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L. I. BLAKE & L. N. MORSCHER.

MECHANISM FOR SEPARATION OF CONDUCTORS FROM NON-CONDUCTORS.

(Application filed Aug. 7, 1900.)

(No Model.)

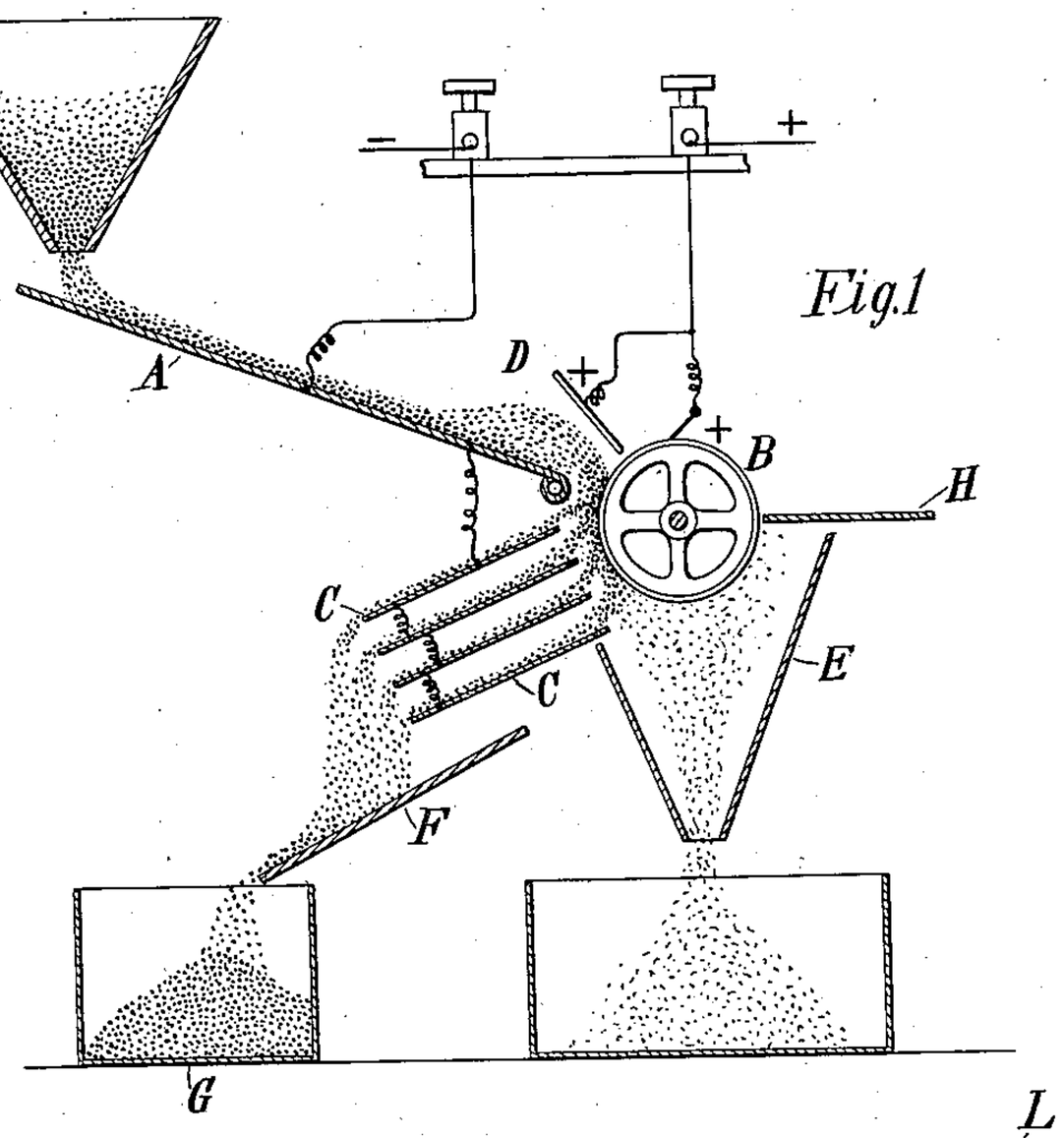

Fig. 1

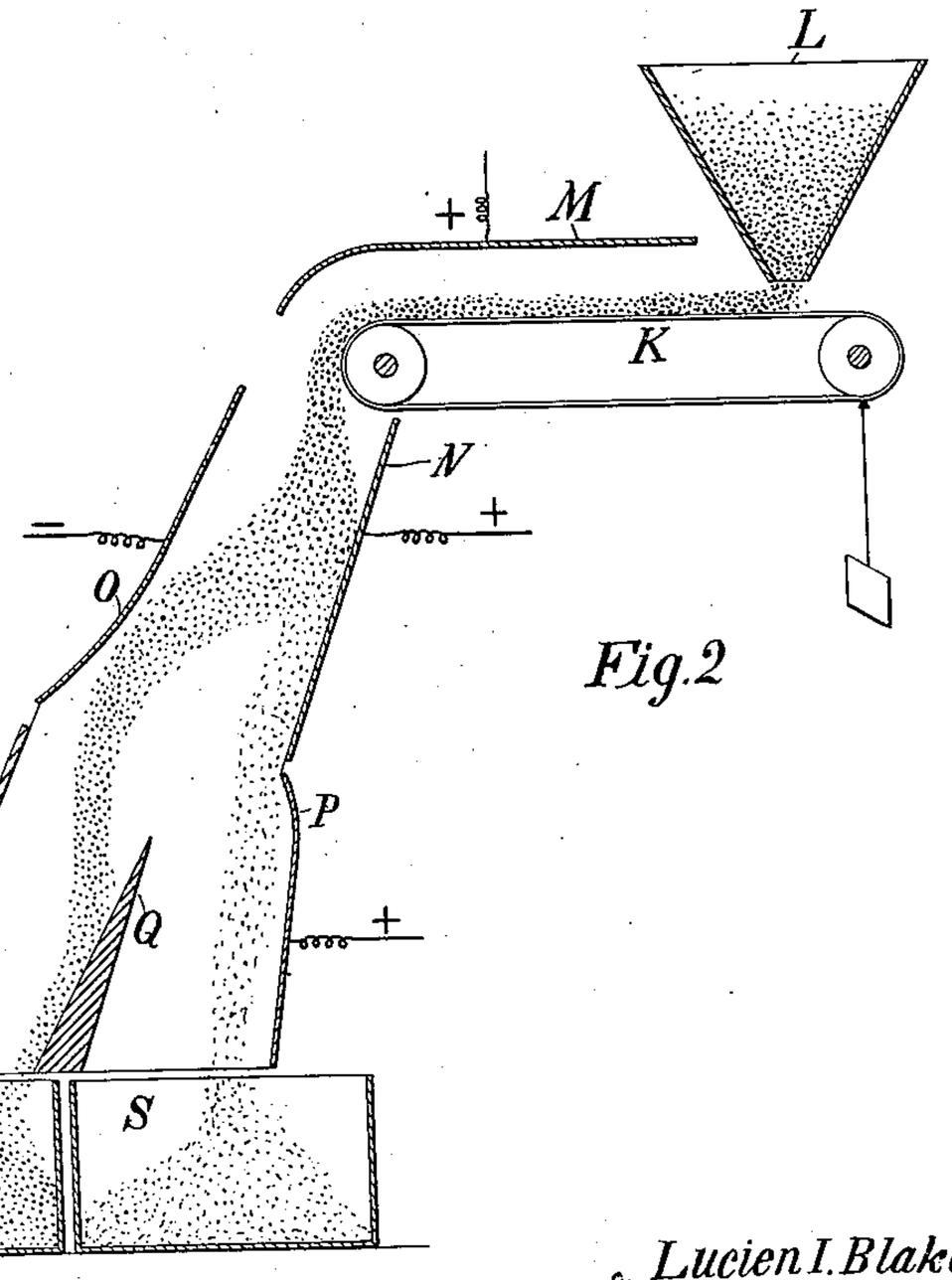

Fig. 2

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UNITED STATES PATENT OFFICE.

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MECHANISM FOR SEPARATION OF CONDUCTORS FROM NON-CONDUCTORS.

SPECIFICATION forming part of Letters Patent No. 668,792, dated February 26, 1901.

Original application filed March 16, 1899, Serial No. 709,238. Divided and this application filed August 7, 1900. Serial No. 26,152. (No model.)

