

No. 875,332.

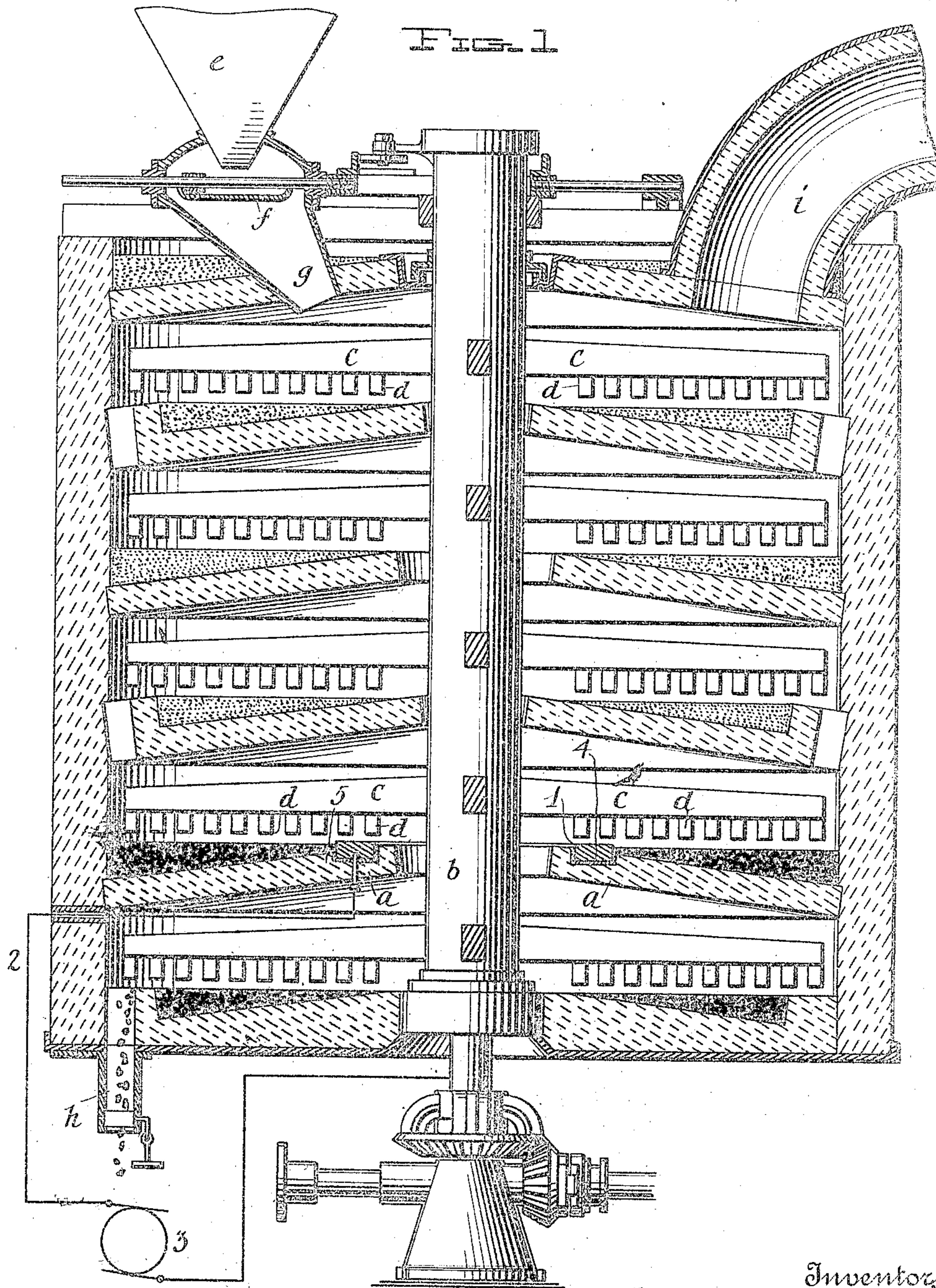
PATENTED DEC. 31, 1907.

