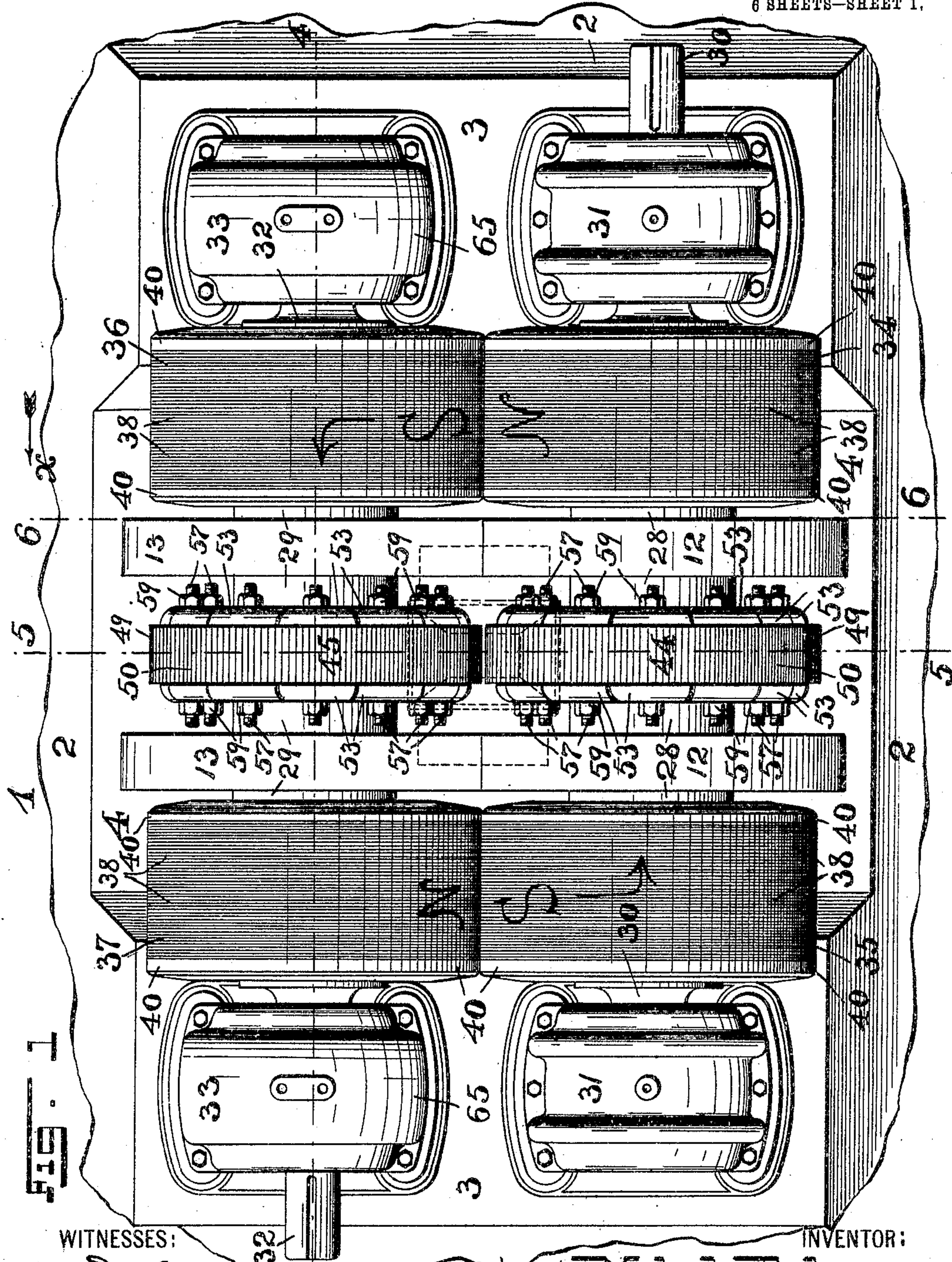


No. 794,703.

PATENTED JULY 11, 1905.

M. DICKERSON.
CRUSHING APPARATUS.
APPLICATION FILED JUNE 11, 1904.

6 SHEETS—SHEET 1.



WITNESSES:

Geo. D. Richards
W. B. Fraentzel

INVENTOR:

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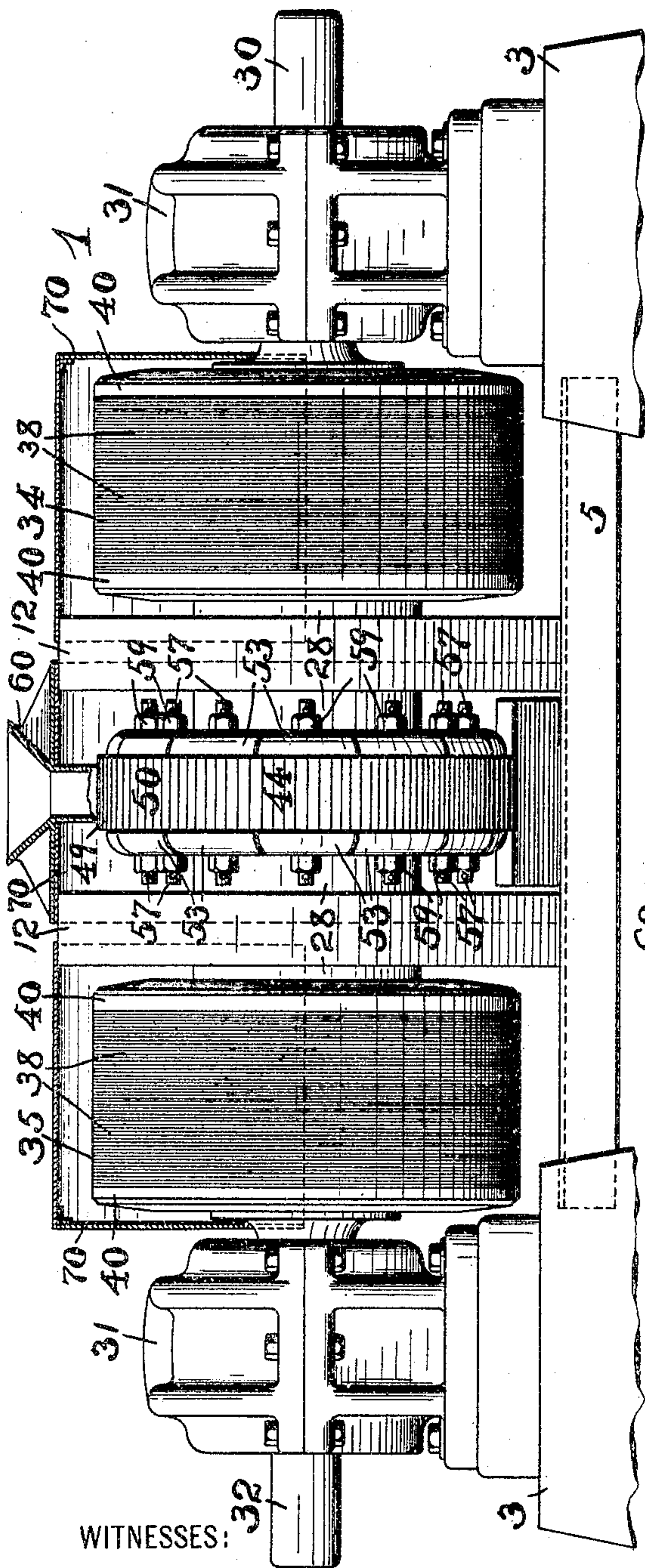
Fredk. Fraentzel,
ATTORNEY

