963,353.

J. E. BLAKE.

REDUCTION MACHINE.

APPLICATION FILED MAR. 17, 1909.

Patented July 5, 1910.

3 SHEETS—SHEET 1.

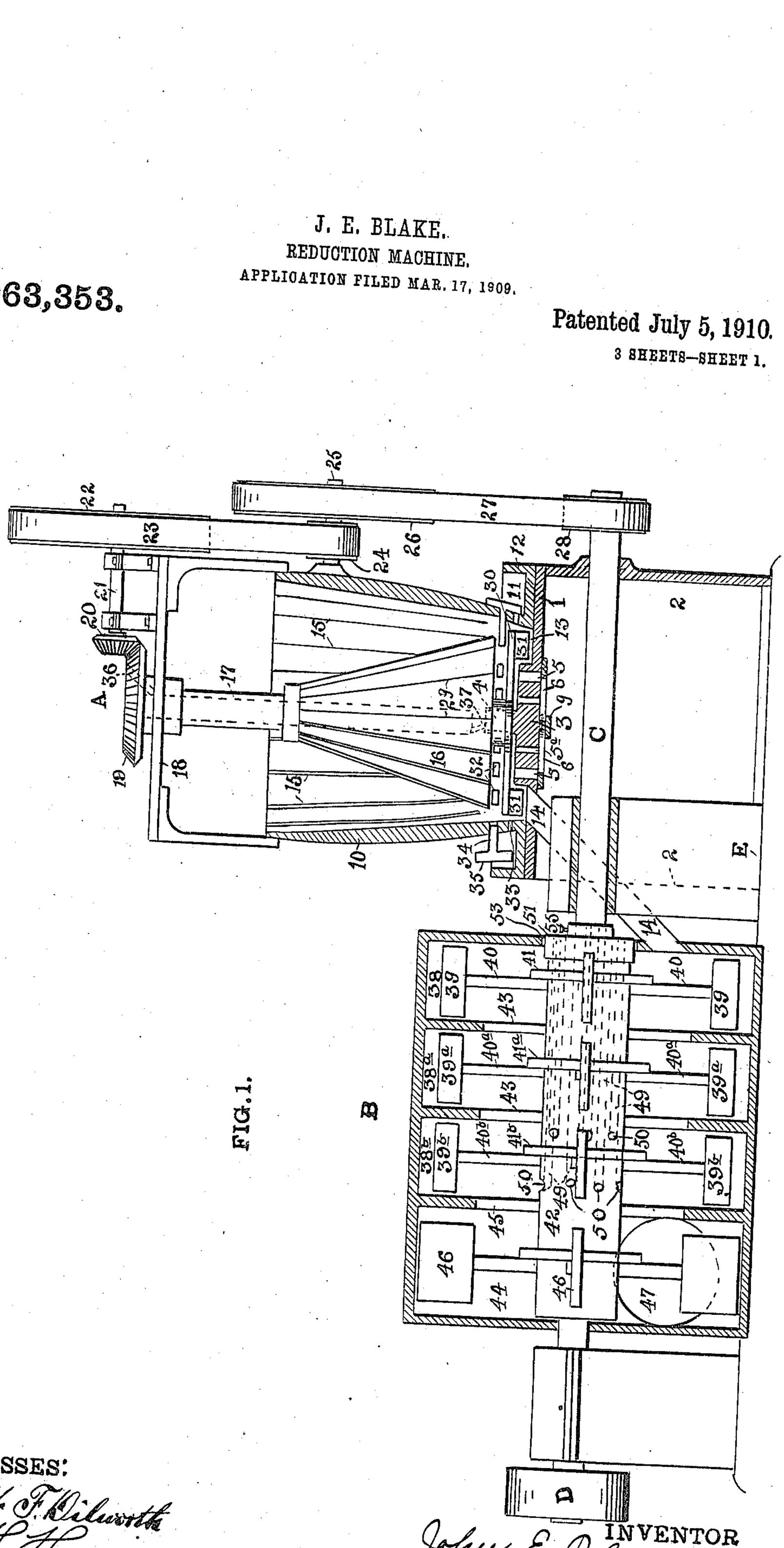


FIG. 1.

WITNESSES:

Robt. F. Dilworth

J. H. Harrison

INVENTOR

John E. Blake,

BY Edward A. Lawrence,

HIS ATTORNEY

963,353.

