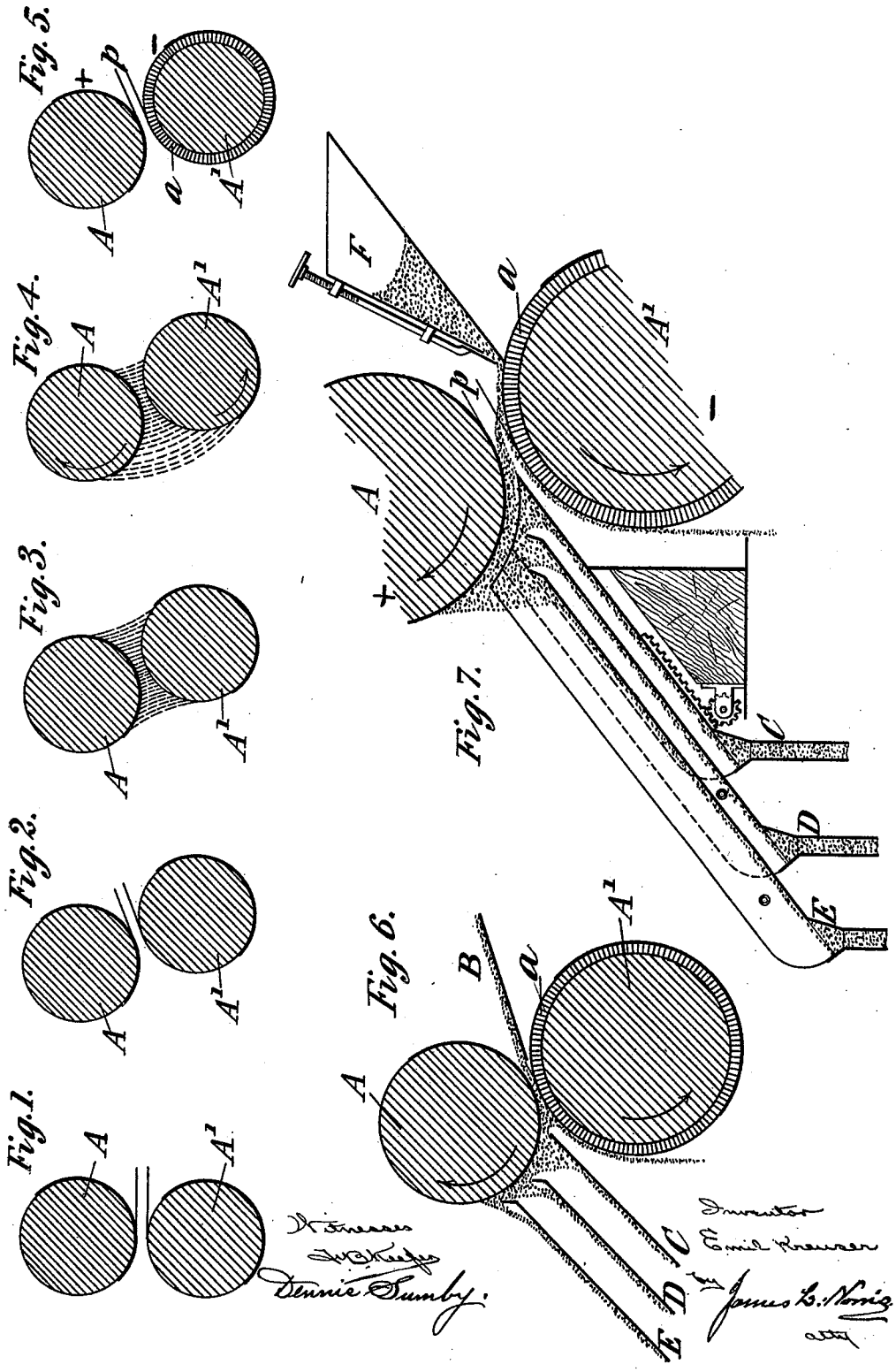
No. 634,356. Patented Oct. 3, 1899.