No. 794,703.

PATENTED JULY 11, 1905.

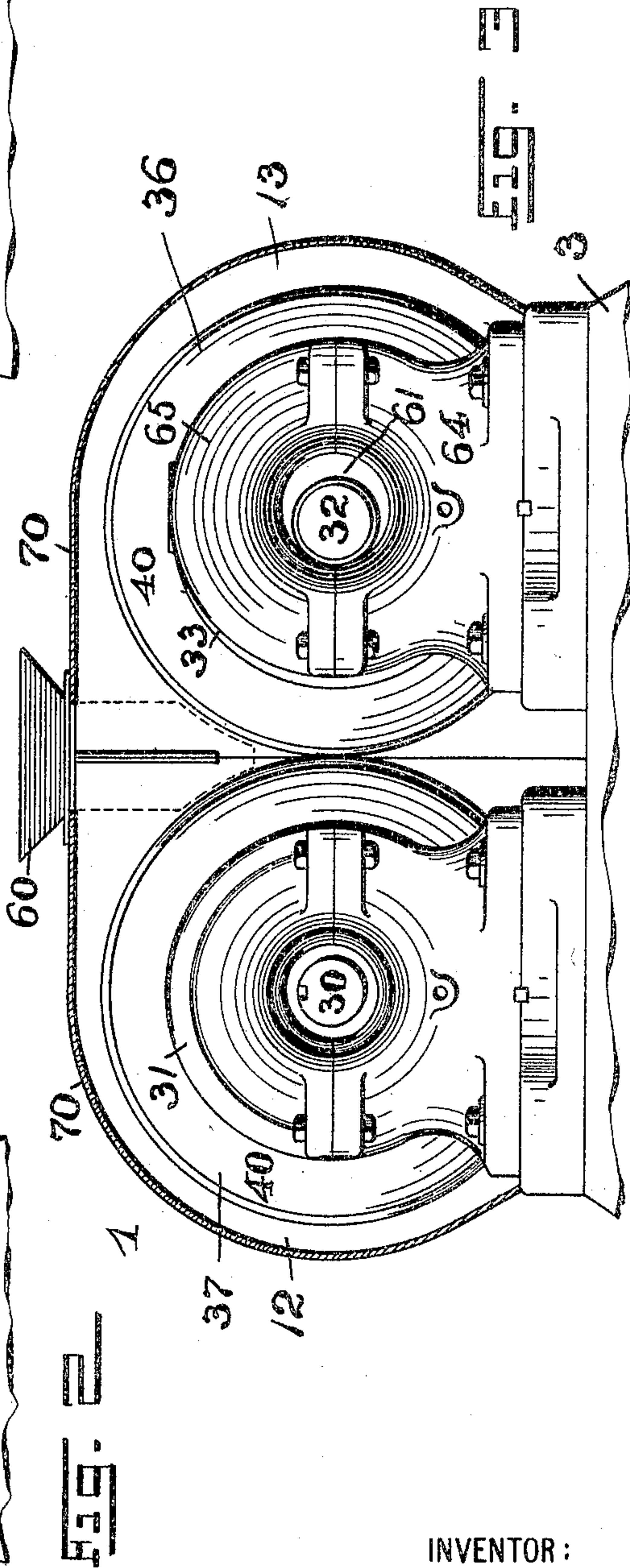
M. DICKERSON.
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APPLICATION FILED JUNE 11, 1904.

6 SHEETS—SHEET 2.



WITNESSES:

Geo. D. Richards
M. B. H. Gaentzel



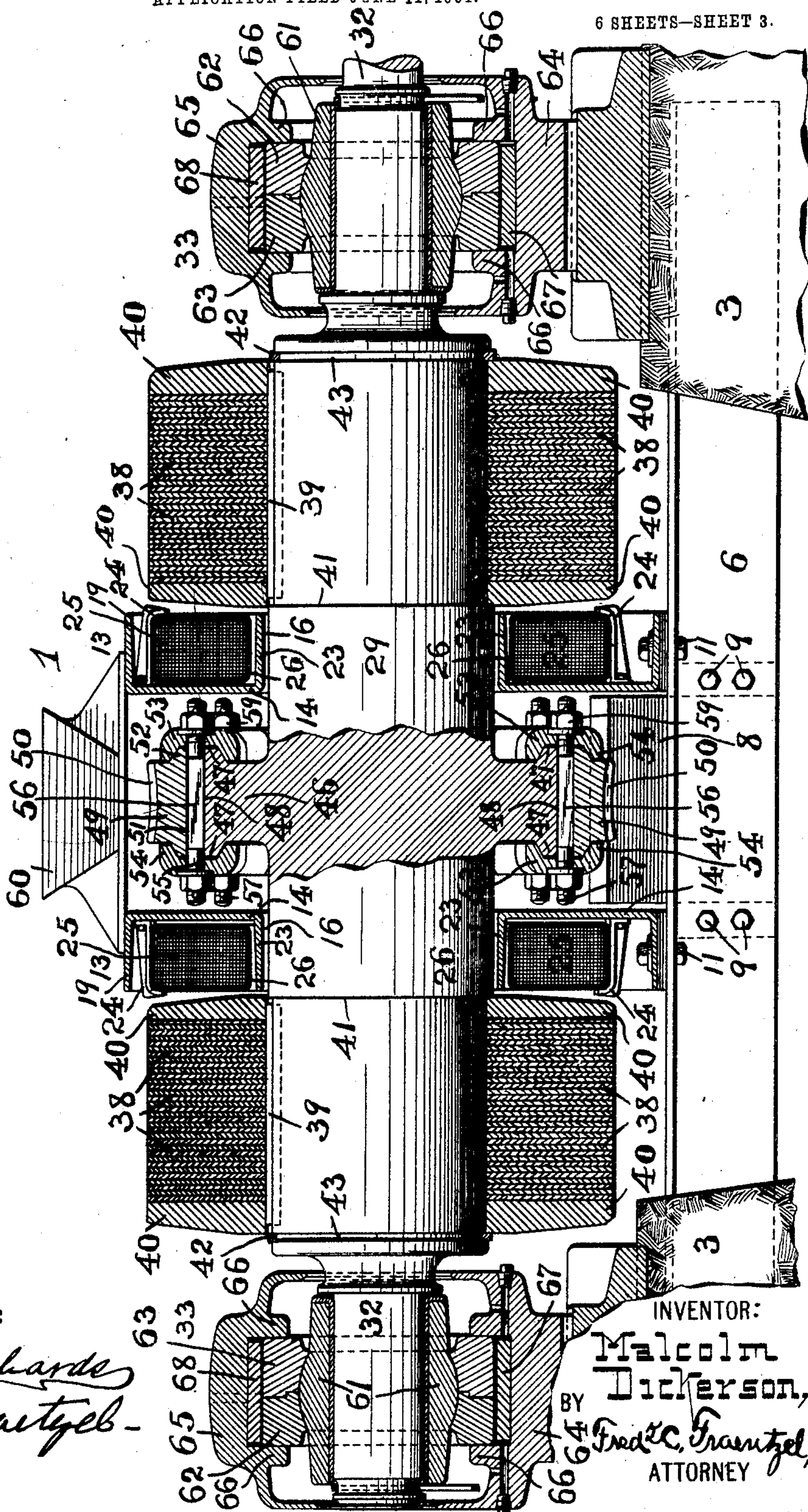
INVENTOR:
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M. DICKERSON.
CRUSHING APPARATUS.
APPLICATION FILED JUNE 11, 1904.