J. E. BLAKE.

REDUCTION MACHINE.

APPLICATION FILED MAR. 17, 1909.

Patented July 5, 1910.

3 SHEETS—SHEET 2.

FIG. 2.

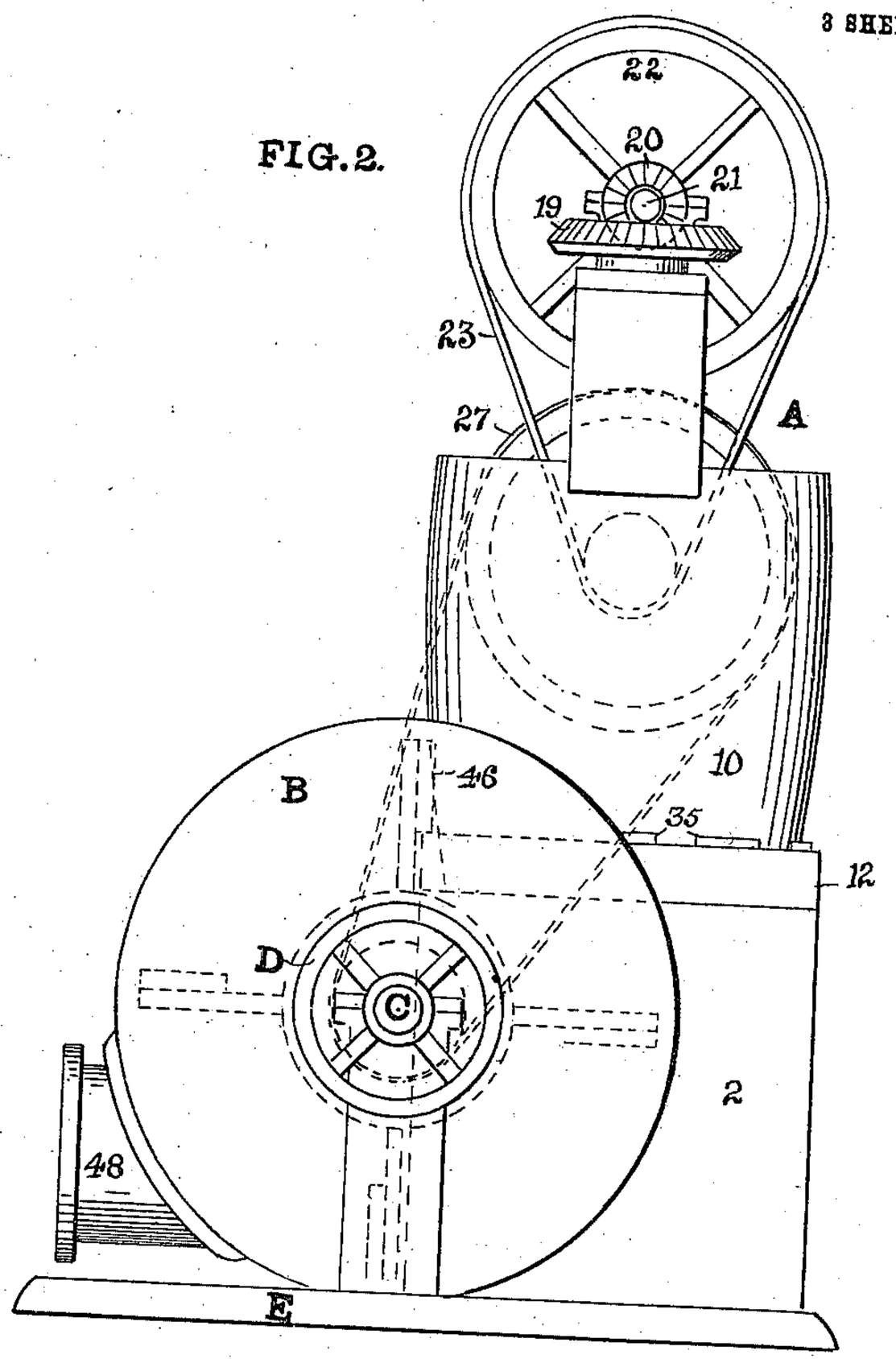


FIG. 3.

