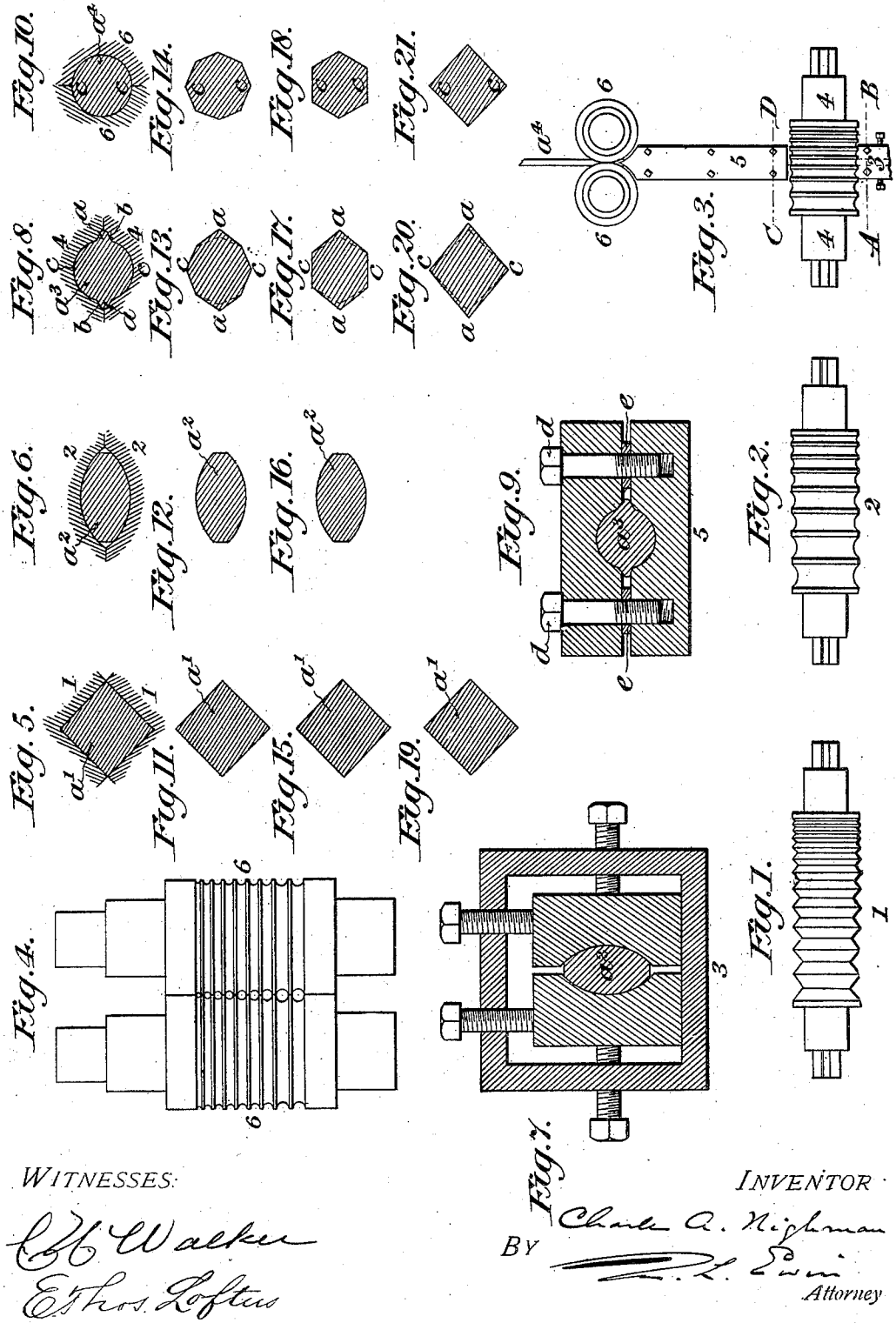
No. 706,993. Patented Aug. 12, 1902.

C. A. NIGHMAN.

ROD ROLLING MILL.

(Application filed Jan. 2, 1902.)

(No Model.) 5 Sheets—Sheet 1.



WITNESSES:

E. H. Walker

E. Thos. Loftus

INVENTOR

Charles A. Nighman

BY

Attorney

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 706,993. Patented Aug. 12, 1902.