6 SHEETS—SHEET 3.

Fig. 4

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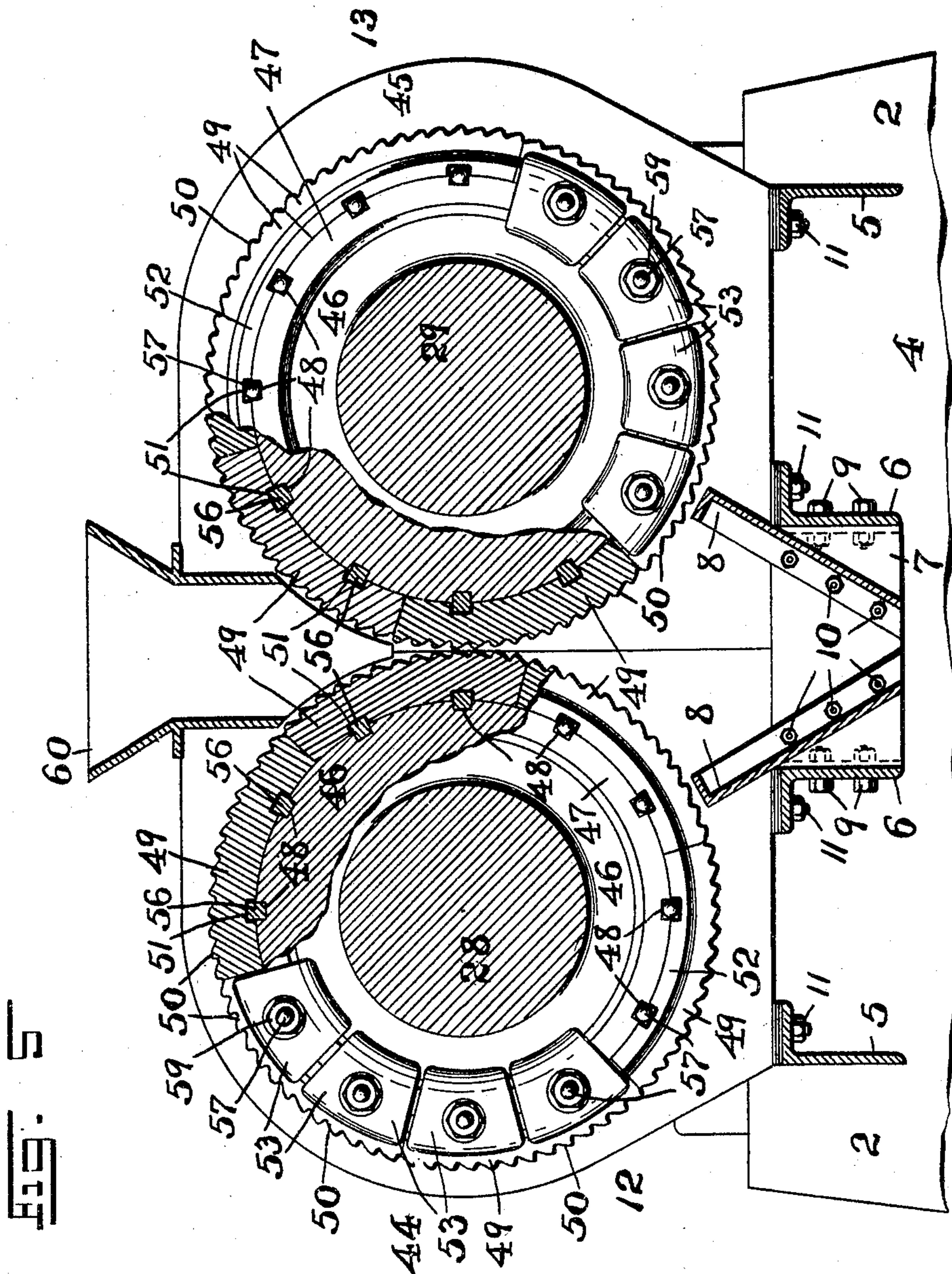
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6 SHEETS—SHEET 4.



