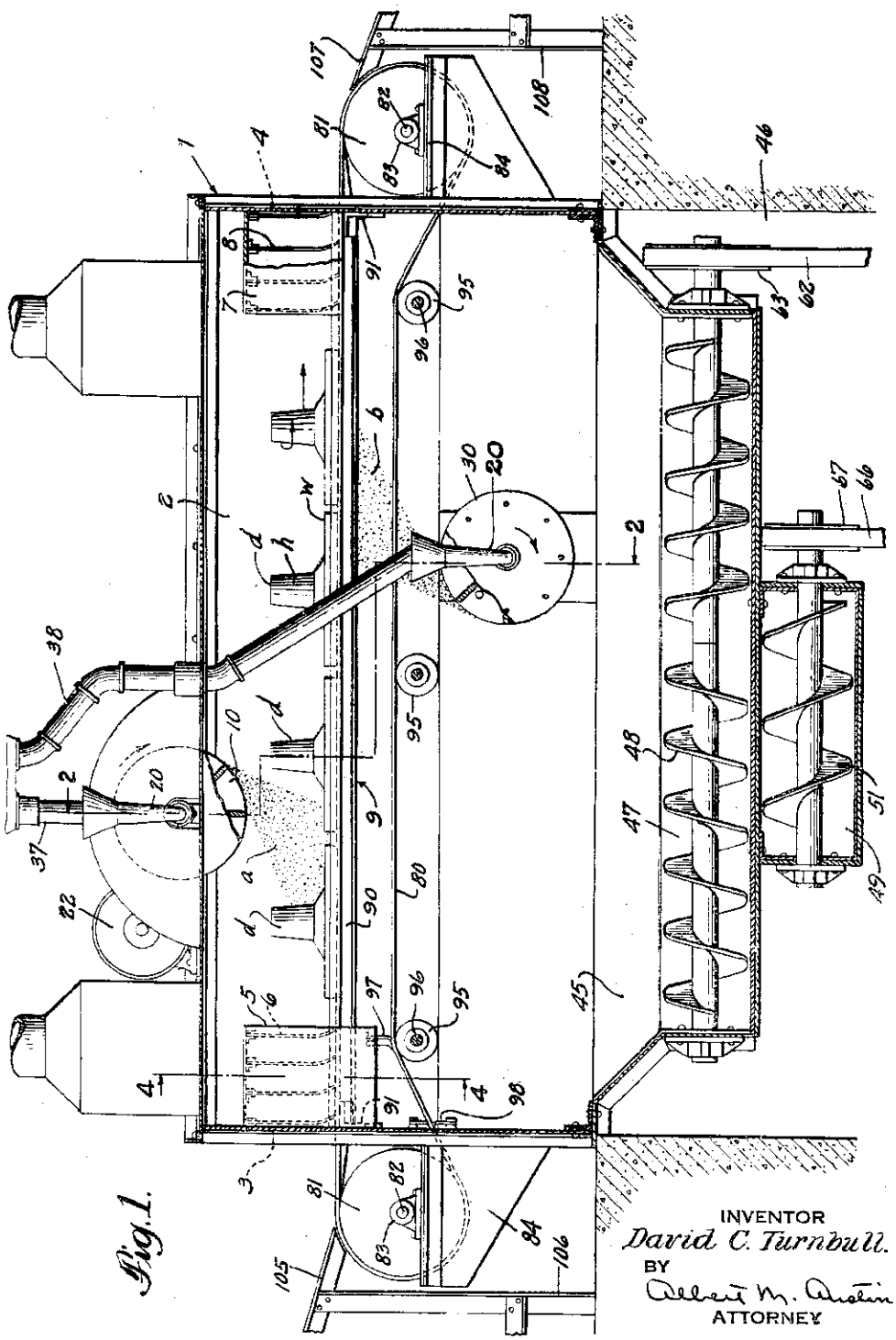

Fig. 1.

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APPARATUS FOR TREATING METAL

Filed July 1, 1936 4 Sheets-Sheet 2

Fig. 6.