C. A. NIGHMAN.

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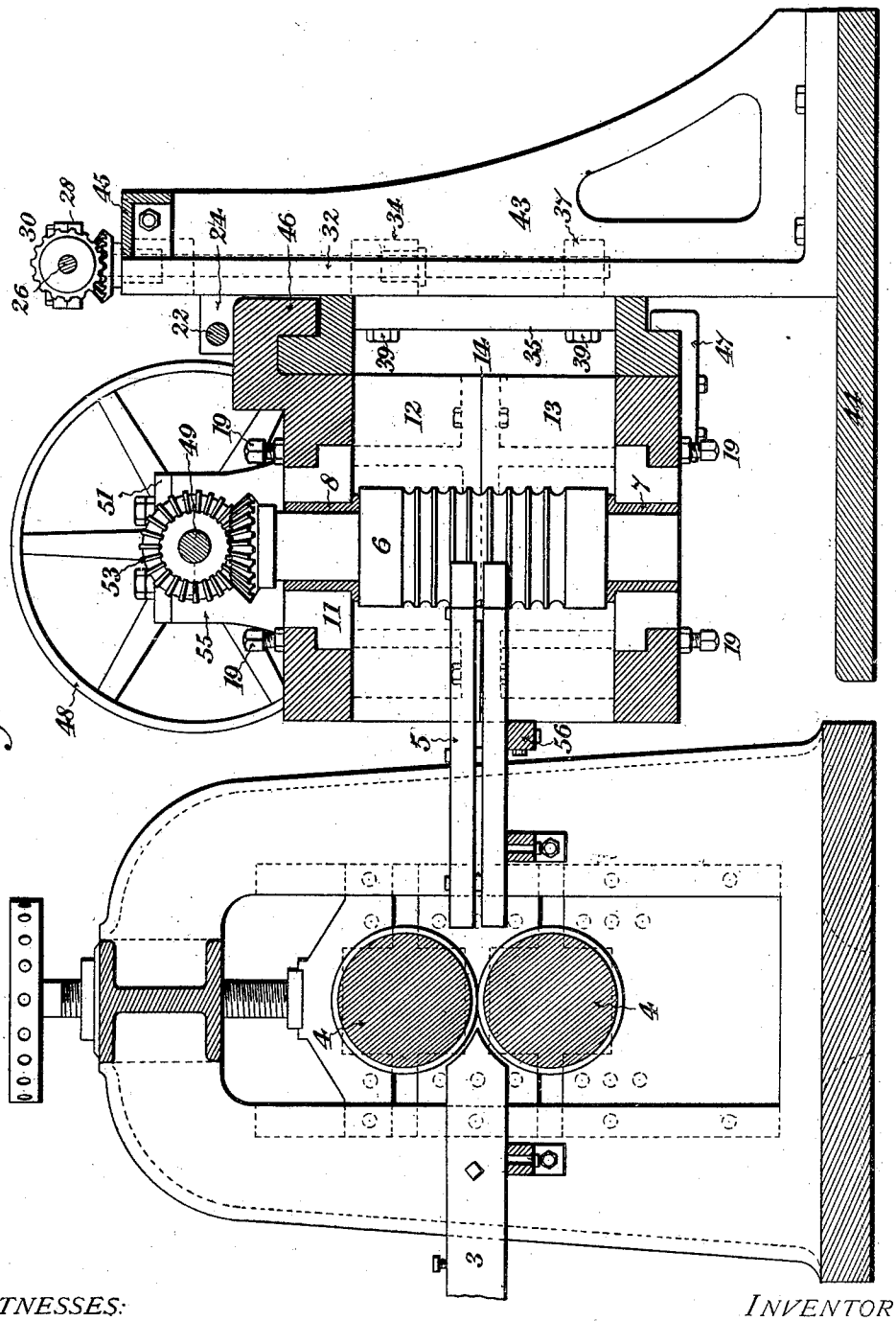


Fig. 22.

WITNESSES:

W. H. Walker.

E. Thos. Loftus

INVENTOR

Charles A. Nighman

BY

Attorney

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 706,993. Patented Aug. 12, 1902.