WITNESSES:

Geo. D. Richards
W. B. Fraentzel

INVENTOR:

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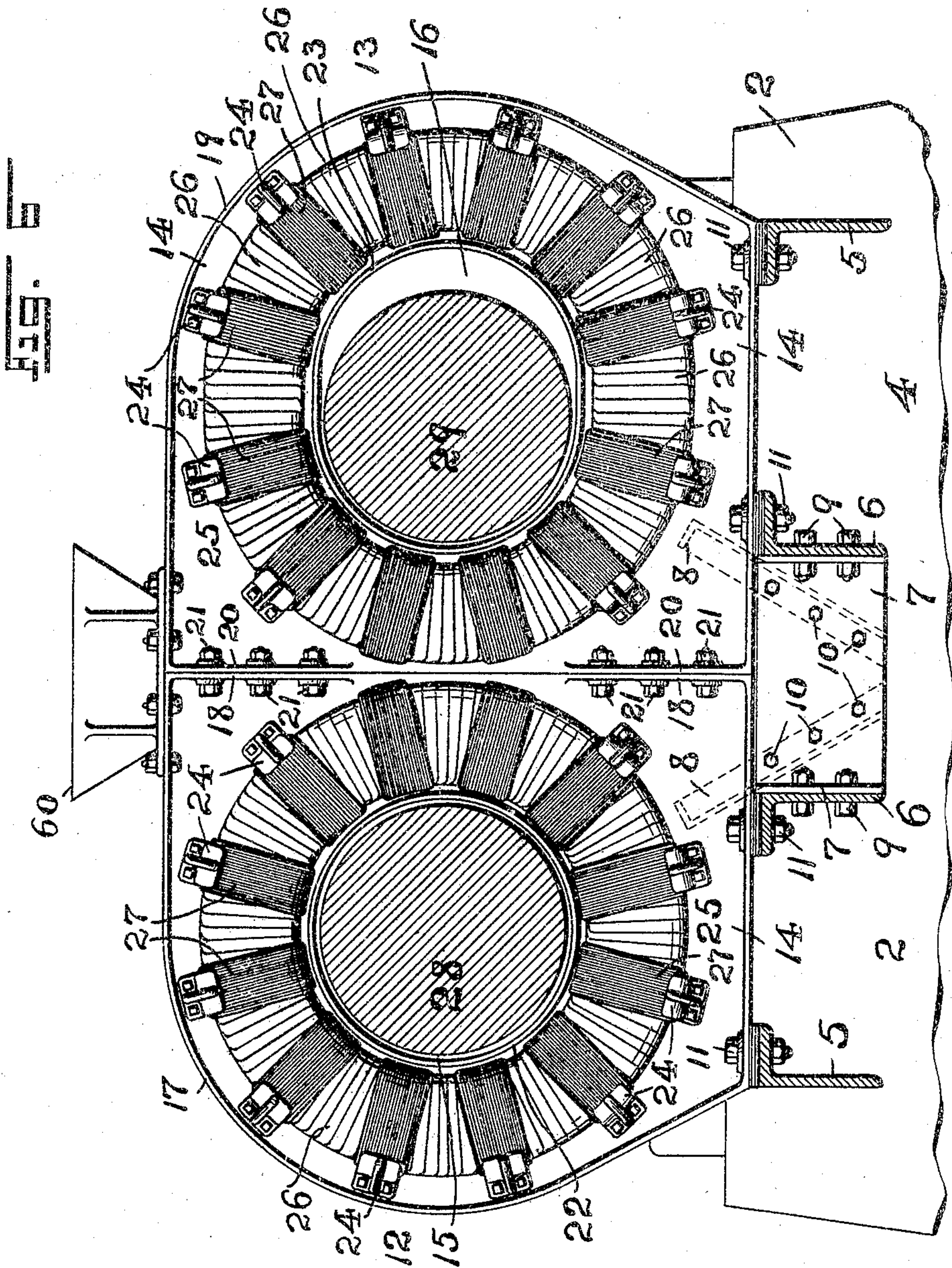
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APPLICATION FILED JUNE 11, 1904.

6 SHEETS—SHEET 5.



WITNESSES:

Geo. D. Richards
W. B. Fraentzel

INVENTOR:

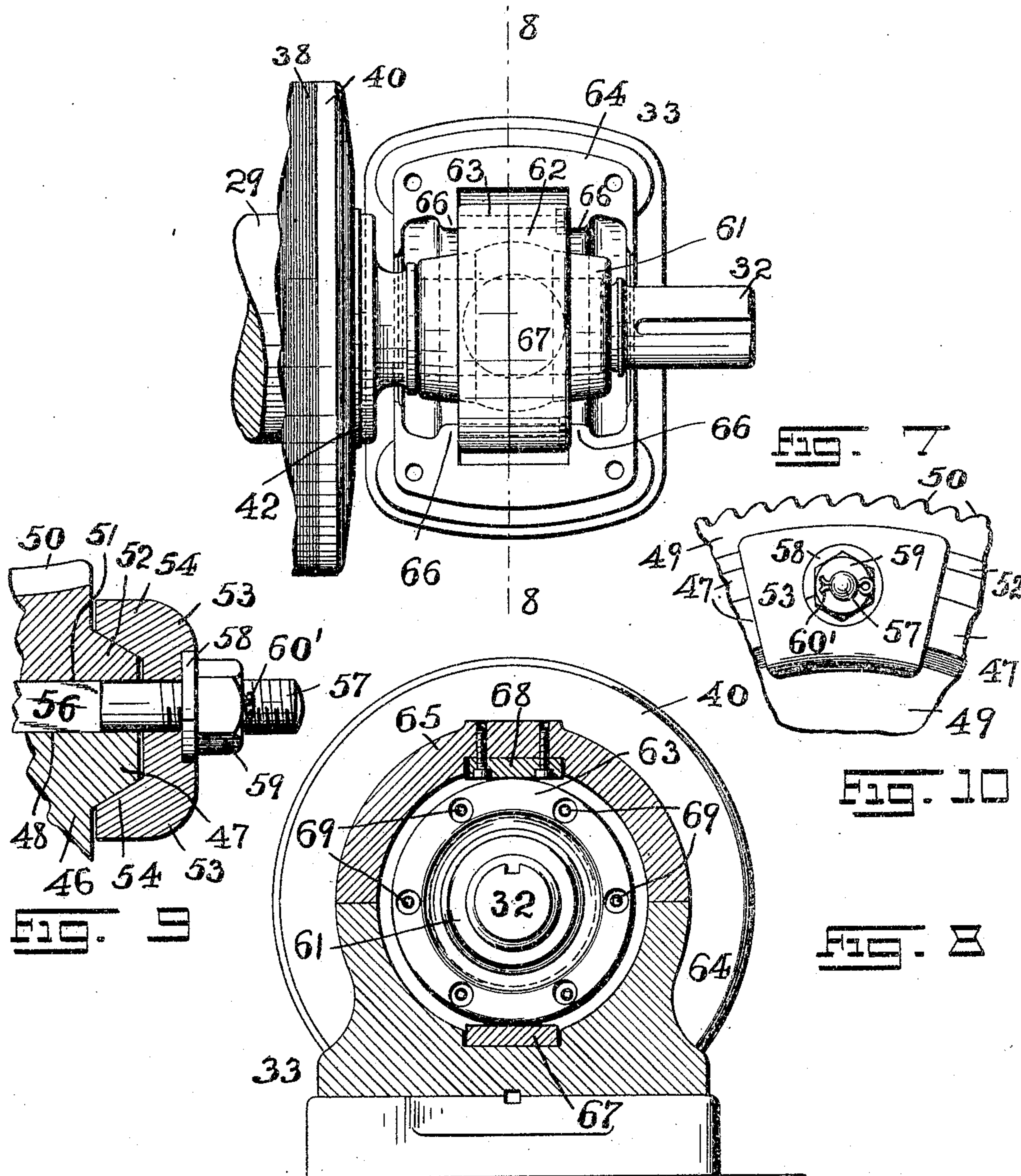
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No. 794,703.

