G. ULLRICH.

METHOD OF AND APPARATUS FOR SEPARATING MAGNETIC MATERIAL.

APPLICATION FILED FEB. 9, 1916. RENEWED APR. 19, 1920.

1,360,601. Patented Nov. 30, 1920.

FIG. 1.

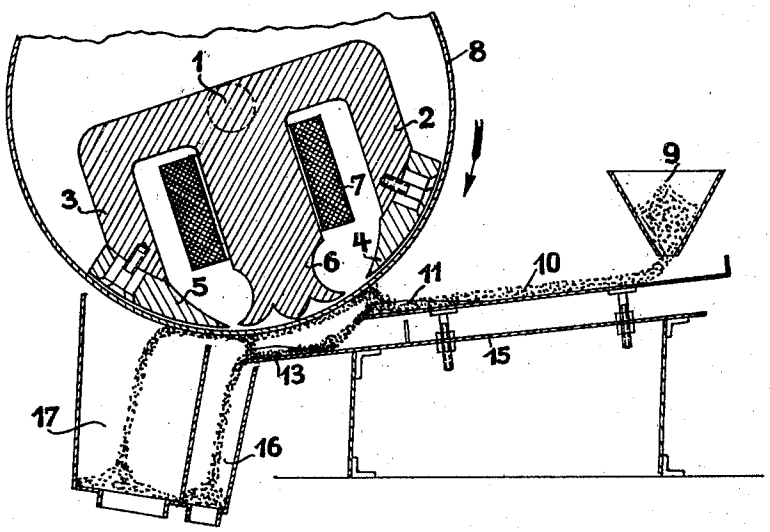
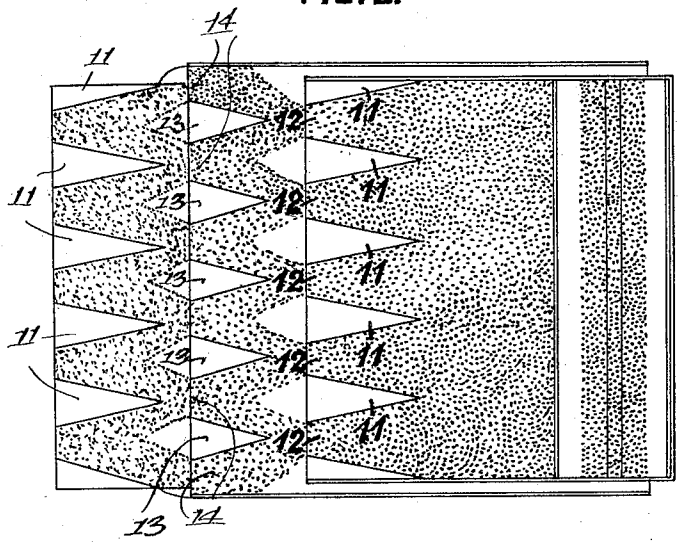


FIG. 2.



Inventor
Georg Ullrich
By Kingsbury
Attorneys.

UNITED STATES PATENT OFFICE.

GEORG ULLRICH, OF MAGDEBURG, GERMANY, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE CHEMICAL FOUNDATION, INC., A CORPORATION OF DELAWARE.

METHOD OF AND APPARATUS FOR SEPARATING MAGNETIC MATERIAL.

1,360,601. Specification of Letters Patent. **Patented Nov. 30, 1920.**

Application filed February 9, 1916, Serial No. 77,306. Renewed April 19, 1920. Serial No. 375,152.

To all whom it may concern:

Be it known that I, GEORG ULLRICH, engineer, a subject of the German Emperor, residing at 2 Winterfeldstrasse, Magdeburg, Germany, have invented certain new and useful Improvements in Methods of and Apparatus for Separating Magnetic Material, of which the following is a specification.

In the separation of magnetic material the attracted material is either carried away at right angles to the direction in which the stream of material flows, as in separators of the ring or annular type, or in the same direction, as in separators of the roller or drum type.

In separators of the first mentioned type, the attraction is effected by annular magnet pole blades which are naturally separated by gaps. The different kinds of material attracted accumulate here alongside each other, being separated by corresponding gaps afforded at the delivery device. Only a comparatively small portion of the breadth of the magnetic field is therefore utilized.

In separators of the second mentioned type the attracted material accumulates without any gaps being afforded at the delivery device and the entire breadth of the magnetic field is therefore utilized. The deposition of the various kinds of separated material takes place however in the following manner. Only the kind of material normally attracted accumulates at first at the delivery device, while the other kinds of material are deposited in the order of the increase or decrease of their permeability upon the kinds previously separated.

As in this case the thickness of the layer of the attracted material will, under otherwise equal conditions, be greater than in the former case, the superimposition necessitates the supply of the raw material being located at a greater distance from the delivery device and consequently, when the strength of the field is the same, necessitates more exciting current than in the former case. Furthermore, the material already attracted weakens the attractive force for the succeeding material still to be attracted. This disadvantage acts prejudicially upon sharp separation.

According to this invention the disadvantages above mentioned are obviated; not only is the entire breadth of the field utilized, but the deposition of the entire magnetic material also takes place directly at the delivery device in lines or streams adjacent to each other and separated according to the different kinds of material.