To all whom it may concern:

Be it known that we, LUCIEN I. BLAKE, of Lawrence, county of Douglas, and LAWRENCE N. MORSCHER, of Neodesha, county of Wilson, State of Kansas, citizens of the United States, have invented a certain new and useful Improvement in Mechanism for Separation of Conductors from Non-Conductors, of which the following is a specification, reference being had to the drawings accompanying and forming part of the same.

The improvement relates generally to the art of separating particles of grains having varying or different electrical conductivity—that is, the separation of conductors (or those known as relatively good conductors) from non-conductors, (or those having relatively poor electric conductivity,) and relates more specifically to the construction of apparatus by which such separation can be effected, the process by which such separation is made having been described and claimed by us in a separate application for Letters Patent pending simultaneously herewith and serially numbered 709,238, filed March 16, 1899, and of which the present application was originally part.

The apparatus herein described and illustrated is more particularly designed for the separation of particles of precious or other metals and their compounds from sand, silica, slate, and other similar material occurring with metals in the state of nature and also for the recovery of metals or their compounds from waste mixtures—such, for example, as result in various processes of ore reduction; but it is evident that the apparatus herein described may be applied to the separation of various other conductors from non-conductors.

The principle of the invention is based upon the facts, (which we have fully and practically proved,) first, that when a mass or mixture of conducting and non-conducting particles or grains is brought into an electrostatic field or is charged directly the conductors acquire their inductive or direct charges instantly, while the non-conductors require an appreciable time to become charged; second, that conductors of one potential when brought into contact with conducting-surfaces of different or opposite potential instantly acquire the same potential as the conducting-surface and are repelled therefrom, while the non-conductors require an appreciable time of contact with such surface before acquiring the same potential as said surface and being repelled. It is evident that the greater the difference in potential between the mixed mass and the conducting-surface the more marked will be the repelling action and that if the potentials are of opposite sign the action will be still more marked. If the mixed mass be simply submitted to the electrostatic field of the earth, its charge will have a certain potential, although it will be neither plus nor minus, but what is generally known as "neutral," in kind. If such a mass be brought into contact with a repelling-plate which has a charge of different potential, the conducting particles will instantly acquire the same potential as the repelling-plate and be repelled, whereas the non-conducting particles will require an appreciable time of contact before acquiring the same potential as that of the plate. In commercial practice, however, it will be found desirable, we think, to charge the mass with electricity of one potential and then recharge it on the repelling-plate with opposite potential. As the separation of the conductors from the non-conductors is due to the difference of time required for said particles, respectively, to acquire the same potential as the repelling-surface, it is evident that this difference in time will be proportionately increased by first imparting to the mixed mass a charge which must be given up to the repelling-plate before the particles of the mass begin to take up a new charge from the repelling-surface. Thus the particles must first lose their initial charge and then take on a new and different charge. The conducting particles lose their original charge and take on the new one immediately; but this double process proceeds so slowly with the non-conducting particles that a very appreciable time lapses before they take up a new charge, during which

period of time they have passed off the repelling-plate into their separate receptacle, as hereinafter more particularly described.

The apparatus by means of which our invention is put in practice consists, in general terms, of a repelling-surface which is electrically charged with a different potential from that of the mass, which by suitable means is conveyed into contact with such repelling-surface. Preferably the plate or other means of conveying the mass to the repelling-surface is so arranged with reference to a source of electricity that the particles of said mass become electrically charged therefrom before the mass passes onto the repelling-surface. This electric charge may be imparted to the mass by induction, in which case an electrically-charged plate is brought near the mass as it passes over the conveying-surface, or may be directly charged, in which case the source of electricity is connected with the conveying-surface over which the mass passes, the mass obtaining its charge by direct contact with the conveying-surface. In connection with the conveying-surface is the repelling-surface. This is preferably, though not necessarily, arranged under the end of the conveying-surface, so that the mass passing from the conveying-surface falls by the action of gravity upon the repelling-surface, which is preferably inclined, so as to be but slightly out of the vertical. This repelling-surface is charged either by induction or by direct charge with an electric charge of different and preferably opposite potential to the charge of the mass as it passes from the conveying-surface. The repelling-surface may be charged by induction by placing opposite it an electrically-charged plate of opposite potential to that desired to be obtained in the repelling-surface, or it may be directly charged by connecting it with a source of electric energy of the desired potential.