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APPLICATION FILED JUNE 11, 1904.

6 SHEETS—SHEET 6.



WITNESSES:

Geo. D. Richards
W. B. Fraentzel

INVENTOR:

Malcolm Dickerson,
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UNITED STATES PATENT OFFICE.

MALCOLM DICKERSON, OF NEWARK, NEW JERSEY, ASSIGNOR OF EIGHTY ONE-HUNDREDTHS TO FREID ENGINEERING COMPANY, OF ORANGE, NEW JERSEY, A CORPORATION OF NEW JERSEY.

CRUSHING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 794,703, dated July 11, 1905.

Application filed June 11, 1904. Serial No. 212,088.

To all whom it may concern:

Be it known that I, MALCOLM DICKERSON, a citizen of the United States, residing at Newark, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Crushing Apparatus; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to characters of reference marked thereon, which form a part of this specification.

This invention relates generally to improvements in crushers; and the invention has for its principal object to provide an apparatus having crushing-rolls, and the special feature of these crushing-rolls lies in the manner and method of applying pressure by means of electromagnets in lieu of the general way of applying pressure in horizontal crushing-rolls mechanically by means of springs, which pressure has to be transmitted through the bearing-surfaces of the journals at a loss in efficiency due to friction.

A further object of this invention is a novel method of applying pressure to the crushing-surfaces of the rolls which shall be very simple and on account of the manner of application is most economical, as well as very efficient, and, furthermore, to provide an apparatus in which the pressure between the crushing-rolls is obtained by magnetic attraction which takes place on each side of the crushing-rolls, the points of greatest attraction being located on rotary poles at the points of contact between each pair of oppositely-located rotary poles and the shafts of the apparatus completing the yoke of the magnetic circuit, whereby by this means the evils of the pressure passing through the bearing-surfaces of the journals are eliminated, so that the bearings have to support only the dead-weight of the rolls.

The invention consists, primarily, in the novel crusher apparatus comprising electromagnetic compression crushing-rolls; and,

furthermore, this invention consists in the general arrangements and combinations of devices and parts, as well as in the details of the construction of the same, all of which will be more fully described in the following specification and then finally embodied in the clauses of the claim, which are appended to and form an essential part of this specification.

In brief, the general construction of the crushing apparatus embodying the principles of my present invention comprises a pair of main shafts supported in bearings, a crusher-roll upon each shaft, exciting-coils, which are preferably stationary and there being preferably two upon each shaft, such coils being supported by a non-magnetic element, and a pair of rolling poles upon each shaft, all arranged that one of the shafts and its parts revolves in fixed bearings or centers, while the other shaft has a movable axis to enable the rolls to accommodate themselves to variations of feed and also to allow any foreign matter, such as bolts or nuts or the like, to pass harmlessly through the machine.

The invention is clearly illustrated in the accompanying drawings, in which—

Figure 1 is a plan view of a crushing apparatus embodying the features of my present invention, with a certain hood or casing omitted from the said view. Fig. 2 is a front view of the apparatus, the hood or casing being represented in longitudinal vertical section; and Fig. 3 is an end view of the apparatus, with the said hood or casing represented in transverse vertical section. Fig. 4 is a longitudinal vertical section of the apparatus, said section being taken on line 4 4 in said Fig. 1, but representing the greater portion of the crusher-roll-carrying shaft in elevation. Fig. 5 is a vertical cross-section taken on line 5 5 in said Fig. 1, representing the crusher-rolls partly in elevation and partly in transverse vertical section. Fig. 6 is a transverse vertical section taken on line 6 6 in said Fig. 1 looking in the direction of the arrow *x*. Fig. 7 is a top view of one of the journals of the movable shaft arranged in a commulative bearing, the upper portion or

housing of the bearing having been omitted from the said view; and Fig. 8 is a transverse vertical section of the said bearing, said section being taken on line 8 8 in said Fig. 7, but the journal portion of the shaft and a pair of disks on said journal being represented in end elevation. Fig. 9 is a detail sectional representation of a portion of one of the crusher-rolls and one of its segmental crushing-sections and clamping device for securing the same in position, and Fig. 10 is a face view of the said parts represented in Fig. 9.

Similar characters of reference are employed in the above-described views to indicate corresponding parts.

Referring now to the several figures of the drawings, the reference character 1 indicates the complete apparatus or crusher, which is set upon a suitable base or foundation 2, comprising the preferably raised end portions 3, with a depressed portion 4 located between the said end portions 3, substantially as illustrated in Fig. 1 of the drawings. Suitably connected with the end portions 3 and extending across the depressed portion 4 of the foundation 2 are a suitable number of beams or supports 5 and preferably other beams or supports 6, between which are arranged and secured suitable cross plates or supports 7, carrying oppositely-placed angular plates or members 8, which form a discharging end or chute to the apparatus, as will be clearly understood from an inspection of the several figures of the drawings. The parts may be suitably secured in their operative positions by means of bolts and nuts 9 and 10, as represented in Figs. 5 and 6 of the drawings; but of course it will be understood that any other suitable means for the purpose of securing these parts may be employed, if desired. Secured upon the upper portions of the said beams or supports 5 and 6, by means of bolts 11 or other suitable fastening means, are a pair of casings or frames 12 and 13, both of which are closed, as at 14, and are respectively provided with centrally-disposed openings 15 and 16, the said opening 16 being of an elongated or elliptical configuration, as represented in Fig. 6 of the drawings. The said casing 12 is made with marginal flanges 17 and 18, and the casing 13 is made with marginal flanges 19 and 20, the flanges 18 and 20 being located against one another and being secured together by means of the bolts and nuts 21, substantially as illustrated; but it will be clearly evident that the said casings may be secured in their fixed positions in any other suitable manner and by the use of other fastening means. In like manner the opening 15 of the casing 12 is bounded by a marginal flange 22 and the opening 16 of the casing 13 is bounded by a marginal flange 23. It will be seen that by this arrangement each casing is made with an annular chamber, and suitably secured in each chamber, by means of suitably-con-

structed holding devices or brackets 24, is a stationary exciting-coil 25, the said coils being made of suitable wire, and the coils of wire being suitably wound with an insulating material 26, and those portions with which the holding devices or brackets 24 are brought in holding engagement, as an additional precaution against wear, being wound with coils or wrappings 27, of twine or rope or other similar insulating or non-magnetic material. These exciting-coils are stationary, as will be understood, and being arranged and secured in the annular chambers of the said casings 12 and 13 are thoroughly protected from contact with the flying pieces of material which is being crushed. The said casings 12 and 13 are also preferably made from manganese-steel, because it best withstands the wear due to the flying pieces of the material while passing through the crusher-rolls during the operations of the machine.