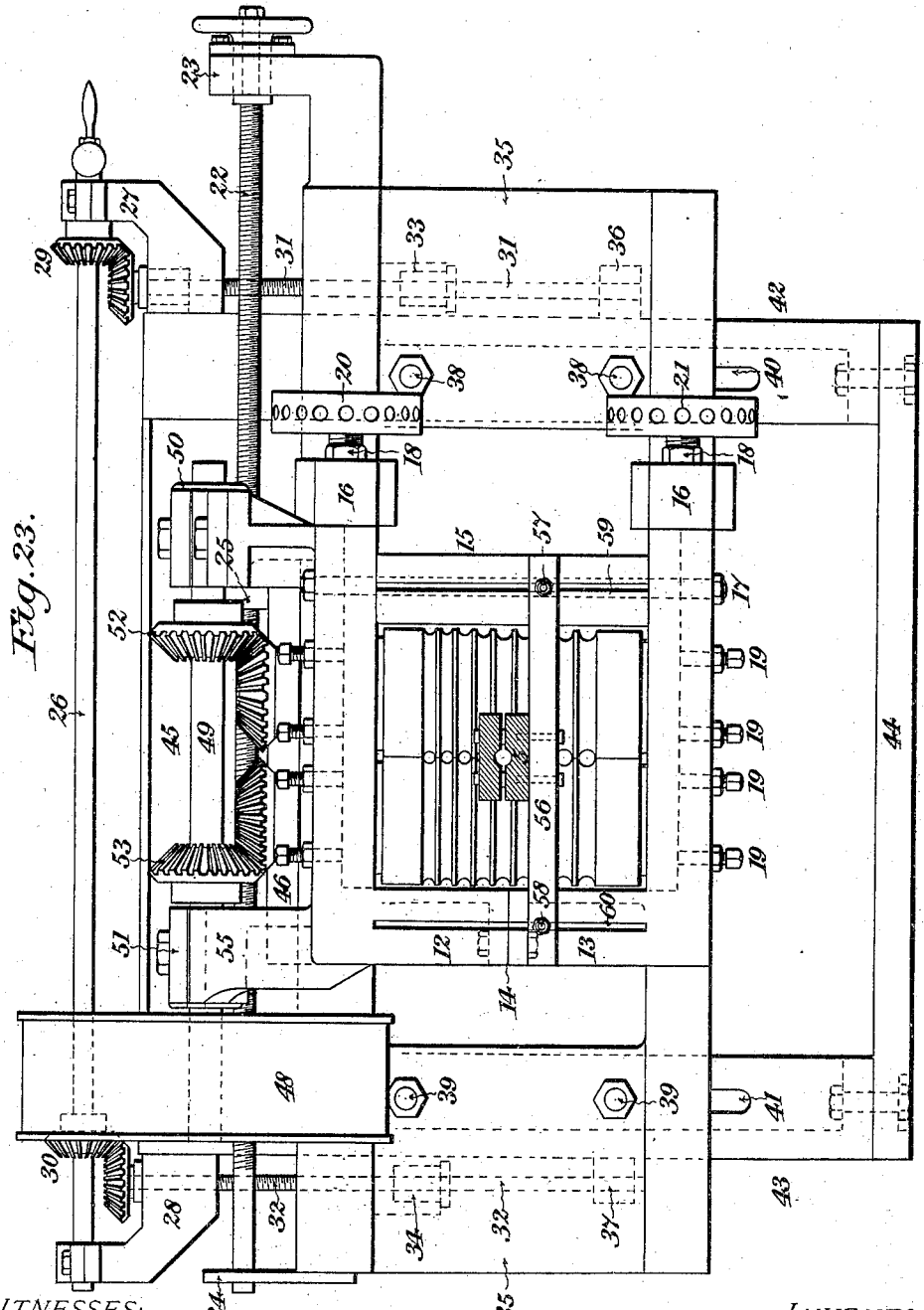
C. A. NIGHMAN.

ROD ROLLING MILL.

(Application filed Jan. 2, 1902.)

(No Model.) 5 Sheets—Sheet 3.

Fig. 23.



WITNESSES:

C. H. Walker.

Ethos. Loftus

INVENTOR.

Charles A. Nighman

BY

Z. L. Lewis,

Attorney.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 706,993. Patented Aug. 12, 1902.

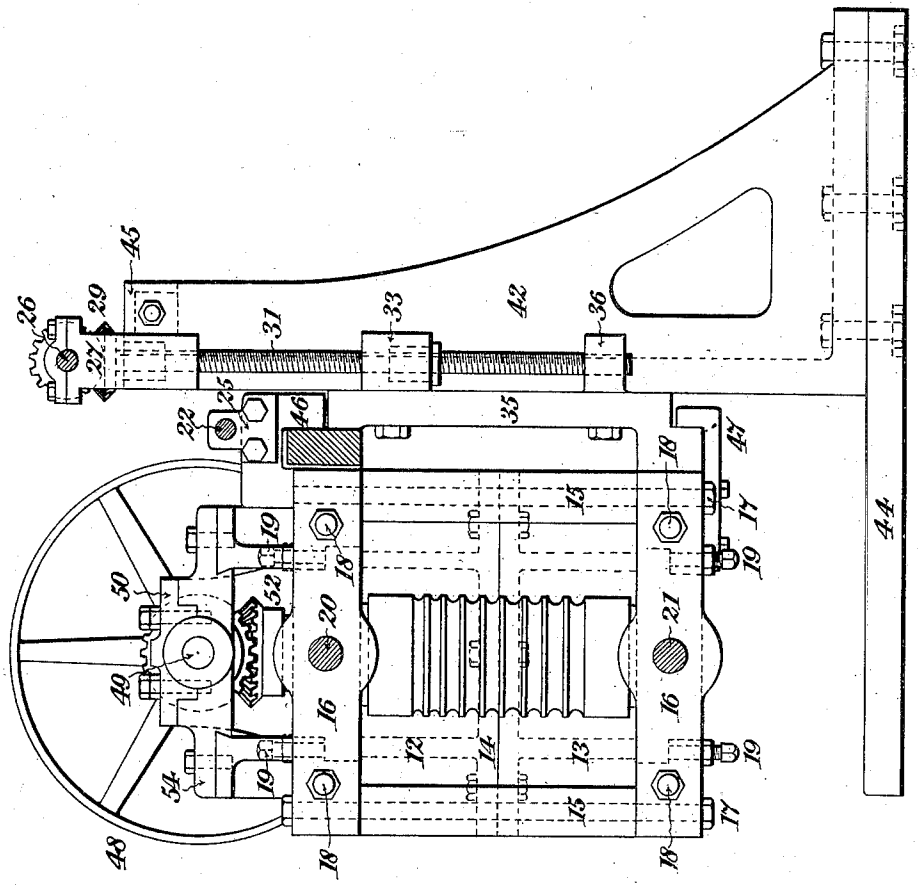
C. A. NIGHMAN.