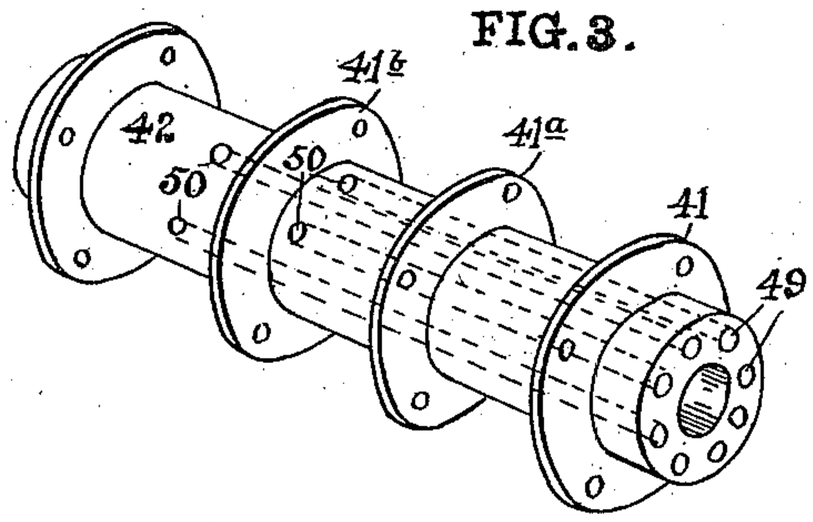
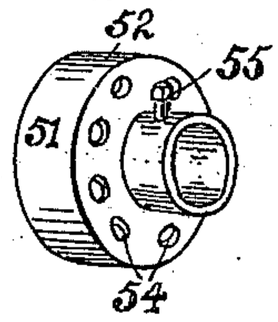


FIG. 4.



WITNESSES:

Robt F. Dilworth

J. H. Harrison

INVENTOR

John E. Blake,

BY Edward A. Laurence.

HIS ATTORNEY

J. E. BLAKE.

REDUCTION MACHINE.

APPLICATION FILED MAR. 17, 1909.

963,353.

Patented July 5, 1910.

3 SHEETS—SHEET 3.

FIG. 5.

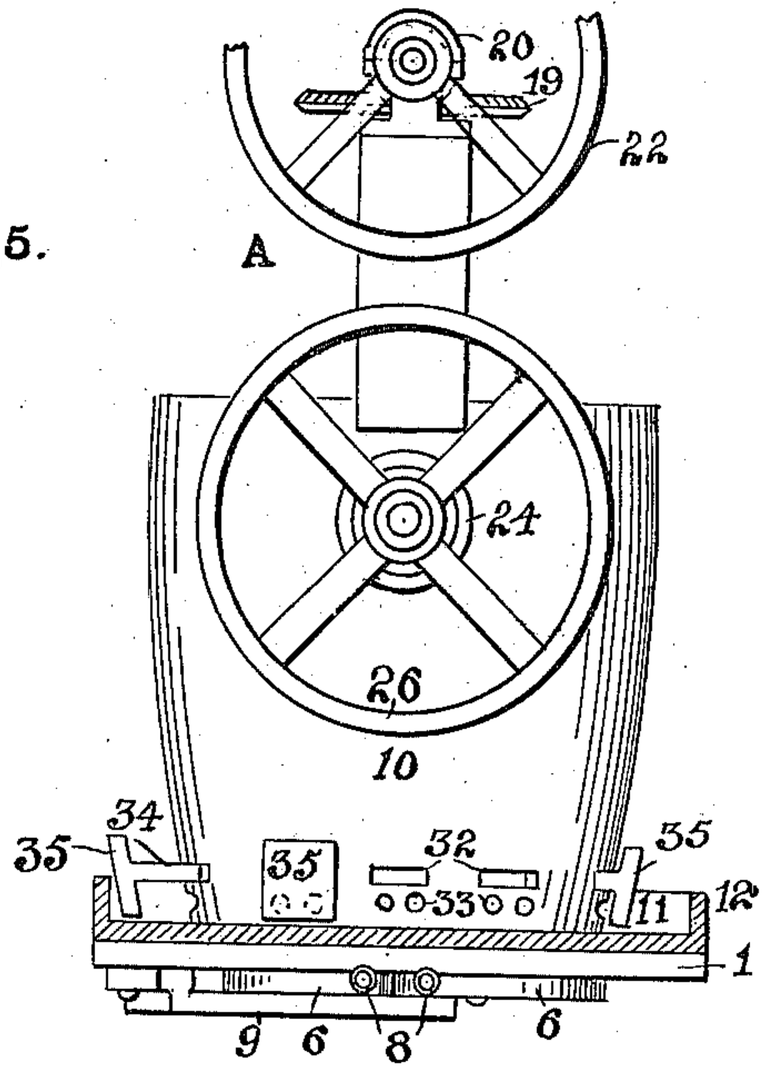


FIG. 6.