Coming now to the movable parts of the apparatus, these comprise two main shafts 28 and 29, the said shaft 28 having its journals 30 arranged to revolve in fixed boxes of any well-known construction of bearings 31, the other main shaft 29, however, having its journals 32 arranged to revolve in movable boxes of the bearings 33, so as to be capable also of a lateral movement in the manner to be presently described. The said shaft 28 extends through and revolves in the central opening 15 of the casing 12, and the said shaft 29 extends through and revolves in the central opening 16 of the casing 13, whereby the exciting-coils 25 are respectively concentric, or approximately so, with the said main shafts of the apparatus. Each main shaft, as will be seen from an inspection of the several figures of the drawings, has arranged upon its respective end portions between the said exciting-coils 25 and the journals of the shafts magnets or magnetic poles 34, 35, 36, and 37, respectively, each magnet or pole, as will be seen from an inspection of Fig. 4, being preferably composed of laminated sheets or disks 38, of electric steel or other suitable metal. The said sheets or disks 38 are strung upon each shaft and are kept from revolving independently of the revolutions of the said shafts by means of suitable keys 39 or other suitable holding means, and the said sheets or disks 38 are compressed longitudinally and are retained in position upon the respective end portions of the said shafts 28 and 29 by means of non-magnetic end plates or disks 40, one plate on each side of the assembled laminated disks or sheets. The said end plates are preferably made of manganese-steel; but other non-magnetic metal may be used, and the plates of each rolling pole are held in place upon the respective shafts by the plate 40 nearest the crushing-roll, being arranged against a shoulder 41 upon the shaft and the other end plate 40 nearest the bearing being held in

place by means of a circular spring-key 42, which is sprung into an annular groove 43, substantially as illustrated in said Fig. 4 of the drawings. As has been stated, the rolling magnets or poles are made up, preferably, of laminated sheets or disks 38, and the reason for laminating the rolling or rotary pole-faces is to reduce the Foucault currents; but of course it will be understood that I may otherwise construct the said rolling magnets or poles, if found desirable. The two pairs of fixed coils 25 arranged about the respective shafts 28 and 29 may be electrically connected in series or otherwise, according to the voltage of the electric current to be passed through them and when electrically excited cause a magnetic circuit through the shaft 29, through the rolling pole 37 at the left of the said shaft 29, (see Fig. 1 of the drawings,) this rolling pole being positive or of N polarity, as indicated, then passing to the rolling pole 35 next to it or to the left of the shaft 28, this pole being negative or of S polarity, the magnetic current then passing through the shaft 28 into the rolling pole 34 at the right of the said shaft 28, (see Fig. 1,) which becomes positive or of N polarity, and into the rolling pole 36 at the right of the shaft 29, which is negative or of S polarity, the magnetic circuit being completed through the shaft 29. The polarities of the rolling poles and the direction of the magnetic circuit are clearly indicated in Fig. 1 of the drawings. Thus the said rolling poles also serve as spacing-rolls, and by this method and arrangement I eliminate the evils of the pressure passing through the bearing-surfaces of the journals, so that the bearings have to support only the dead-weight of the crusher-rolls and shafts.

Referring now to Figs. 1, 2, 4, and 5 of the drawings, it will be seen that I have arranged upon the central portion of each main shaft 28 and 29 and between the casings 12 and 13 a pair of oppositely-located crusher-rolls 44 and 45. Each crusher-roll comprises an annular web 46 upon each main shaft, the said webs 46 being of any suitable width and being provided on opposite sides with annular ribs 47 and said webs 46 being provided also in their cylindrical faces with laterally-extending slots or channels 48. Suitably arranged upon the said cylindrical surfaces of the webs 46 are correspondingly-formed crusher sections or members 49, which are provided upon their outer convex faces with crusher teeth or serrations 50 and upon their inner concave faces with laterally-extending slots or channels 51. Each crusher section or member 49 is also provided with segmental rib portions 52 on opposite sides of the section and nearest the concave surface thereof. The said annular ribs 47 and segmental rib portions 52 are substantially of the configuration represented in Figs. 4 and 9 of the drawings and

are for the purpose of suitably receiving and retaining in place certain retaining-clamps 53, which are provided with the holding-jaws 54 and each clamp having an opening 55. That the said retaining-clamps 53 may be tightly bound upon the said annular ribs 47 and segmental rib portions 52 to thereby retain the several crusher-plates or wear-plate sections 49 in place, I have arranged in the openings of the retaining-clamps 53 and each pair of registering slots or channels 48 and 51 certain fastening or tightening bolts, substantially as illustrated. Each bolt is made with a main body 56 of an angular cross-section adapted to be fitted in the angular groove or channel formed by the slots 48 and 51, and with the screw ends 57, which extend from the openings 55 of the retaining-clamps 53 for the reception of washers 58 and nuts 59, whereby the parts are securely fastened in their operative positions, so that when the clamps 53 are applied and drawn tight by said bolts a continuous composite rib results, which, owing to its taper edges, holds all the pieces central, and the two complete crusher-rolls are produced, the same being arranged in their oppositely-located positions in the manner indicated more particularly in Fig. 5 of the drawings with the crusher-teeth or serrations 50 of the crusher sections or plates 49 arranged opposite each other, preferably as represented in said figure of the drawings. To minimize the wear and to increase the magnetic reluctance at these points, the said crushing plates or sections 49, as well as the retaining-clamps, are all preferably made of manganese-steel. A suitably-constructed hopper 60 is arranged directly above the two crusher-rolls, preferably in the manner represented in the dotted outline in Fig. 1 of the drawings and as illustrated in Figs. 2 to 6, inclusive, for feeding the material which is to be crushed directly between the crushing-sections of plates of the said rolls.