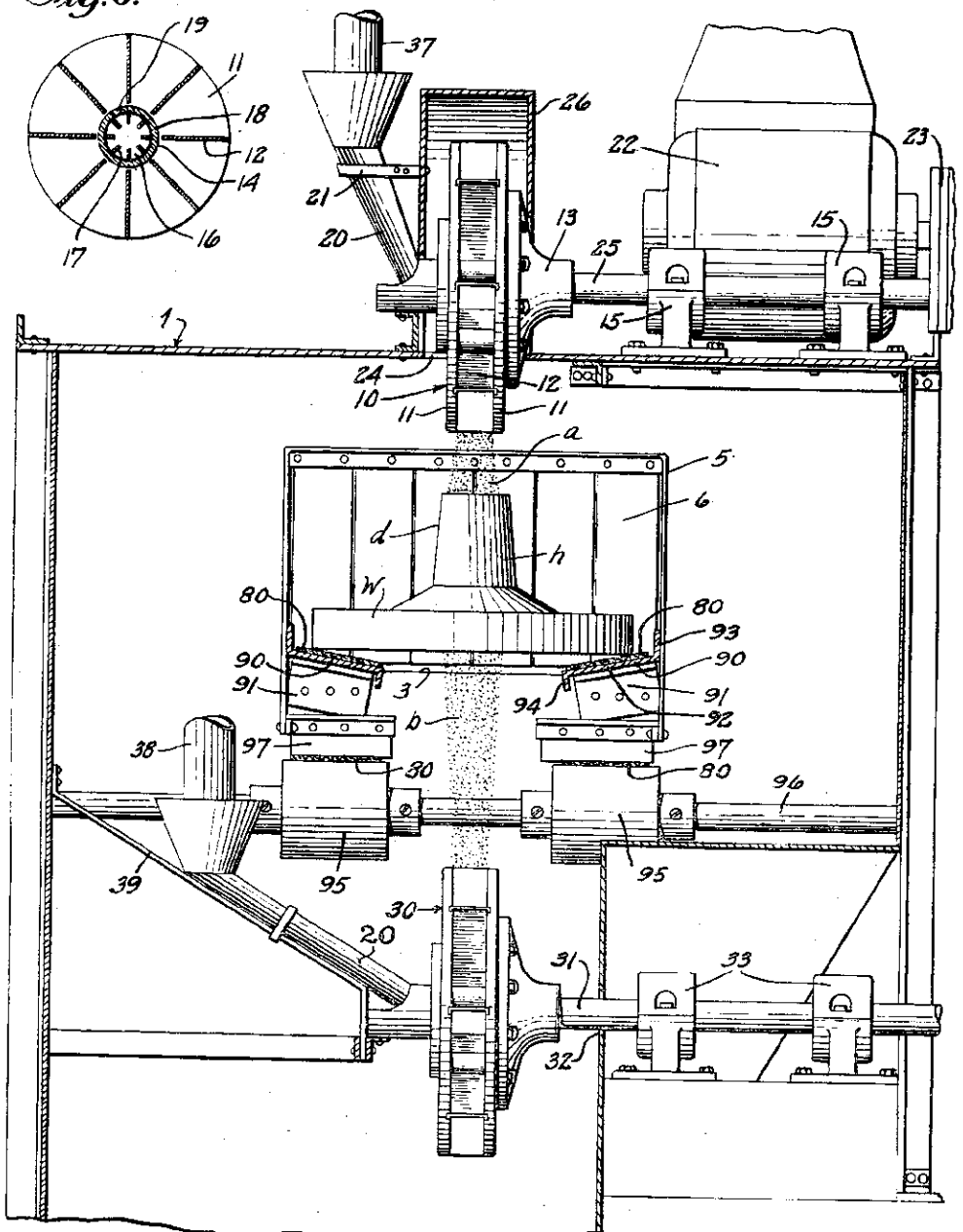

Fig. 2.