A. J. DULL & J. WEATHERBY, JR.

PROCESS OF DESULFURIZING AND AGGLOMERATING COMMINUTED ORES.

APPLICATION FILED FEB. 4, 1907.

2 SHEETS—SHEET 1.



Witnesses
24 Feb 1908
C. H. Giesbauer.

Inventors
Andrew J. Dull and
Joseph Weatherby, Jr.
by *A. B. Wilson & Co*
Attorneys

No. 875,332.

PATENTED DEC. 31, 1907.

A. J. DULL & J. WEATHERBY, JR.

PROCESS OF DESULFURIZING AND AGGLOMERATING COMMINUTED ORES.

APPLICATION FILED FEB. 4, 1907.

2 SHEETS—SHEET 2.

FIG. 2

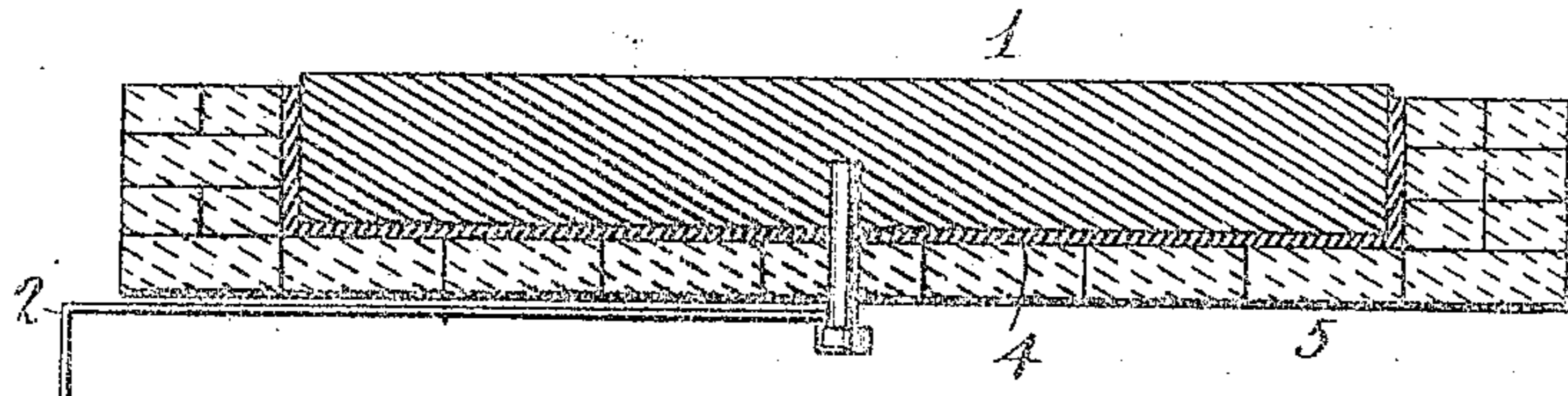