From the foregoing description it will be clearly evident that the crusher-plates 49 being segmental they can easily be replaced as they become worn or broken, and the bolts that bind the retaining-clamps in position also act as keys to prevent the said segmental crusher-plates from slewing on the shaft. The washers 58 upon the end portions 57 of the bolts are preferably lock-washers against which the nuts 59 are screwed down and are held in place by the split cotter-pins 60', passed through holes in the end portions of said bolts, as more clearly illustrated in Figs. 9 and 10 of the drawings. The crusher-teeth of the segmental crusher-plates are preferably made concave for the purpose of concentrating the ore or other material which is to be crushed between the rolls, and when viewed from the side the teeth of the segmental crusher-plates are preferably of the shape and configuration represented in the

drawings to secure a wide angle of bite. As has been previously stated, one of the crusher-rolls and its shaft, as 28, revolves in the fixed bearings 31, while the other crusher-roll and its shaft 29 revolves in the movable boxes of the bearings 33 that a lateral movement of said second crusher-roll may be the result, whereby the rolls automatically accommodate themselves to variations of feed and, furthermore, permit the passage of foreign matter—such as bolts, nuts, or nails—harmlessly through the machine.

Upon each journal 32 of the shaft 29 is a journal-box 61, which is carried by two disks 62 and 63, bolted together by means of bolts or screws 69, so as to form a wheel or roller upon each end of the said shaft 29. Each wheel or roller thus provided is operatively arranged between annular flanges 66 within the bottom housing 64 and the upper housing 65 of the bearing, the seat of each journal-box being spherical, as represented in Fig. 4 of the drawings, to permit of the alinement of the bearings in all positions of the shaft 29. The said supporting wheel or roller formed by the disks 62 and 63 in each bearing 33 rides upon a removable disk or plate 67 at the bottom of the housing 64, and a corresponding disk or plate 68 is bolted to the top of the upper housing 65, preferably in the manner illustrated in Figs 4, 7, and 8 of the drawings. These disks or plates 67 and 68 form the bottom and top boundaries for each wheel or roller, the arrangement and construction of the parts being such that an easy rolling movement of the wheel or roller within the housings of the bearings 33 is permitted to enable the proper movement laterally of the said shaft 29 and its crusher-roll, the bore of the housings being larger than the wheel, as may be found desirable and as will be seen from an inspection of said Fig. 8. The housings of the various bearings are suitably connected and secured in any usual manner, and the bearings are secured in their respective positions upon the end foundations in any well-known manner.

Suitable shells or housings 70 may be arranged about the rolling poles of the apparatus, as clearly indicated in Fig. 2 of the drawings, as a precautionary measure and protection against injury from dust and flying particles of the material which is being crushed.

The many advantages of the crushing apparatus are clearly evident from the foregoing description of my invention and need not be further dwelt upon.

I am aware that changes may be made in the arrangements and combinations of the various devices and parts, as well as in the details of the construction of the said parts without departing from the scope of my present invention. Hence I do not limit my invention to the exact arrangements and combinations of the devices and parts as described in

the previous specification and as illustrated in the accompanying drawings, nor do I confine myself to the exact details of the construction of any of the said parts.

Having thus described my invention, what I claim is—

1. The combination, with main operating-rolls arranged upon separate shafts revolving in the same plane, one of said rolls and its shaft having a pure rotary motion, and the other roll and its shaft being slidably mounted so as to be capable of a lateral motion in the plane passing through the central axes of the said shafts, and an electromagnet encircling each shaft, said electromagnets having their central axes in the same plane passing through the central axes of the said shafts, and the electromagnet on the one shaft being located directly opposite the electromagnet upon the other shaft, substantially as and for the purposes set forth.

2. The combination, with main operating-rolls arranged upon separate shafts revolving in the same plane, one of said rolls and its shaft having a pure rotary motion, and the other roll and its shaft being slidably mounted so as to be capable of a lateral motion in the plane passing through the central axes of the said shafts, electromagnets encircling said shafts, said electromagnets having their central axes in the same plane passing through the central axes of the said shafts, and comprising fixed energizing-coils having central openings through which the shafts of said rolls extend, substantially as and for the purposes set forth.

3. The combination, with a pair of main operating-rolls, arranged upon separate shafts revolving in a horizontal plane, one of said rolls and its shaft having a pure rotary motion, and the other roll and its shaft being slidably mounted so as to be capable of a lateral motion in the said horizontal plane passing through the central axes of the said shafts, and a pair of electromagnets encircling each shaft on opposite sides of the respective rolls, said electromagnets having their central axes in the same horizontal plane passing through the central axes of the said shafts, and the electromagnets on the one shaft being located directly opposite the electromagnets upon the other shaft, substantially as and for the purposes set forth.

4. The combination, with a pair of main operating-rolls, arranged upon separate shafts revolving in a horizontal plane, one of said rolls and its shaft having a pure rotary motion, and the other roll and its shaft being slidably mounted so as to be capable of a lateral motion in the said horizontal plane passing through the central axes of the said shafts, a pair of electromagnets encircling each shaft on opposite sides of the respective rolls, said electromagnets having their central axes in the same horizontal plane passing

through the central axes of the said shafts, and comprising fixed energizing-coils having central openings through which the shafts of said rolls extend, substantially as and for the purposes set forth.

5. In a crushing apparatus, the combination, with a pair of crusher-rolls, one of said rolls having a pure rotary motion and the other roll having a rotary motion and also capable of a lateral movement, of rolling electromagnetic poles relatively connected with said crusher-rolls for applying pressure to said rolls and also serving as spacing-rolls, substantially as and for the purposes set forth.

6. The combination, with a pair of main operating-rolls, and their shafts, of rolling magnets relatively connected with the said shafts so as to roll opposite each other, substantially as and for the purposes set forth.

7. In a crushing apparatus, the combination, with a pair of crusher-rolls, one of said rolls having a pure rotary motion and the other roll having a rotary motion and also capable of a lateral movement, of rolling electromagnetic poles relatively connected with said crusher-rolls for applying pressure to said rolls and also serving as spacing-rolls, and means for energizing said electromagnetic poles, consisting of fixed energizing-coils located on opposite sides of said crusher-rolls, substantially as and for the purposes set forth.

8. The combination, with a pair of main operating-rolls, and their shafts, of a pair of rolling magnets located upon each shaft, one magnet being upon each side of a roll, and all arranged that the rolling magnets upon the two shafts will be located opposite each other in pairs, substantially as and for the purposes set forth.