The method consists in first separating in the well known manner a portion of the magnetic material from the stream of material supplied to a magnetic field, and then deflecting the rest of the stream of material to another point of the delivery device which separates further magnetic material from the remainder. If the stream of material be very wide it may be divided from the commencement into several adjacent lines or streams separated by gaps. A portion of the magnetic material is then first attracted from each stream and this attracted portion is deposited in corresponding streams at the delivery device. The remainder of the material may then be deflected once more or several times in succession, into other streams lying in the direction of the gaps or blank spaces. From these other streams the further magnetic kinds of material are separated in succession in corresponding streams which are located at the delivery device between the material previously deposited. If graduated magnetic fields be employed, the different kinds of material of different permeability do not separate on top of each other at the delivery device, but alongside each other, and are separated according to the kind of material in streams arranged in the same direction as the supply of the material.

It is already known to divide up a stream of material; this division however takes place before any separation commences. The division consists in the irregular lateral displacement of the material so that a central gap or blank space is formed, along both sides of which lies a line of material which is not homogeneously bounded externally. Separation therefore takes place in the gap or blank space, the material being drawn into it. Practically, this separation can only be very incomplete, because the magnet cannot act uniformly upon the breadth of the stream of material. On the contrary it only reaches the particles of material lying close to the gap or blank space, while the more re-

motely situated particles of material are slightly attracted or not attracted at all. This disadvantage, however, is obviated according to the present invention.

One constructional form of apparatus for carrying out the improved method of separation is illustrated in the accompanying drawing, in which:—

Figure 1 is a cross-section showing a separator of the drum type having a graduated field, and a supply device for effecting the sub-division of the stream of material.

Fig. 2 is a plan view of the supply device.

The magnetic body which oscillates about the spindle 1 and forms two zones, comprises two side counter magnet poles 2 and 3, which, for the purpose of regulating the zones, are provided with laterally adjustable shoes 4 and 5, and a common magnet pole 6, which is excited by a coil 7. A delivery drum 8 is adapted to rotate about the magnetic body in the direction indicated by the arrow. The weaker zone is formed between the shoe 4 and the pole 6, and the stronger zone is formed between the shoe 5 and the said pole 6.

The material delivered at 9 falls on to the supply device along the whole breadth of the surface 10 thereof, upon which surface the material is conveyed in any desired manner, and conducted to the weaker zone. Prior to coming within reach of this zone the main stream of material is divided up by means of guide devices 11 into separate lines or streams 12, the breadth of which corresponds to the distance between the guide devices 11 which are separated by gaps or blank spaces corresponding to the breadth of the guide devices 11.

From these streams of material the strongly magnetic material is attracted first, so that it adheres to the delivery drum in a form corresponding to the breadth of the streams 12. The material not attracted falls on to the surface 15, this material, before it comes within reach of the stronger zone, being divided up by means of guide devices 13 into separate streams 14. The breadth and distance apart of the guide devices 13 may be so proportioned with respect to each other that the streams 14 pass between the streams 12 of the delivery drum. The remaining portion of the magnetic material is attracted from the streams 14, by the zone 5, 6 and is compelled, owing to the peculiar formation of the material supply device to so deposit itself upon the drum 8, that the gaps afforded between the streams of strongly magnetic material are filled up.

In the form shown, the guide devices 11 are somewhat wider than the guide devices 13, so that narrow gaps or blank spaces are formed between the streams of material on the delivery drum.

If the material is to be separated into more than two magnetic sorts, more zones and more rows of guide devices for forming the streams must accordingly be provided. The breadth of the streams need not be the same for all kinds of material. On the contrary it may with advantage be proportional to the amount of the different kinds contained in the material.

The position of the said members with respect to the magnetic body may be varied by adjusting them singly or together in any desired manner. The guide devices 11 and 13 may be formed integral with the members affording the surfaces 10 and 15, or they may be attached thereto.

The different kinds of material may be collected in various ways, *e. g.*, the unattracted material may be collected at 16, and that which has been attracted and separated according to permeability collected at 17 in compartments corresponding to the streams and located alongside one another.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. A method of separating magnetic material consisting in subdividing a stream of the material into a plurality of streams separated by gaps, subjecting the material so divided to magnetic attraction adapted to separate the most strongly magnetic material, then deviating the streams into positions alining with the gaps of the initial subdivision and magnetically attracting the less magnetic material into paths between the paths of the material first attracted, and finally discharging the grades separately.

2. A method of separating magnetic material consisting in subdividing a stream of the material into a plurality of streams separated by gaps, subjecting the material so divided to magnetic attraction adapted to separate the most strongly magnetic material, then deviating the streams a number of times in succession into other streams alining with the gaps of the initial subdivision and magnetically attracting the less magnetic material into the paths between the paths of the material first attracted.

3. Apparatus for separation of magnetic material, comprising a plurality of rows of guide members arranged one behind the other, the guide members of each succeeding row being so disposed with respect to the guide members of the previous row that the streams of material formed by one row of guide members are delivered in non-alinement with the gaps between the adjacent row of guide members, and a magnetic separating element operating in proximity to each series of streams and having conveying means operating in the general direction of flow of the material.

4. Apparatus for separation of magnetic

material comprising a plurality of rows of guiding devices, in which the guiding devices of one row are broader than those of a row in advance thereof, so that the streams of material formed in the direction of the gaps between adjacent rows of guide members are narrower than the gaps or blank spaces between the rows, and a magnetic separating element operating in proximity to each series of streams and having conveying means operating in the general direction of flow of the material.

In testimony whereof the foregoing specification is signed in the presence of two witnesses.

GEORG ULLRICH.

Witnesses:
A. H. ENTENMANN,
L. ROATHENUS.