ROD ROLLING MILL.

(Application filed Jan. 2, 1902.)

(No Model.) 5 Sheets—Sheet 4.

Fig. 24.



WITNESSES:

C. H. Walker,

E. Thos. Loftus

INVENTOR.

Charles A. Nighman

BY

Attorney

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C

No. 706,993. Patented Aug. 12, 1902.

C. A. NIGHMAN.

ROD ROLLING MILL.

(Application filed Jan. 2, 1902.)

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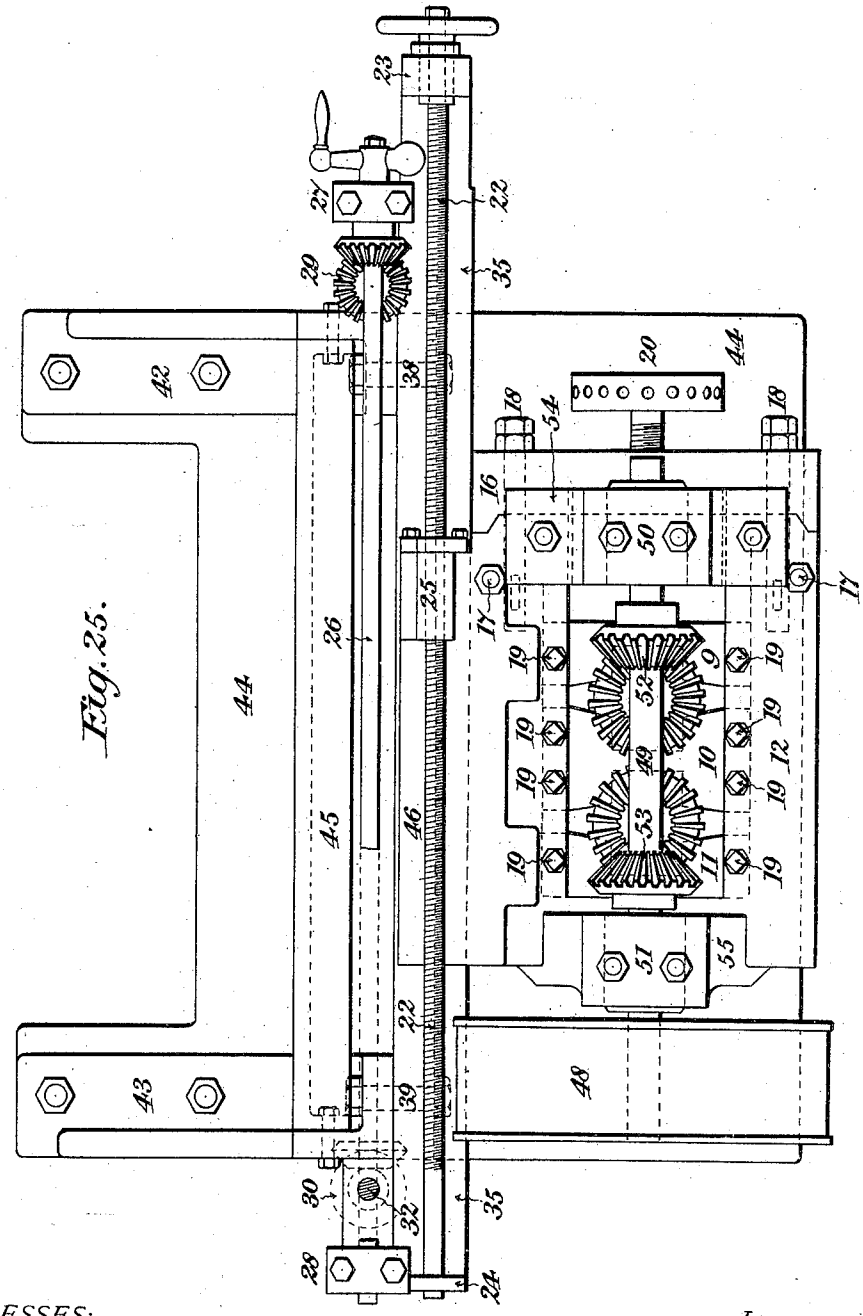


Fig. 25.