9. In a crushing apparatus, the combination, with a crusher-roll and its shaft journaled in fixed bearings, of a second crusher-roll and shaft, all revolving in the same plane passing through their central axes, a roller device on the journal portions of said shaft, bearings in which the said roller devices are movably arranged, and electromagnets encircling said shafts for producing a lateral movement of said second crusher-roll and applying pressure to said rolls, said electromagnets having their central axes in the same plane passing through the central axes of said shafts, substantially as and for the purposes set forth.

10. In a crushing apparatus, the combination, with a crusher-roll and its shaft journaled in fixed bearings, of a second crusher-roll and shaft, all revolving in the same plane passing through their central axes, a roller device on the journal portions of said shaft, bearings in which the said roller devices are movably arranged, electromagnets encircling said shafts for producing a lateral movement of said second crusher-roll and applying pressure to said rolls, said electromagnets having

their central axes in the same plane passing through the central axes of said shafts, and comprising fixed energizing-coils encircling the said shafts and located on opposite sides of said crusher-rolls, substantially as and for the purposes set forth.

11. In a crushing apparatus, the combination, with a pair of oppositely-placed shafts, each shaft carrying a crusher-roll, of a cylindrical electromagnet upon each shaft said electromagnets having their cylindrical surfaces arranged opposite each other, for applying pressure to said shafts and their crusher-rolls, substantially as and for the purposes set forth.

12. In a crushing apparatus, the combination, with a pair of oppositely-placed shafts, each shaft carrying a crusher-roll, of a cylindrical electromagnet upon each shaft said electromagnets having their cylindrical surfaces in close rolling relation opposite each other, for applying pressure to said shafts and their crusher-rolls, and comprising fixed energizing-coils encircling the said shafts, substantially as and for the purposes set forth.

13. In a crushing apparatus, the combination, with a pair of crusher-rolls, one of said rolls having a fixed rotary motion and the other roll having a rotary motion and also capable of a lateral movement, of electromagnets rotatively connected with said crusher-rolls for applying pressure to said rolls, and comprising fixed energizing-coils, and stationary casings, an energizing-coil being arranged in each casing, the said casings forming housings for said electromagnets and having a closed side between each roll and each magnet, substantially as and for the purposes set forth.

14. In a crushing apparatus, the combination, with a pair of crusher-rolls, one of said rolls having a fixed rotary motion and the other roll having a rotary motion and also capable of a lateral movement, of electromagnets rotatively connected with said crusher-rolls for applying pressure to said rolls, and comprising fixed energizing-coils, and stationary casings, an energizing-coil being arranged in each casing, the said casings forming housings for said electromagnets and having a closed side between each roll and each magnet, and means for securing each coil in its housing consisting of brackets 24, substantially as and for the purposes set forth.

15. In a crushing apparatus, the combination, with a pair of crusher-rolls, one of said rolls having a fixed rotary motion and the other roll having a rotary motion and also capable of a lateral movement, of electromagnets rotatively connected with said crusher-rolls for applying pressure to said rolls, and comprising fixed energizing-coils, and stationary casings, each casing having a central opening and marginal flanges surrounding said openings and the outer edges of said casings, all forming a chamber in each casing, and an energizing-

coil secured to each casing and arranged in the chamber thereof, substantially as and for the purposes set forth.

16. In a crushing apparatus, the combination, with a shaft, of a crusher-roll on said shaft, consisting, essentially, of an annular web on said shaft, segmental crusher-plates on said web, said web and segmental crusher-plates being provided with oppositely-placed slots, retaining-clamps on opposite sides of said annular web and said crusher-plates, said clamps being provided with perforations, and tightening-bolts in said perforations and said slots, each bolt having an angular body portion and screw ends extending from said retaining-clamps, and a tightening-nut upon each screw end, substantially as and for the purposes set forth.

17. In a crushing apparatus, the combination, with a pair of shafts, of an electromagnet upon each shaft, and a crusher-roll on each shaft, consisting, essentially, of an annular web on each shaft, segmental crusher-plates on said web, said web and segmental crusher-plates being provided with oppositely-placed slots, and said web and said segmental crusher-plates having rib portions extending from their sides, retaining-clamps on opposite sides of said rib portions, said clamps being provided with perforations, and tightening-bolts in said perforations and slots, substantially as and for the purposes set forth.

18. In a crushing apparatus, the combination, with a crusher-roll and its shaft journaled in fixed bearings, of a second crusher-roll and shaft, a roller device on the journal portions of said shaft, and bearings, each bearing comprising a bottom and a top housing, a disk in the bottom housing and a disk in the top housing forming bottom and top boundaries, respectively, between which the roller devices are movably arranged, and electromagnets on said shafts for producing a lateral movement of said second crusher-roll and its shaft and applying pressure to said rolls, substantially as and for the purposes set forth.

19. In a crushing apparatus, the combination, with a crusher-roll and its shaft journaled in fixed bearings, of a second crusher-roll and shaft, a roller device on the journal portions

of said shaft, and bearings, each bearing comprising a bottom and a top housing, a disk in the bottom housing and a disk in the top housing forming bottom and top boundaries, respectively, between which the roller devices are movably arranged, and electromagnets on said shafts for producing a lateral movement of said second crusher-roll and its shaft and applying pressure to said rolls, substantially as and for the purposes set forth.

20. In a crushing apparatus, the combination, with a crusher-roll and its shaft journaled in fixed bearings, of a second crusher-roll and shaft, a roller device on the journal portions of said shaft, and bearings, each bearing comprising a bottom and a top housing, a disk in the bottom housing and a disk in the top housing forming bottom and top boundaries, respectively, between which the roller devices are movably arranged, and electromagnets on said shafts for producing a lateral movement of said second crusher-roll and its shaft and applying pressure to said rolls, said electromagnets comprising energizing-coils encircling the said shafts and located on opposite sides of said crusher-rolls, substantially as and for the purposes set forth.

21. A crushing apparatus comprising a foundation and supporting-beams, casings upon said beams, each casing having a central opening, an energizing-coil secured to each casing, bearings upon said foundations, a pair of shafts, one of said shafts having a fixed revoluble motion in one set of said bearings, roller devices upon the journal portions of said other shaft, said roller devices being arranged in the housing of said other set of bearings and capable of a lateral movement in said bearings, a crusher-roll upon each shaft, and rolling electromagnetic poles on said shafts energized from said energizing-coils, substantially as and for the purposes set forth.

In testimony that I claim the invention set forth above I have hereunto set my hand this 28th day of May, 1904.

MALCOLM DICKERSON.

Witnesses:

FREDK. C. FRAENTZEL,
GEO. D. RICHARDS.