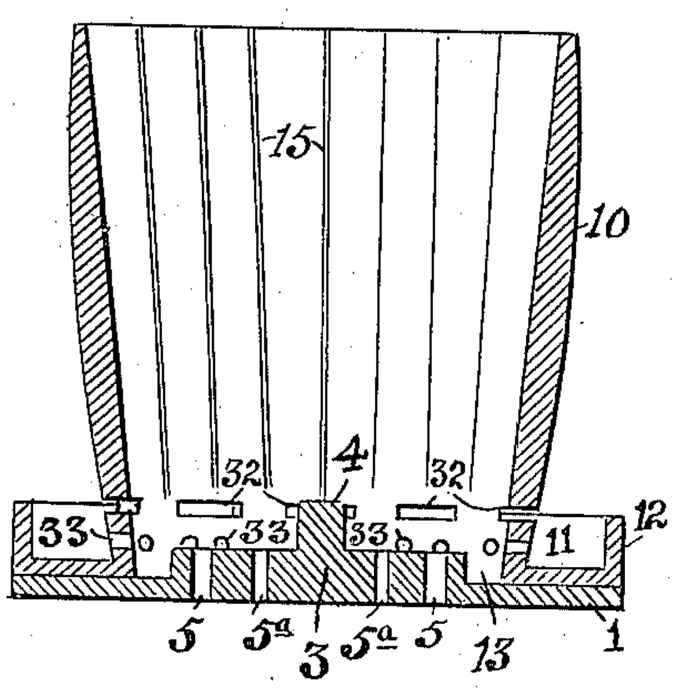
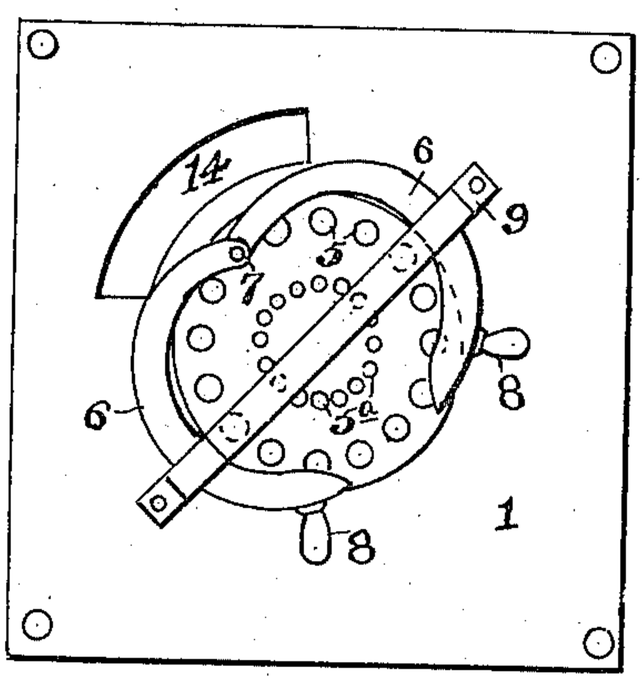


FIG. 7.



WITNESSES:

Robt F. Dilworth

J. H. Hamsoy

INVENTOR

John E. Blake,

BY Edward A. Lawrence.

HIS ATTORNEY

UNITED STATES PATENT OFFICE.

JOHN E. BLAKE, OF PITTSBURG, PENNSYLVANIA, ASSIGNOR TO BLAKE CRUSHER AND PULVERIZER COMPANY, OF PITTSBURG, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

REDUCTION-MACHINE.

963,353. Specification of Letters Patent. **Patented July 5, 1910.**

Application filed March 17, 1909. Serial No. 483,885.

To all whom it may concern:

Be it known that I, JOHN E. BLAKE, a citizen of the United States, and residing in the city of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented or discovered new and useful Improvements in Reduction-Machines, of which the following is a specification.

My invention relates to a new and improved machine or mechanism for pulverizing or reducing material or substances to a fine or impalpable powder.

It is more particularly intended for pulverizing combustible material, such as coal or coke, and intermingling the same with the necessary amount of air to produce the desired combustion.