FIG. 3

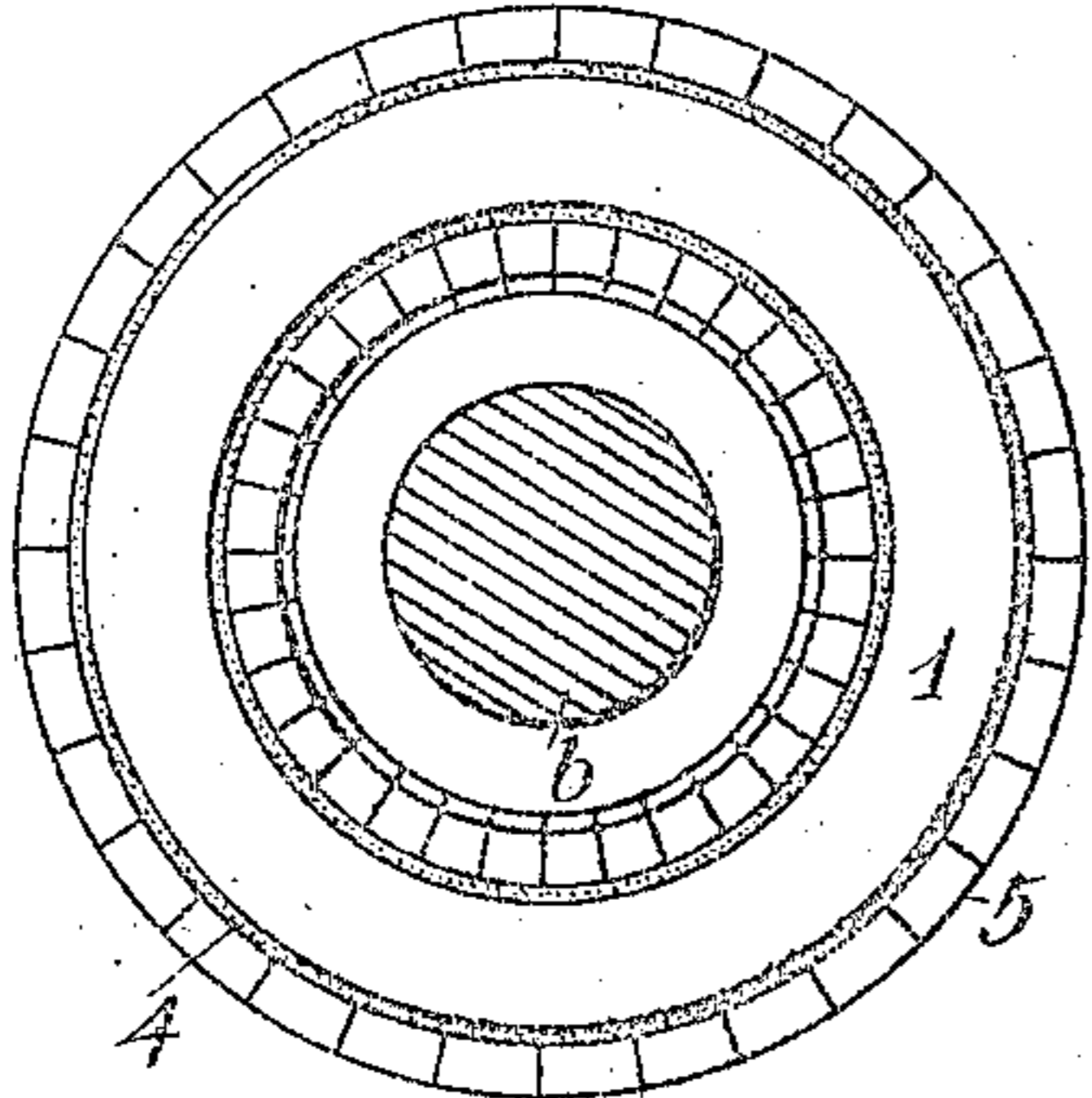


FIG. 4

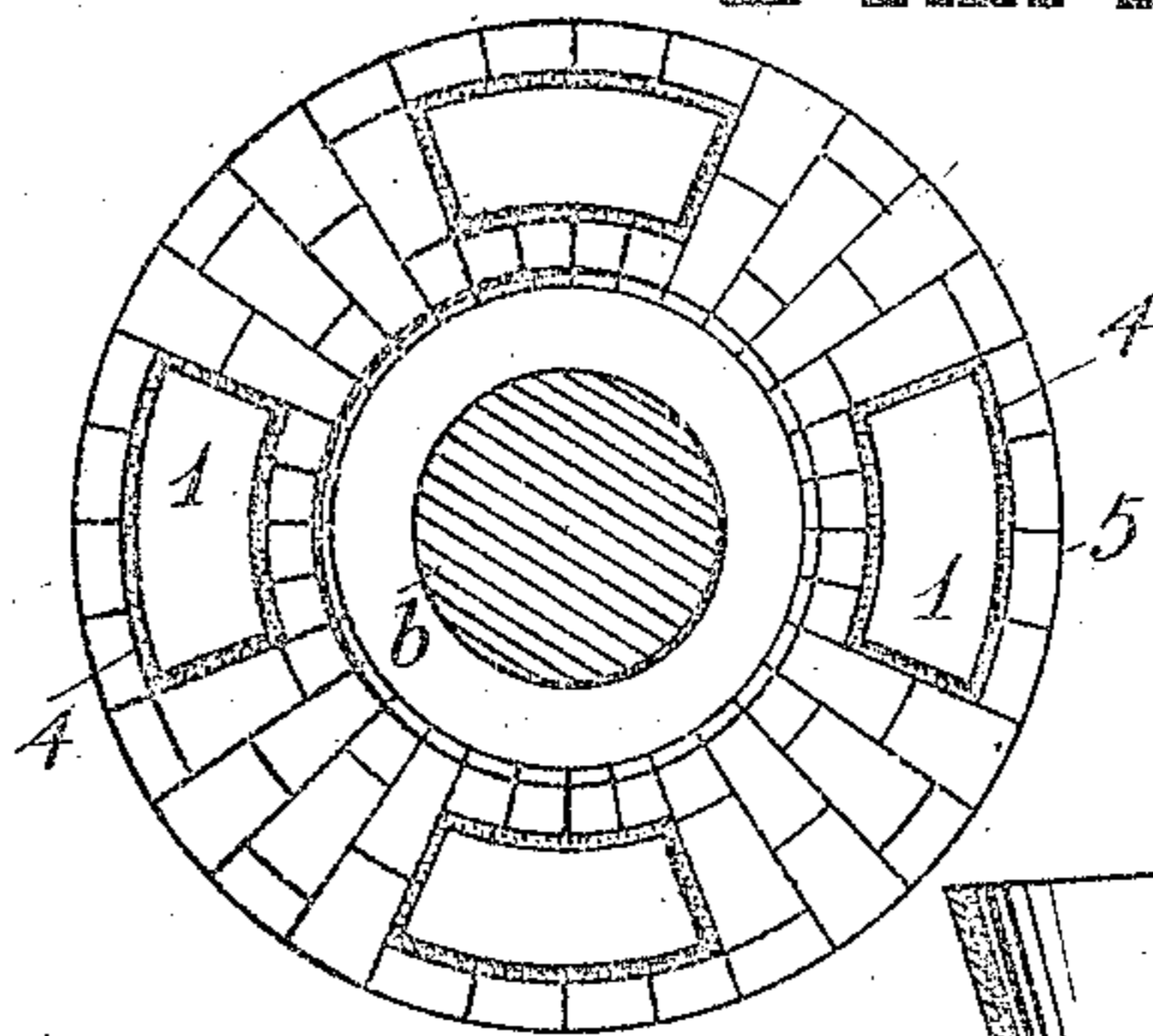
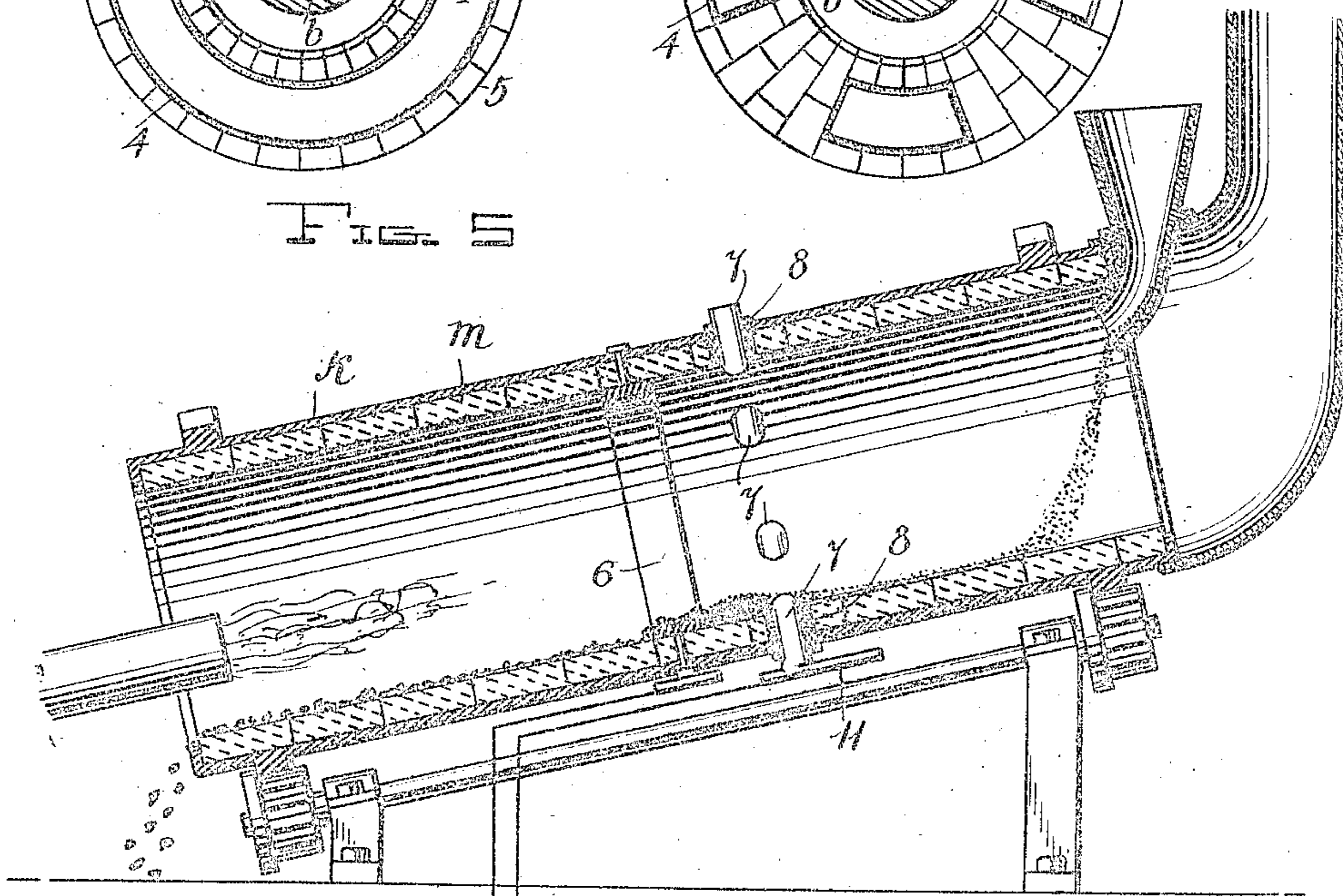