WITNESSES:

E. Walker.

E. Thos. Loftus

INVENTOR.

Charles A. Nighman

BY

Attorney.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

CHARLES A. NIGHMAN, OF JERSEY CITY, NEW JERSEY.

ROD-ROLLING MILL.

SPECIFICATION forming part of Letters Patent No. 706,993, dated August 12, 1902.

Application filed January 2, 1902. Serial No. 88,095. (No model.)

To all whom it may concern:

Be it known that I, CHARLES A. NIGHMAN, a citizen of the United States of America, and a resident of Jersey City, in the State of New Jersey, have invented a new and useful Improvement in Rod-Rolling Mills, of which the following is a specification.

This invention relates exclusively to rod-rolling trains, and primarily to what are classed as "angular trains," one set of rolls in the improved mill, hereinafter termed the "finishing-rolls," being at right angles to those of the preceding set, hereinafter termed the "next-to-the-last rolls."

The invention consists in a novel construction of said next-to-the-last rolls as to shape of pass, in the combination of parts as a whole preferably employed for the production of rods from the ingot or billet, including finishing-rolls into which the rod is guided from said next-to-the-last rolls, and in the appurtenances of a set of vertical rolls, preferably said finishing-rolls, forming part of the improved mill, as hereinafter described and claimed.

The objects of the invention are to provide the rod from end to end within the next-to-the-last pass with laterally-projecting longitudinal ribs by which to truly and steadily guide the rod into the finishing-pass and by means of the surplus metal contained in such ribs to fill out and perfect the rod in the finishing-pass; to prevent the formation of fins at either of said passes, and thus to prevent the waste which has heretofore occurred at both ends of rods; to facilitate the rolling of rods in maximum lengths and the production of uniform and perfect rods at increased speed and reduced cost, and to facilitate the adjustment and operation of said vertical finishing-rolls.

The product of the improved mill may be of round, octagonal, hexagonal, or square cross-section and of any size.

Five sheets of drawings accompany this specification as part thereof.

Referring to the drawings, Figures 1, 2, and 3 together represent diagrammatically the improved rod-rolling mill as a whole. Fig. 4 represents an elevation of the finishing-rolls shown at the top in Fig. 3. Fig. 5 represents a cross-section through the rod in the final pass of the breaking-down rolls, Fig. 1, illustrating the product of said rolls. Fig. 6 represents a cross-section through the rod in the corresponding pass of the "oval" rolls, Fig. 2, illustrating the product of these rolls. Fig. 7 represents a cross-section on the line A B, Fig. 3, showing the oval rod in its guide. Fig. 8 represents a cross-section through the ribbed rod in the corresponding pass of the next-to-the-last rolls, as shown at the bottom in Fig. 3, illustrating the product of the "rib-rolls." Fig. 9 represents a cross-section on the line C D, Fig. 3, showing the ribbed rod in its guide; and Fig. 10 represents a cross-section through the rod in the corresponding pass of the finishing-rolls, Fig. 4, showing the finished rod. The foregoing figures illustrate the production of round rods. Figs. 11, 12, 13, and 14 represent successive cross-sections of the rod, illustrating the production of octagonal rods. Figs. 15 to 18, inclusive, illustrate in like manner the production of hexagonal rods; and Figs. 19 to 21, inclusive, illustrate in like manner the production of square rods by the improved mill. Fig. 22 is a sectional elevation of said rib-rolls, the guide leading therefrom, and the finishing-rolls. Fig. 23 is a front elevation of said finishing-rolls, showing said guide in cross-section in the foreground. Fig. 24 is a side elevation of said finishing-rolls with portions broken away, and Fig. 25 is a plan view of said finishing-rolls. Figs. 4 to 25, inclusive, are enlarged with reference to Figs. 1, 2, and 3, the enlargement of Figs. 5 to 21, inclusive, being seven diameters.

Like reference letters and numbers indicate like parts in all the figures.