The action of our apparatus is as follows: The mass of mixed conductors and non-conductors passing through the electrostatic field of the earth have a charge of a certain potential, though neither plus nor minus in kind, or, passing over the conveying-surface and being subjected to the influence of a source of electricity, as described, receives a charge of electricity of one potential and either plus or minus, as the case may be. Passing from the end of the conveying-surface the mass is brought in contact by gravity or any other suitable means with the repelling-surface. As that surface is charged with electricity of a different or preferably opposite potential to the charge sustained by the mass, the mass seeks to acquire the same potential as that of the repelling-surface. If the mass is already charged with an opposite potential to that of the repelling-surface, it first has to give up the charge which it already has. The conducting particles immediately give up their charge and immediately take on the new charge of the repelling-plate and are at once repelled from the said surface. The non-conducting particles, however, give up their first charge very slowly, meanwhile clinging to the surface of the repelling-plate by reason of the fact that they are charged oppositely to the repelling-surface. While clinging to this surface the non-conducting particles travel down and along toward its lower end. After the non-conducting particles have given up their initial charge they commence very slowly to take on the charge of the repelling-plate. Before they have received sufficient charge of the same potential as that of the repelling-surface to cause their repulsion they have passed off at the lower end of the plate and have fallen into a receptacle provided for them. The conducting particles which were immediately repelled from the place have also been received in a separate receptacle. If the mass is not originally charged with a potential opposite in kind to that of the repelling-surface, the same action as above described takes place, except that the mass does not have to give up one kind of charge before commencing to take on the other. The difference in time between the acquisition of the new potential by the conductors and non-conductors, respectively, will therefore be shorter than if the mass were charged with an opposite potential before coming into contact with the repelling-plate.

It is apparent that various modifications of the apparatus above described may be suggested, all of which, however, will contain the essential features of our invention.

We here illustrate and describe two modifications which fully set forth the general feature of the invention.

Figure 1 is a view in section of one form of apparatus made in accordance with our invention. Fig. 2 represents in section another modification of our invention.

Referring to Fig. 1, A is an inclined conveying-surface of any suitable material and shape, upon which the mass of finely-ground and mixed conductors and non-conductors is fed from a hopper J. The conveying-surface A is here directly connected with a source of electricity of one potential—as, for example, with a source of electricity bearing the minus sign. The mass passes over the conveying-surface A, becoming charged with electricity of the minus sign. B is a wheel of any suitable material and size, so arranged that the mass passing from the conveying-surface A shall be brought by gravity or other means against the periphery of the wheel. This wheel is connected with a source of electricity of sign opposite to that of the conveying-surface A, and therefore opposite to that with which the mass is charged as it passes from the conveying-surface. As the charged mass falls upon the periphery of the wheel B the conductors immediately lose their minus charge, take up a plus charge, and are repelled from the periphery of the wheel in the manner above described and as shown in the

drawings. The non-conductors, however, cling to the periphery of the wheel and are carried around by its revolution, either falling off when reaching the lower part of the wheel or being scraped off by a scraper H of any suitable form. The non-conducting particles thus falling from the wheel B pass through a trough E into a suitable receptacle. The conducting particles which are repelled from the periphery of the wheel B fall upon an incline F and pass into a suitable receptacle G. To assist in the separation of the conducting from the non-conducting particles as the former are repelled from the periphery of the wheel B, we find it of advantage, although not necessary, to use a series of shutters or inclined platforms C, arranged opposite to the portion of the wheel B, where the conducting particles are repelled. These shutters are connected with a source of electricity of the same sign as the conveying-plate A. When the conducting particles become charged with electricity of the same sign as the wheel B, these particles are not only repelled by the plate-wheel B, but are also attracted by the shutters C. This attraction assists materially in the separation of the conducting particles from the non-conducting particles which cling to the periphery of the wheel B. The shutters C are open at both sides, so that the conducting particles can pass into the shutters and fall upon the plate F, and so into the receptacle G. We also find it desirable, although not necessary, to use a plate D, arranged near and above the lower end of the conveying-surface A. This plate is connected with a source of electricity of similar sign to the wheel B and is given a charge of sufficient strength to attract the particles as they pass down the plate A and to lift them part of the distance between the plate A and the plate D. The charge should not be strong enough, however, to cause the particles to be lifted into contact with the plate D. The particles of the mixed mass passing down the conveying-surface A are lifted by the plate D and deposited upon the periphery of the wheel B in a much more scattered condition than if they fell directly from the end of the incline A upon the periphery of the wheel, thus insuring a quicker and more intimate contact of the conducting particles against the periphery of the wheel B than would otherwise be obtained. The attraction of the plate D also assists materially in the rapidity of the feed of the mixed mass onto the wheel B.