FIG. 5



Witnesses
J. L. B. Smith
C. A. Griesbauer.

Andrew J. Dull and
Joseph Weatherby, Jr. Inventors

by *H. W. Wilson & Co.*
Attorneys

UNITED STATES PATENT OFFICE.

ANDREW J. DULL, OF HARRISBURG, AND JOSEPH WEATHERBY, JR., OF NEW CUMBERLAND,
PENNSYLVANIA; SAID WEATHERBY ASSIGNOR TO SAID DULL.

PROCESS OF DESULFURIZING AND AGGLOMERATING COMMINUTED ORES.

No. 875,332.

Specification of Letters Patent.

Patented Dec. 31, 1907.

Application filed February 4, 1907. Serial No. 355,692.

To all whom it may concern:

Be it known that we, ANDREW J. DULL, a citizen of the United States, residing at Harrisburg, in the county of Dauphin, State of Pennsylvania, and JOSEPH WEATHERBY, JR., a citizen of the United States, residing at New Cumberland, in the county of Cumberland and State of Pennsylvania, have invented certain new and useful Improvements in Processes of Desulfurizing and Agglomerating Comminuted Ores; and we do 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.

Our invention is an improved process of desulfurizing and agglomerating comminuted ore to convert the same into a cinder, which may be subsequently treated in a blast furnace, and it consists in primarily heating comminuted ore to a degree sufficient to burn out the major portion of the sulfur, but insufficient to fuse the ore, and then subjecting such heated and partially de-sulfurized ore to the action of an electric arc maintained for a sufficient period of time to partially fuse the ore and reduce it to the condition of an agglomerated mass or cinder of sufficient size and weight to enable it to be treated in a blast furnace without danger of being blown out of such blast furnace by the action of the blast.

Our invention further consists in subjecting heated comminuted ore to the action of an electric arc, the oxygen of which serves to promote the consumption and liberation of the sulfurous content of the ore, and the heat of which agglomerates or "cinders" the ore.

Our invention further consists in reducing the resistance of comminuted ore by primarily heating the same to facilitate the agglomeration thereof by the action of an electric arc.

Our invention further consists in subjecting heated comminuted ore to the action of an electric arc produced between two electrodes, one of which is movable with reference to the other to cause the heated ore to be agglomerated by the action of the arc, and the cinder thus produced to be broken off and removed from the sphere of action of the arc by the movement of one of the electrodes with reference to the other.

Our invention further consists in converting a non-magnetic ore into a magnetic ore

by subjecting the same to the action of an electric arc.

In the accompanying drawings,—Figure 1 is a diagrammatic sectional view of a roasting furnace of the stirrer type, provided with means for de-sulfurizing and agglomerating comminuted iron ore in accordance with our improved process; Fig. 2 is a detail sectional view illustrating the construction of one of the electrodes; Fig. 3 is a detail top plan view of the same; Fig. 4 is a similar view showing a modified form of electrode; Fig. 5 is a diagrammatic sectional view of a cement furnace modified to enable the same to be used for carrying out our improved process.

In order to adapt a roasting furnace of the stirrer type, such as shown in Fig. 1, for use in carrying out our improved process, we provide one or more electrodes 1, which are placed on one or more of the lower roasting floors *a*. These electrodes are connected by suitable conductors 2 to the negative pole of a generator, indicated at 3. The shaft *b* of the furnace is utilized as a conductor, and hence the teeth *d* of the stirrer-arms *c* revolved by the said shaft, become electrodes, which move over the electrodes 1 at a suitable distance therefrom. The comminuted ore, with its sulfurous content, is fed into the upper end of the furnace by means of the hopper *e*, pan *f* and chute *g*.

The interior of the furnace is heated by the usual means and in the usual manner, and combustion therein is maintained in the usual way, the heat being of such a degree as is sufficient to consume the major portion of the sulfur, but insufficient to fuse the ore. Owing to the stirring action of the stirring-arms and fingers over the floors of the furnace, and the descent of the ore from floor to floor of the furnace, the major portion of the sulfur is removed from the ore before the ore reaches the floor or floors on which the electrode or electrodes 1 is or are placed. As the electrodes formed by the fingers of the rakes over such floor or floors move over such electrode or electrodes 1, electric arcs are formed between the electrodes of the movable rakes or arms and the fixed electrodes 1, and the ore on the said floors while in its heated condition is subjected to the action of such arcs, the heat of which is superadded to the heat caused by the combustion in the furnace, and the said arcs