In the production of round rods I preferably and conveniently reduce the ingot—say four inches square in cross-section—to the proper size for a given diameter of rod—say to one and three-sixteenths inches for a one-inch rod—by the successive passes of a three-high set of breaking-down rolls 1 in a customary manner. The square product a' is then passed once through said oval rolls 2. The oval product a^2 is then introduced with a quarter-turn through a guide 3 into the corresponding pass of said rib-rolls 4, where the rod a^3 is provided with laterally-projecting ribs $a\,a$, Fig. 8, by corresponding lateral enlargements

b b of the pass. Otherwise this pass is of the same shape and dimensions as the corresponding pass of the finishing-rolls 6 and as the final product a^4. In other words, it corresponds in shape with the final product at two diametrically opposite points *c c*, and between these points is of full size, so as to require no change of shape at these points in the finishing-rolls. The rod a^3 passes from said rib-rolls 4 into a guide 5, having a passage-way of corresponding shape adjusted as to size by screw-bolts *d* and washers *e*, as shown in Fig. 9, and is automatically delivered by said guide 5 with said ribs *a* perpendicular to the grooves forming the corresponding pass of the finishing-rolls 6. (Compare Figs. 8, 9, and 10.) Within said pass of the finishing-rolls 6 the surplus metal contained in said ribs *a* being still sufficiently hot owing to the shape and proportions of such ribs is forced into the rod, causing every portion of the circumference of the rod to be equally filled out. This is accompanied by a slight elongation, which aids in giving the rod a perfect finish.

In the production of octagonal rods, Fig. 14, as illustrated by Figs. 11 to 14, inclusive, I proceed in precisely the same manner, and the only change in the apparatus is the modification of the passes of the rib-rolls 4 and the passage of the succeeding guide 5 to make them correspond in shape with Fig. 13 and the passes of the finishing-rolls 6 to make them correspond in shape with Fig. 14. Hexagonal rods, Fig. 18, are produced in the same manner as illustrated by Figs. 15 to 18, inclusive, and square rods, Fig. 21, by the same process in part as illustrated by Figs. 19 to 21, inclusive, the square rod a' being fed directly into the rib-rolls 4 with or without the aid of a guide 3. In producing all said angular shapes the laterally-projecting longitudinal ribs *a* are made of angular forms best suited to disappear perfectly in the finished rods, as illustrated by Figs. 13, 17, and 20; but in all cases the functions of said ribs are the same—namely, to prevent any torsional displacement or turning of the rod between the rib-rolls 4 and the finishing-rolls 6, to supply surplus metal for filling out and perfecting the rod in the finishing-pass in a form and at a heat that will insure its incorporation into the body of the rod, and to prevent the formation of fins in the finishing-passes. Such ribs *a a* differ from "fins" in that they are not accidental and are not formed between the collars by the escape of metal at the sides of the passes, and are not confined to the ends of the rod or situated at irregular intervals or of uncertain shape, and are not of such proportions as to render them liable to quickly chill; but they are purposely formed by lateral enlargements of the next-to-the-last pass and extend uniformly the entire length of the rod, and are adapted to retain sufficient heat to fully disappear in the body of the finished product and to fill out and improve said finished product. In all cases, moreover, two portions *c c* of the circumference midway between said ribs *a a* are given their final shape in the next-to-the-last pass. In producing round rods a^4, Fig. 10, such portions *c c* are segments of a cylinder. In producing octagonal rods they constitute four of the eight sides. In producing hexagonal rods they constitute two of the six sides, and in the production of square rods they constitute two of the four angles.

The oval rolls 2, rib-rolls 4, and finishing-rolls 6 are each preferably provided with a number of passes of graduated sizes, as shown, although but one pass of each set of said rolls is used in my process at a given operation. The different grooves are used as in some other processes for rolling rods of different sizes, and thus obviate frequent changes of the rolls.

The improved means for supporting, adjusting, and operating the vertical rolls will now be described. These rolls are preferably and conveniently the finishing-rolls 6, as aforesaid, and are shown in detail by Figs. 22 to 25, inclusive, in connection with Figs. 3 and 4. Referring to said Figs. 22 to 25, it will be seen that the pair of rolls 6 are hung in brasses 7 and 8 at top and bottom, between carriages 9, 10, and 11 at top, as shown in Fig. 25, and between like carriages at bottom in a vertically and horizontally movable housing, the principal parts of which are a pair of heavy castings 12 and 13, rigidly united with each other by a bolted joint 14, (shown in Figs. 22 to 24,) a pair of posts 15 at the open edge of the housing, and a pair of caps 16 at the same edge, removable for the removal and introduction of the rolls 6 with their carriages, &c. Said posts 15 are held in place by bolts 17, which may be through-bolts, and said caps 16 by cotter-bolts 18. (Best shown with the aid of dotted lines in Fig. 25.) The vertical rolls 6 are adjusted within said housing to aline their respective pairs of grooves with each other by vertical screws 19 (best shown in Fig. 23) and then closely clamped together, through the agency of their housings 7 and 8 and carriages 9, 10, and 11, by horizontal "feed-screws" 20 and 21. To aline any pass of the vertical rolls 6 with a given pass of preceding or succeeding horizontal rolls—said next-to-the-last rolls 4, for example—the vertical rolls 6, with their housing, are first moved horizontally into general alinement with the appropriate pass of the horizontal rolls by means of a screw 22, swiveled to a relatively fixed support 23, steadied at its other end by a supplemental support 24 and coacting with a nut 25, fast on the housing. The vertical rolls 6, with their housing, are then raised or lowered until their appropriate pass is in line with that of the horizontal rolls. This is accomplished by turning a horizontal hand-shaft 26, mounted in fixed bearings 27 and 28 and connected by beveled gears 29 and 30 with a pair of vertical screws 31 and 32, which coact, respec-