Referring now to Fig. 2, K is the conveying-surface, (herein shown as an endless belt,) upon which the mixed mass is deposited from a suitable hopper L. The conveying-surface in this instance is grounded and is neutral. Over the lower end of the conveying-surface is placed a plate M, which is charged with electricity of one potential—as, for example, of the plus sign. The space between this plate and the conveying-surface is such as to insure that the mixture being charged by the plate will not be lifted from the belt by electrical attraction. As the mass passes over the conveying-surface K it receives by induction from the plate M an electrical charge of a sign opposite to that of M. Passing from the conveying-surface K the mass is brought into contact with the inclined repelling-plate N, which plate sustains an electrical charge of opposite potential to that sustained by the mass coming in contact with it. This charge may be given either by directly connecting the plate N with a source of electricity of the desired sign or by placing opposite said plate a plate O, which sustains an electrical charge of sign opposite to that desired to be imparted to the plate N, thereby inducing in the plate N a charge of sign opposite to that of the plate O. P is another plate arranged below the plate N and sustaining an electrical charge of sign the same as that of N. Q is a partition to maintain the separation of the two streams of conducting and non-conducting material. R and S are receptacles to receive said particles when separated. The mixed mass passing under the plate M receives by induction a charge opposite in sign to that of the plate M. When the combined mass comes in contact with the plate N, the conducting particles give up their charge and receive another charge of the same sign as the plate N and are thereupon repelled from the surface of said plate. If the plate O is used, it will attract the conducting particles as they are repelled from the plate N, and thus assist in separating them from the non-conducting particles. The latter give up their charge of electricity very slowly upon the surface of the plate N and take up a new charge with equal slowness. Before they have received sufficient charge to cause them to be repelled from the plate N they have passed along the surface and off from its lower end. The plate P serves, further, to guide the non-conducting particles as they leave the plate N and maintain them in a stream. The partition Q is so arranged that the non-conducting particles will fall inside of the same and the conducting particles outside.

As heretofore explained, it is not necessary that the conveying-surfaces in any of the modifications of our invention should be so connected or arranged in relation to the source of electricity that the mass passing over said surface should receive a charge of definite sign, the electrostatic field of the earth answering to give to the mass an initial potential different from that of the charge-repelling plate. Nevertheless, in commercial practice it is desirable to use two fields of opposite potential in the manner suggested in the modifications hereinbefore described.

It is evident that the conveying-surfaces may be of any suitable material and shape, that the conveying and repelling surfaces may be differently arranged, and that the means for subjecting the mass to the elec-

trostatic charges may be differently arranged relatively thereto without departing from the spirit of our invention, the main feature of which is the arrangement of such parts so that the combined mass having been subjected to an electrostatic field or charge of one potential is then subjected to an electrostatic field or charge of different or preferably opposite potential, whereby the conducting particles instantly acquire the same charge as the repelling-surface and are repelled therefrom, while the non-conductors take so long to become electrified by the repelling-surface that they fall from the bottom of such surface before repulsion occurs. It is also evident that other changes in relative arrangement of parts may be made within our invention.

Having thus described our invention, what we claim as new, and desire to cover by Letters Patent, is—

1. In an apparatus for effecting the separation of the conducting particles of a mixed mass from the non-conducting particles of the same, an electrically-charged repelling-surface of different potential from that of the mass, and means for conveying said mass into contact with said repelling-surface.

2. In an apparatus for effecting the separation of the conducting particles of a mixed mass from the non-conducting particles of the same, a conveying-surface, a source of electrostatic energy arranged relatively thereto for imparting to the mass an electric charge, and a repelling-surface electrically charged at a different potential from that of the mass and arranged to receive the charged mass.