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APPARATUS FOR TREATING METAL

Filed July 1, 1936 4 Sheets-Sheet 3

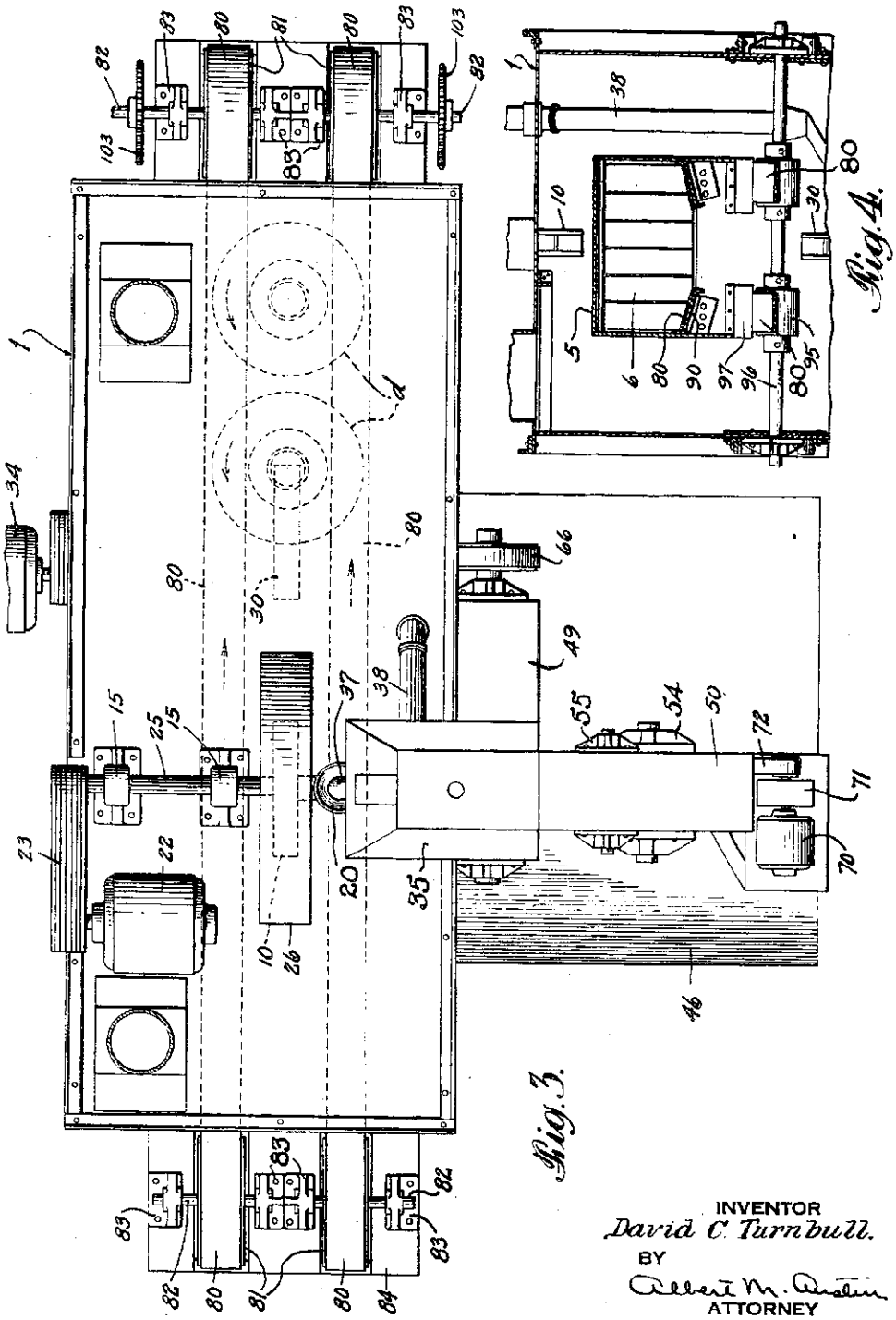

Fig. 3.

Fig. 4.

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APPARATUS FOR TREATING METAL

Filed July 1, 1936 4 Sheets-Sheet 4

Fig. 5.