tively, with nuts 33 and 34, fast on the back of an apron 35, that carries said housing. Relatively fixed steps 36 and 37 steady the lower ends of said vertical screws 31 and 32. When the desired alinement is effected, the apron 35 and therewith the rolls 6 and their housing are clamped against vertical displacement by horizontal bolts 38 and 39, passing through said apron 35 and through vertical slots 40 and 41 in the face-webs of a pair of standards 42 and 43, that are rigidly bolted to the bed-plate 44 and constitute therewith the stationary main frame of the set of rolls. A tie-beam 45 and attaching-bolts unite the upper ends of said standards 42 and 43, and the apron 35 slides on their planed faces. The upper casting 12 of the housing of the vertical rolls 6 is constructed with a strong hook or hooks 46 at its upper edge, by which it overhangs the offset and planed upper edge of the apron 35, as best shown in Fig. 24. The lower edge of the apron 35 is offset and planed in like manner and embraced by a hook or hooks 47, as shown in Figs. 22 and 24, rigidly bolted to the lower casting 13 of the housing.

The vertical rolls 6 are driven by belt from a drum on overhead line-shafting. A flanged driven pulley 48 is fast on a driven shaft 49, mounted in pillow-bearings 50 and 51 at the top of the housing, and pairs of beveled gears 52 and 53 connect said driven shaft 49 with the respective rolls 6. The vertical rolls are thus adapted to be driven independently of the horizontal rolls and to have their speed regulated with nicety, while the employment of splined shafts and the like is avoided.

The bearing 50 at the open end of the housing of the vertical rolls 6 is formed on a cap 54, (best shown in Fig. 24,) which is removed, together with the previously-described cap 16, when the rolls 6 are to be removed from the housing. The base 55 of the other bearing 51 may be integral with said upper casting 12 of the housing.

The guide 5, by which the ribbed rod is introduced into the pass of the vertical finishing-rolls, is supported at its delivery end by a bar 56, as shown in Fig. 23. The guide is fixedly bolted to this bar at mid-length of the latter, and the supporting-bar 56 is held at the required height by means of bolts 57 and 58, the heads of which slide in vertical T-grooves 59 and 60 in the face of the front post 15 at the open edge of the housing and in the face of the housing-castings 12 and 13, respectively. Said bolts 57 and 58 and the other end of the guide 5 at the rib-rolls 4 should be loosened before the adjustment of the vertical rolls 6 is begun. The line-train, composed of said breaking-down, oval, and rib rolls 1, 2, and 4, is driven in customary manner, and apart from the details as to passes hereinbefore specified may be of any known or improved construction. The appurtenances of said rib-rolls 4 (shown in Fig. 22) are of known construction, as are all the features of said oval guide 3. Further description thereof is therefore omitted as unnecessary.

The vertical rolls 6 may in some cases be the rib-rolls of the improved train and the finishing-rolls horizontal. The mechanical details of such vertical rolls 6 may vary widely without departing from the mode of operation hereinbefore set forth, and other like modifications will suggest themselves to those skilled in the art.

The number of the sets of rolls is not considered material; but those hereinbefore specified are considered sufficient for the reduction of rods of any size from the ingot or billet and a less number would not suffice, except for the production of square rods, where the rod is passed directly from the breaking-down rolls to the rib-rolls, as aforesaid.

The novel process herein described, apart from the apparatus by which the same is carried into effect, is more fully set forth and claimed in my companion specification forming part of an application for patent for "Improvement in methods of rolling rods," filed in the United States Patent Office the 2d day of January, 1902, Serial No. 88,096, and forms no part of the apparatus invention hereinafter claimed.