I show new and improved means for regulating the amount of granulated material admitted to the pulverizer, and for regulating the amount of air intermingled with said material during its granulation.

Many novel constructions and arrangements of parts will appear from the following description.

In the accompanying drawings, which are, however, merely illustrative of a practical embodiment of the principles of my invention and not intended to limit the scope thereof to the constructions shown, Figure 1 is a longitudinal section of the complete machine, portions being shown in full lines for the sake of clearness; Fig. 2 is an end elevation of the machine, looking toward the right in Fig. 1; Fig. 3 is a detail perspective of the hub upon which the pulverizing paddles and fan are mounted; Fig. 4 is a similar view of the cap for the end of said hub; Fig. 5 is an end elevation of the granulating mechanism looking toward the left in Fig. 1; Fig. 6 is a vertical section of the granulator barrel and base plate, and Fig. 7 is an inverted plan of the base plate.

The following is a detailed description of the drawings.

The machine in general is composed of two main operative elements, viz., the granulating mechanism A, and the pulverizing mechanism B which receives the granulated material from element A. Both A and B are shown as power-driven from the main shaft C which is provided with a band wheel D by means of which said shaft may be coupled to any suitable source of power, not shown.

E is the bed of the machine from which the main shaft C is journaled horizontally, and upon which the elements A and B are mounted.

I will first describe the granulating mechanism, A.

1 is the base plate horizontally supported in any convenient manner from bed E, as by open frame 2—2 which permits a free circulation of air under plate 1.

3 is an annular table upwardly extending from and, preferably, integral with plate 1, and axially provided with a cylindrical boss 4.

5—5 represent an annular series of holes extending up through table 3, and 5^a—5^a represent a second series of holes concentric with series 5—5.

6—6 are a pair of substantially semi-annular plates, pivoted, as at 7, to the under face of plate 1, and adapted, when drawn together with their free ends abutting, to close the series of holes 5—5 against the upward passage through said holes of air. It is evident that a partial closing of plates 6—6 will partially close the holes 5—5, so that the amount of air admitted through said holes 5—5 may be adjusted to a nicety. Handles 8—8 may be provided to facilitate the adjustment of said plates 6—6. To maintain said plates in their proper horizontal position, close against the under surface of plate 1, I prefer to provide a support or strap, 9, attached at both ends to said plate 1 and upwardly supporting the plates 6—6.

10 is the granulator barrel, preferably of the contour shown, and open at both ends. The bottom of the barrel is provided with an outwardly extending horizontal flange 11 which is preferably annular and provided at its edge with an upwardly turned lip, 12. The barrel is mounted on plate 1 and may be secured thereto by any convenient means, such as bolts passing through flange 11 and plate 1, not shown. The bottom diameter of the barrel is greater than that of the table 3, thus providing between said barrel and

said table an annular trough or depression, 13.

14 is an inclosed chute or passage leading from a point in the bottom of said trough 13 to the pulverizing mechanism B.

15—15 represent longitudinal, angular ribs on the interior wall of the barrel 10 assisting in the granulating process.

16 is the rotatable cone member of the granulating mechanism, which is adapted to be vertically seated in barrel 10.

17 is the axial shaft of cone 16 and is provided at its lower end with a cylindrical seat which fits down over the central boss 4 of table 3, thus rotatably supporting said cone. The upper end of said shaft 17 extends up through a journal in the frame 18 carried by barrel 10 and is provided at its upper end with a beveled gear 19 which meshes with a similar gear 20 mounted on the horizontal shaft 21 journaled on the frame 18. 22 is a large pulley on the other end of shaft 21 operatively connected by belt 23 to a small pulley 24 mounted on spur shaft 25 journaled in the barrel 10. 26 is a large pulley mounted on said shaft 25 and operatively connected by belt 27 to small pulley 28 mounted on main shaft C. It will thus be seen that the cone 16 will be rotated from the main shaft C but at a reduced speed as compared with the speed of said shaft.

29—29 are vertical, angular ribs on cone 16 adapted to assist in granulating the material passed through the granulating mechanism.

30—30 are horizontal arms mounted on axial shaft 17 below cone 16 and provided at their extremities with scrapers 31—31 which travel in trough 13 when the shaft 17 rotates, thus assisting in depositing the material, precipitated into said trough, in chute 14.