# E. KREUSER.

## ELECTROMAGNETIC APPARATUS FOR SEPARATING ORES.

(Application filed Feb. 28, 1899.)

(No Model.)




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# UNITED STATES PATENT OFFICE.

EMIL KREUSER, OF MECHERNICH, GERMANY.

## ELECTROMAGNETIC APPARATUS FOR SEPARATING ORES.

SPECIFICATION forming part of Letters Patent No. 634,356, dated October 3, 1899.

Application filed February 28, 1899. Serial No. 707,212. (No model.)

*To all whom it may concern:*

Be it known that I, EMIL KREUSER, retired director of royal mines, a citizen of Germany, residing at Mechernich, Rhine Province, Germany, have invented certain new and useful Improvements in Electromagnetic Apparatus for Separating Ores, (for which I have applied for a patent in the following countries, viz: Germany, November 18, 1898, and Great Britain, February 8, 1899, No. 2,849,) of which the following is a specification.

For the separation of ores having only a weak magnetic action the only arrangements heretofore employed consisted in reducing the sectional area of the magnetic poles to such an extent as by the consequent bringing closely together of the magnetic lines of force so great a concentration thereof was effected as to enable them to attract the weakly magnetizable ore particles. With this arrangement when the ore or mixture of ores treated contains minerals having different degrees of magnetic susceptibility the separation thereof has to be effected by successive operations, the materials being made to pass successively through magnetic fields having different degrees of concentration or generated by electric currents of different strength.

According to the present invention, on the other hand, a different method of operating is employed whereby in one and the same apparatus the simultaneous separation of minerals having varying magnetic susceptibilities into a corresponding number of separated quantities can be effected, thus affording great advantages both as regards cost of plant and duration of the separating process.

According to this new method no concentrated fields are produced by the reduction of the polar surfaces and only the most concentrated part of the field used for the ore separation, as was heretofore the case; but by the arrangement of two revolving electromagnets with cylindrical polar surfaces placed one above the other a broad field of magnetic lines of force is produced, the strength of which decreases progressively from the middle of the field, where it is strongest, to either side, this entire magnetic field of varying strength being made operative for the separation of the ores and not only the most concentrated part thereof, as was heretofore the case. By this means it is rendered possible to effect the simultaneous separation of minerals having different degrees of magnetic permeability in one and the same operation, which feature constitutes the principal advantage of the present invention as compared with the processes heretofore employed.

The method of operating consists in arranging two cylindrical electromagnets one above the other so that in cross-section they present two opposite circular poles of different polarity, as in Figures 1 and 2 of the accompanying drawings, where the upper magnet A is, say, of north polarity, while A′ is of south polarity. In consequence of the opposite rotation of these poles the field of magnetic lines of force situated between them receives a peculiar form, the lines of force being bulged outward in the direction of rotation of the magnets, as indicated in the sections at Figs. 3 and 4, where Fig. 3 shows the lines of force when the magnets A A′ are stationary, while Fig. 4 shows the same when the magnets revolve in the direction of the arrows. The lower part of the said field must, if a correct separation of the ores is to be effected, be weakened, which is effected by surrounding it with a tightly-fitting cylindrical covering of non-magnetizable material, which must be of a thickness equal to at least half the narrowest part of the air-space between the upper and lower poles, as indicated at Fig. 5, where $a$ is the cylindrical covering of non-magnetizable material, and the distance $p$ between this and the polar surface A is equal to one-half the total distance between the poles A and A′. The covering $a$ prevents the particles of ore resting thereon from being attracted by the lower pole A′, so as to adhere to the surface of $a$; but it does not prevent the passage of the magnetic lines of force through the operative field, and thus it enables the process of fractional separation to be effected in the manner above described. If a particle of ore is delivered onto the lower pole, it will, if at all magnetizable, be attracted by the upper pole at the point of the smallest air-space, if not earlier in its course. In consequence of the rotation of the poles it then passes into fields of gradually-decreasing strength, and it will consequently fall away

from the upper pole at that point of the circular path where the action of gravity overbalances the magnetic attraction. With one and the same kind of ore all the following particles will be raised to the same height. A mineral of a less magnetizable nature will be acted upon by gravity at an earlier point of the travel, while a mineral having a higher magnetic susceptibility will only fall away at a still greater distance from the point of strongest attraction, and in each case all particles having one and the same degree of magnetic susceptibility will fall away at one and the same point of the path through which it travels.