Having thus described said improvement, I claim as my invention and desire to patent under this specification—

1. A rod-rolling mill having, in combination, a set of rolls having their pass-forming grooves constructed with rib-forming enlargements, means for guiding the rod by its ribs as it issues from said rolls to prevent any twisting thereof, and a set of rolls arranged to receive the ribbed rod from the guiding means and to roll the ribs into the body of the rod.

2. A rod-rolling mill having, in combination, a set of rolls having their pass-forming grooves constructed with rib-forming enlargements, a guide, conformed internally to the continuously-ribbed rod so produced, arranged to receive the ribbed rod as it issues from said rolls and to prevent any twisting thereof, and a set of finishing-rolls arranged to receive the ribbed rod from said guide and to roll the ribs into the body of the rod.

3. A rod-rolling mill having, in combination, a set of horizontal rolls having their pass-forming grooves constructed with rib-forming enlargements, a guide, conformed internally to the continuously-ribbed rod so produced, arranged to receive the ribbed rod as it issues from said rolls and to prevent any twisting thereof, and a set of vertical rolls arranged to receive the ribbed rod from said guide and to roll the ribs into the body of the rod.

4. A rod-rolling mill having, in combination, a set of rolls having their pass-forming grooves constructed at their lateral edges with rib-forming enlargements, a guide, conformed internally to the continuously-ribbed rod so produced, arranged to receive the ribbed rod

as it issues from said rolls and to prevent any twisting thereof, and a set of rolls arranged to receive the ribbed rod from said guide and to roll the ribs into the body of the rod.

5. A rod-rolling mill having, in combination, breaking-down rolls, oval rolls, a guide for the oval rod, as hereinbefore specified, rib-rolls arranged to receive the oval rod through said guide with their pass-forming grooves perpendicular to the major diameter of such oval rod and constructed with rib-forming enlargements, a guide, conformed internally to the continuously-ribbed rod so produced, arranged to receive the ribbed rod as it issues from said rib-rolls and to prevent any twisting thereof, and finishing-rolls, arranged to receive the ribbed rod from said last-named guide, with their pass-forming grooves perpendicular to said ribs.

6. A rod-rolling mill having, in combination, a line-train composed of breakimg-down rolls, oval rolls, and rib-rolls, the latter constructed with rib-forming passes, a guide arranged to feed the oval rod into a pass of said rib-rolls with a quarter-turn, a guide, conformed internally to the continuously-ribbed rod so produced, arranged to receive the ribbed rod as it issues from said rib-rolls and to prevent any twisting thereof, and vertical finishing-rolls arranged to receive the ribbed rod from said last-named guide and to roll the rib into the body of the rod.

7. A rod-rolling mill having, in combination with a set of horizontal rib-rolls having a number of passes of graduated size each constructed with rib-forming enlargements, a guide, conformed internally to the continuously-ribbed rod so produced, adjustable for rods of different sizes and movable horizontally into line with any pass of said rolls, a set of vertical rolls arranged to receive the ribbed rod from said guide and having a number of passes of graduated size, and means for moving said vertical rolls horizontally and vertically to bring any of their passes into alinement with the corresponding pass of said horizontal rolls and with said guide.

8. In a rod-rolling mill, the combination with a set of horizontal rolls and a set of vertical rolls, each having a number of passes, of a movable housing for said vertical rolls, means carried by said housing for alining the grooves of the respective vertical rolls with each other and for pressing these rolls into close contact with each other, an apron supporting said housing, means for sliding said housing upon said apron and thereby moving said vertical rolls horizontally into alinement, means for raising and lowering said apron and therewith said housing and vertical rolls, and a stationary main frame supporting said apron and housing.

9. In a rod-rolling mill, the combination with a set of horizontal rolls and a set of vertical rolls, each having a number of passes of a movable housing for said vertical rolls, means carried by said housing for alining the grooves of the respective vertical rolls with each other and for pressing these rolls into close contact with each other, an apron supporting said housing, means for sliding said housing upon said apron and thereby moving said vertical rolls horizontally into alinement, means for raising and lowering said apron and therewith said housing and vertical rolls, a stationary main frame, and means for fixedly clamping thereto said apron and therewith said housing.

10. In a rod-rolling mill, the combination with a set of horizontal rolls and a set of vertical rolls, each having a number of passes of graduated size, of a movable housing for said vertical rolls, means carried by said housing for alining the grooves of the respective vertical rolls with each other and for pressing these rolls into close contact with each other, an apron supporting said housing, means for sliding said housing upon said apron and thereby moving said vertical rolls horizontally into alinement, means for raising and lowering said apron and therewith said housing and vertical rolls, a stationary main frame, and means for fixedly clamping thereto said apron and therewith said housing.

CHARLES A. NIGHMAN.

Witnesses:
JAS. L. EWIN,
LESLIE S. LOCKHART.