32—32 represent an annular series of horizontally slotted openings in the wall of barrel 10 just below the level of the bottom of cone 16, and 33—33 represent an annular series of air holes located below said slots, preferably two of such holes below each of said slots.

34—34 represent slides which are adapted to be introduced into slots 32—32 and extend, when in their innermost positions, across the space between the barrel and the cone and underneath the bottom of the cone, thus reducing the opening between the barrel and cone down which the granulated material must drop to reach the trough 13. It is evident that the quantity of granulated material which is delivered to the pulverizer B may be controlled by the adjustment of the slides 34—34.

35—35 represent the heads of the slides 34—34, which are preferably shaped to fit snugly against the contour of the outer surface of the barrel 10 when said slides are completely closed, covering the mouths of the air holes 33—33 and preventing the admission of air therethrough to the interior of the barrel. The outward movement of slides 34—34 is limited by lip 12 which prevents the accidental displacement of the slides from their seats in slots 32—32.

The object of introducing air into the granulating mechanism A is to dry the output of such mechanism before it is admitted to the pulverizing mechanism B. A large percentage of moisture is contained in the fuel, such as run-of-mine coal, which, if permitted to remain, causes the coal to clog or gum, thus delaying the pulverizing of the fuel and impairing the quality of the output of the pulverizing mechanism. By the admission of the proper quantity of air into the output of the granulating mechanism before it is admitted to the pulverizing mechanism, the material is admitted to the pulverizing mechanism in the proper condition to respond properly to treatment, thus greatly expediting and aiding the pulverizing process. The slides 34—34 are of sufficient length and when closed extend sufficiently far beneath the cone 16, that they may be drawn outwardly sufficiently to uncover the air holes 33—33 without withdrawing the ends of the slides from beneath cone 16 or increasing the output of the granulator.

36 is an oil hole for the lubrication of the journal in frame 18 through which shaft 17 passes, and 37 is a similar oil hole through the block in the interior of the hollow shaft 17 which forms the top of the seat for boss 4, thus providing convenient means for oiling the lower bearing of shaft 17.

I will now describe the pulverizing mechanism, B, which receives the product of the granulating mechanism, A, and reduces it to a fine powder.

The pulverizing mechanism is preferably of the general type and construction shown, and contains one or more paddle drums, 38, 38^a and 38^b, in which are operated the pulverizing paddles 39—39, 39^a—39^a, and 39^b—39^b, respectively, mounted on arms 40—40, 40^a—40^a, and 40^b—40^b, which are in turn secured, respectively, to circumferential flanges 41, 41^a and 41^b on the hub 42 which is keyed or otherwise secured to the main shaft C.

43—43 represent axial openings surrounding hub 42 and establishing communication between the paddle drums 38, 38^a and 38^b.

44 is the fan drum adjacent to the paddle drum 38^b with which it communicates by means of axial opening 45 surrounding hub 42. Said fan sucks the air and material through the granulating and pulverizing mechanisms and discharges the same through the perimetral opening 47 in the drum 44

into the pipe or flue 48 which in turn discharges the same into the combustion chamber or fire box of the furnace.

It is advantageous to add to the pulverized material an additional supply of air before it is delivered to the combustion chamber. This auxiliary supply is preferably added before the completion of the pulverizing process. To effect this I provide the hub 42 with a series of longitudinal passages 49—49, extending from the front end of the hub 42, viz., the end toward the granulating mechanism A, to within the paddle drum 38^b, into which drum they discharge by means of radial ports 50—50 preferably placed alternately on either side of the flange 41^b so as to distribute the air evenly throughout the drum. If desired, these, or similar passages may be caused to discharge into either or both of the other paddle drums but I find that a better result is obtained by leading the auxiliary air supply into the last paddle drum. If desired said auxiliary air supply may be led directly into the fan drum but the arrangement illustrated is preferred. I prefer to separate the individual members of the passages 49—49 by a distance substantially equal to their diameter. To control the admission of air into the mouths of said passages 49—49, I rotatably mount on shaft C the cap 51 which is provided with an annular flange 52 which extends through the axial opening 53 in the end wall of drum 38 and over the end of the hub 42. The face of cap 51 is provided with an annular series of holes 54—54, corresponding in size, number and arrangement with the mouths of passages 49—49. It is evident that when the cap 51 is turned into the proper position, the holes 54—54 register with said passages 49—49, thus admitting a full supply of air to said passages. By turning the cap 51 the supply of air may be completely cut off from said passages, or reduced or increased, as occasion may demand. To enable the cap to be secured in any position to which it may be turned, a set screw 55 may be provided to engage the shaft C.