By the above-described means, therefore, a mass composed of different kinds of ore can be readily separated into its components according to their different degrees of magnetic susceptibility.

The exact carrying out of this separating process is dependent upon a correct speed of rotation being imparted to the upper magnetic pole, which determines both the form of the magnetic field, as also the path through which the ore particles fall away in consequence of the momentum imparted to them. In order to prevent the different kinds of ore thus separated by magnetic action from becoming to a certain extent mixed together again in falling, a suitable appliance for intercepting the particles as they fall is a necessary adjunct of the above-described mode of operating. This is effected by introducing into the operative magnetic field a series of superposed inclined chutes equal in number to the different classes into which the ores are separated, such chutes being made adjustable, so as to enable them to be brought exactly into the correct position for intercepting their particular class of ore.

The above-described method of operating can be carried out with all electromagnetic ore-separators having two opposite revolving magnets with cylindrical polar surfaces, if such poles be arranged as above described, the lower pole having its magnetic attraction weakened, as before explained, and inclined intercepting chutes being introduced into the magnetic field. By its use three, and even four, separate classes of ore can be obtained at one operation.

The new mode of operating will be more readily understood on reference to the accompanying drawings, in which—

Figs. 1 and 2 show two modes of arranging the two cylindrical magnets one above the other. Figs. 3 and 4 show the flux of the magnetic lines of force, respectively, with stationary and with revolving magnets. Fig. 5 shows the lower polar surface covered with non-magnetizable material. Figs. 6 and 7 show sections of the electromagnetic ore-separators in combination with devices for intercepting and conveying away the separated different kinds of ores.

A is the upper cylindrical magnet, (north pole,) and A′ the lower one, (south pole.) $p$ is the distance between the poles. $a$ is the covering of non-magnetizable material tightly surrounding the lower magnetic pole.

The device for intercepting and conveying away the separated ores consists of three chutes C D E, of which the lowest, C, catches the weakest magnetic materials, D the stronger magnetic material, and E the strongest magnetic material. The chutes are so arranged as either to be simultaneously adjusted in position in the magnetic field, or each chute can be separately adjusted, according as may be required by the material acted upon.

The crushed ore is supplied direct onto the covering of the lower magnetic pole either by a chute B, as at Fig. 6, or by a hopper F, with adjustable discharge-opening, as at Fig. 7.

Having thus described the nature of this invention and the best means I know of carrying the same into practical effect, I claim—

1. An electromagnetic ore-separator, consisting of two revolving, cylindrical electromagnets arranged one above the other and having cylindrical polar surfaces, the rotation of which produces a magnetic field bulged in the direction of rotation, a cylindrical, non-magnetizable covering tightly fitting the lower cylindrical polar surface to weaken its magnetic attraction relative to that of the upper cylindrical polar surface which raises the ore particles consecutively through polar fields of gradually-decreasing strength, and inclined chutes arranged, substantially as described, to correspond accurately with the several zones of the separated falling ore particles.

2. In electromagnetic ore-separators consisting of two revolving electromagnets with cylindrical polar surfaces the combination of two opposite revolving cylindrical polar surfaces arranged one above the other, a tightly-fitting cylindrical covering of non-magnetizable material to the lower cylindrical polar surface to weaken its magnetic attraction relative to that of the upper cylindrical polar surface, and superposed inclined chutes introduced into the polar field for intercepting and conveying away the different grades of ore as they are separated from each other by the magnetic attraction of the upper cylindrical polar surface, substantially as described.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

EMIL KREUSER.

Witnesses:
HENRY HASPER,
WOLDEMAR HAUPT.