serve to still further reduce the percentage of sulfur in the ore, and to partially fuse the ore so that the same becomes agglomerated or formed into "cinders", which are usually
 5 porous, and which vary in size from about that of a pea to about that of an egg, and which are of sufficient weight to be adapted to be treated finally in a blast furnace with-
 10 out danger of being blown out of the blast furnace by the force of the blast. Owing to the fact that each arc has an electrode which is movable with reference to the other and which moves past the other, the "cinder" or agglomerated mass of ore formed between
 15 two such electrodes becomes broken therefrom by the movement of the movable electrode, so that such "cinder" or agglomerated mass, immediately after it has been formed, is taken out of the sphere of action
 20 of the arc, so that a given portion of the ore is only momentarily exposed to the action of an electric arc. The ore thus "cindered" or agglomerated is discharged through the draw-off pipe *h* of the furnace by the action
 25 of the arms or rakes over the floors of the furnace. Products of combustion escape from the furnace through the exit pipe *i* in the roof thereof.

We have found by the working of our im-
 30 proved process that the electrical resistance of ordinary comminuted iron ore with a sulfurous content is greatly decreased by heating, so that such ore when highly heated, is of very much lower resistance than when
 35 cold. The degree of heat in an ordinary roasting furnace, such as here shown, while sufficient to eliminate the greater portion of the sulfur is insufficient to fuse the ore. Our invention consists in superheating such
 40 heated ore electrically by exposing it to the action of an electric arc, and we find that an arc of sufficient intensity to de-sulfurize, and agglomerate or "cinder" the ore may be
 45 maintained by an electric current of comparatively low voltage, hence we greatly reduce the power required for producing the current used in carrying out our improved process, and in so doing effect a correspond-
 50 ing economy and to a corresponding extent obviate loss by leakage of the current. We find ordinary comminuted iron ore with a sulfuric content to be non-magnetic, but that when such ore has been agglomerated or "cindered" by our improved process, the
 55 same has been so converted as to be magnetic to a comparatively high degree.

In practice, we have made the electrodes 1 of cast iron of circular and segmental form, have embedded the same in asbestos, as at 4,

and have further insulated the same by 60 means of fire-brick 5, in which the asbestos has been embedded, so that only the upper surfaces of the electrodes 1 are exposed.

In Fig. 5 we show an ordinary revolving cement furnace, modified for use in carrying 65 out our improved process. In this furnace an electrode 6 is provided, which is in the form of an iron ring placed in the furnace and insulated from the metallic cylinder *k* there-
 70 of by fire-brick *m*. At a suitable distance in advance of the annular electrode 6, and spaced therefrom, we provide a number of electrodes 7, which project through and are insulated from the shell of the furnace, as at 8. One pole of the generator, indicated at 9, 75 is connected to the annular electrode 6. The other pole thereof is connected by a conductor 10 to a contact device 11, with which the electrodes 7 successively make sliding
 80 contact as the furnace revolves, so that an arc is established between each electrode 7 as it reaches the lower side of the furnace, and the electrode 6. The action of the arcs thus momentarily established and pretermitted is in effect identical with that hereinbefore de- 85 scribed.

Having thus described our invention, what we claim as new, and desire to secure by Let-
 ters-Patent, is,—

1. The process of desulfurizing and ag- 90 glomerating ore, consisting in heating the same to a degree sufficient to burn out the major portion of the sulfur, but insufficient to fuse the ore, and subjecting such heated and partially desulfurized ore to the action of 95 an electric arc, substantially as described.

2. The process of agglomerating ore by ex-
 100 posing the same to the action of an electric arc, and moving one of the electrodes with respect to the other to break off the agglom-
 erated ore mass.

3. The process of agglomerating ore by
 105 first heating the same to reduce its electrical resistance, exposing the heated ore to the action of an electric arc, and moving one of
 the electrodes, between which the arc is pro-
 110 duced, with respect to the other to break off the agglomerated ore mass or cinder between them, and removing such mass or cinder from the sphere of action of the arc.

In testimony whereof we have hereunto set our hands in presence of two subscribing witnesses.

ANDREW J. DULL.

JOSEPH WEATHERBY, Jr.

Witnesses:

JOS. F. WEAVER,

EDWARD M. WINTERS.