3. In an apparatus for effecting the separation of the conducting particles of a mixed mass from the non-conducting particles of the same, a conveying-surface, a source of electrostatic energy arranged relatively thereto for imparting to the mass an electric charge, and a repelling-surface electrically charged at an opposite potential from that of the mass and arranged to receive the charged mass.

4. In an apparatus for the purpose above described, a conveying-surface, a source of electrostatic energy arranged relatively thereto for imparting to the mass an electric charge, and a moving repelling-surface electrically charged at a different potential from that of the mass and arranged to receive the charged mass.

5. In an apparatus for the purpose above described, a conveying-surface, a source of electrostatic energy arranged relatively thereto for imparting to the mass an electric charge, and a moving repelling-surface electrically charged at an opposite potential from that of the mass and arranged to receive the charged mass.

6. In an apparatus for the purpose above described, a conveying-surface, a source of electrostatic energy arranged relatively thereto for imparting to the mass an electric charge, a repelling-surface electrically charged at a different potential from that of the mass and arranged to receive the charged mass, and opposite said repelling-surface an electrically-charged surface of opposite potential to that of the repelling-surface.

7. In an apparatus for the purpose above described, a conveying-surface, a source of electrostatic energy arranged relatively thereto for imparting to the mass an electric charge, a repelling-surface electrically charged at a different potential from that of the mass and arranged to receive the charged mass, and opposite said repelling-surface an inclined surface electrically charged at an opposite potential to that of the repelling-surface.

8. In an apparatus for the purpose above described, a conveying-surface, a source of electrostatic energy arranged relatively thereto for imparting to the mass an electric charge, a repelling-surface electrically charged at a different potential from that of the mass and arranged to receive the charged mass, and opposite said repelling-surface a series of inclined shutters electrically charged at an opposite potential to that of the repelling-surface.

9. In an apparatus for the purpose above described, a conveying-surface, a source of electrostatic energy arranged relatively thereto for imparting to the mass an electric charge, an electrically-charged plate of the same sign as the charge of the repelling-surface and arranged above the lower end of the conveying-surface and between it and the repelling-surface, whereby the particles of the mass are attracted and lifted part of the way between the conveying-surface and said plate and deposited on the repelling-surface in a scattered condition, and a repelling-surface electrically charged at a different potential from that of the mass and arranged to receive the charged mass.

10. In an apparatus for the purpose above described, the conveying-surface, a source of electrostatic energy arranged relatively thereto for imparting to the mass an electric charge, a moving repelling-surface electrically charged at an opposite potential from that of the mass and arranged to receive the charged mass, an electrically-charged inclined surface of opposite potential to that of the repelling-surface and arranged opposite thereto, and an electrically-charged plate of the same sign as the charge of the repelling-surface arranged above the lower end of the conveying-surface and between it and the repelling-surface, substantially as and for the purposes above described.

11. In an apparatus for the purpose above described, the conveying-surface, a source of electrostatic energy arranged relatively thereto for imparting to the mass an electric charge, a revolving repelling-surface electrically charged at an opposite potential from that of the mass and arranged to receive the charged mass, an electrically-charged inclined surface of opposite potential to that of the repelling-

surface and arranged opposite thereto, an electrically-charged plate of the same sign as the charge of the repelling-surface arranged above the lower end of the conveying-surface and between it and the repelling-surface, and a scraper arranged to remove from the revolving repelling-surface any non-conducting particles which may adhere thereto.

12. In an apparatus for the purpose above described, the conveying-surface, a source of electrostatic energy arranged relatively thereto for imparting to the mass an electric charge, a revolving repelling-surface electrically charged at an opposite potential from that of the mass and arranged to receive the charged mass, an electrically-charged inclined surface of opposite potential to that of the repelling-surface and arranged opposite thereto, an electrically-charged plate of the same sign as the charge of the repelling-surface arranged above the lower end of the conveying-surface and between it and the repelling-surface, a scraper arranged to remove from the revolving repelling-surface any particles which may be adhering, and guiding-surfaces for receiving and guiding into proper receptacles the separated streams of conductors and non-conductors.

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