The operation of my invention is as follows: The material in the condition in which it is obtained from the mine or other source of supply is dumped into the top of barrel 10 and is granulated between the inner wall of barrel 10 and cone 16, dropping down between said barrel and cone into the trough 13, whence it is drawn by means of the fan suction and the action of scrapers 31—31 into the chute 14 which delivers it to pulverizing mechanism B. The action of the fan 46 draws air in through holes 5—5, 5^a—5^a, and 33—33 and into the pulverizer with the granulated material. The material, mixed with the air is passed successively through each of the paddle drums 38, 38^a and 38^b, wherein it is reduced to an impalpable powder, a further supply of air being introduced into the product in the paddle drum 38^b, said auxiliary air supply being drawn in through passages 49—49 by the action of fan 46. The product is thence sucked out into the fan drum 44 and expelled through pipe 48 into the combustion chamber of the furnace. The result is that a highly combustible mixture of carbon and oxygen is driven into the combustion chamber. As it is not necessary to operate the granulating mechanism at as great a speed as that required for the pulverizing mechanism, some means, such as the arrangement of belts and pulleys shown, is provided to reduce the rotary motion applied to the cone 16. It is necessary to regulate the amount of granulated material admitted to the pulverizing mechanism. This is accomplished by the adjustment of the slides 34—34, a sufficient number of the same being closed so that only the quantity of material required will escape from between the barrel and the cone and drop into trough 13. It is also important that the exact amount of air be admitted to the machine to provide a proper mixture of carbon and oxygen at the discharge. This may be easily accomplished by the regulation of the means provided and described for the various air admissions. Thus I prefer at all times to admit sufficient air through passages 49—49 to add to the material an additional supply of oxygen during the pulverizing process, but by turning the cap 51 to the proper position, such auxiliary supply of air may be increased, decreased or shut off when desired. When the minimum quantity of material is being precipitated into trough 13, and the minimum amount of air is to be mingled with the product, I close all the air entrances except the holes 5^a—5^a in the table 3, sufficient air being admitted through said holes 5^a—5^a to the machine. When an additional quantity of air is desired, the slides 34—34 may be withdrawn slightly so as to uncover a sufficient number of air holes 33—33, but not sufficiently to withdraw the inner ends of the slides 34—34 from beneath the cone 16 and thus increase the quantity of material precipitated into trough 13. It is thus evident that the quantities and proportions of granulated material and air may be regulated to a nicety to suit the circumstances, so that any required heat or combustion can be readily obtained. In case pieces of iron or other substances not pulverizable by the machine are present in the material to be treated, they are readily discovered in the granulating mechanism, and the same may be stopped by throwing the belt for the removal of the obstructions or objectionable substances. This may be accomplished with-

out the cessation of the pulverizing mechanism which may continue to operate, supplying its product to the combustion chamber so that the fire may be sustained until the granulating mechanism is again started.

It is evident from the above that my machine is well balanced, the steps to the operation being distributed in such a manner that the best results and greatest efficiency are obtained, with the minimum of power and wear to the machine.

Although, for the sake of clearness, I have minutely described the accompanying drawings, I do not wish to limit myself thereby but claim broadly:—

1. In a granulating mechanism of the character described, means for regulating the output of said mechanism, means for the lateral admission of air into said mechanism controlled by said first mentioned means and a perforated bottom for the upward admission of air into said mechanism.

2. In a granulating mechanism of the character described, means for regulating the output of said mechanism, means for the lateral admission of air into said mechanism controlled by said first mentioned means, means for the upward admission of air through the bottom of said mechanism and a sliding shutter for regulating said upward admission.

3. In a granulating mechanism of the character described, means for admitting air into said mechanism and combined slidable means for controlling the output of said mechanism and controlling said air admission means.

4. In a granulating mechanism of the character described, the combination of means for the admission of air into the product being treated in the mechanism, slidable means for regulating the product of said mechanism, and means whereby the air admission means are controlled by said slidable means without increasing the output of said mechanism above its minimum, for the purpose described.

Signed at Pittsburg, Pa., this 16th day of March, 1909.

JOHN E. BLAKE.

Witnesses:
E. A. LAWRENCE,
J. H. HARRISON.