Dec. 30, 1958 L. SCHLEBUSCH 2,866,551

INDUCTION INFLUENCED SCREENING APPARATUS

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FIG. 1.

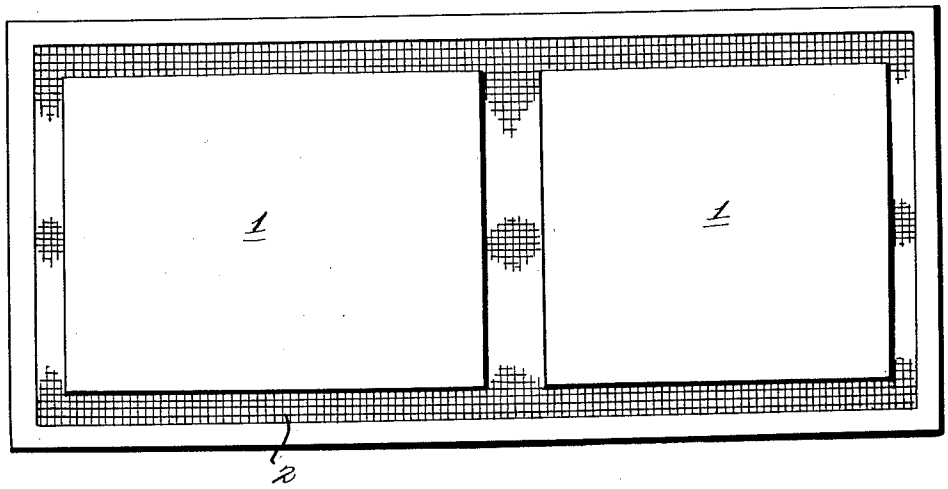


FIG. 2.

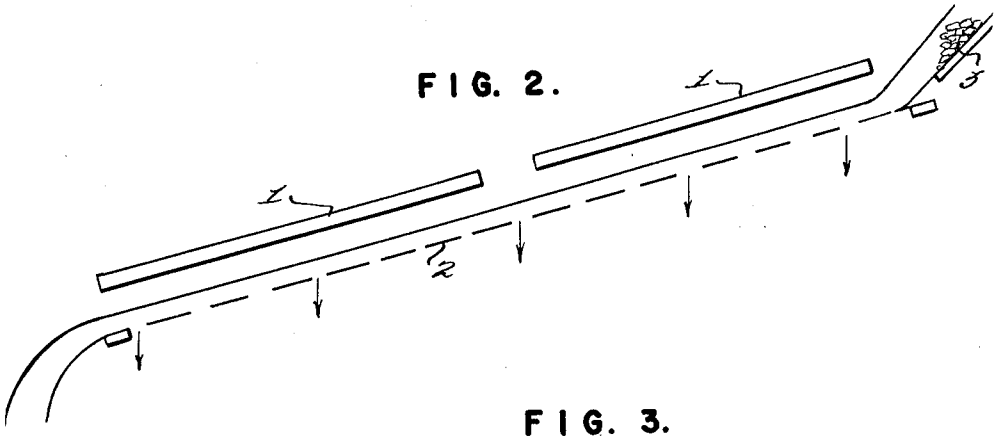
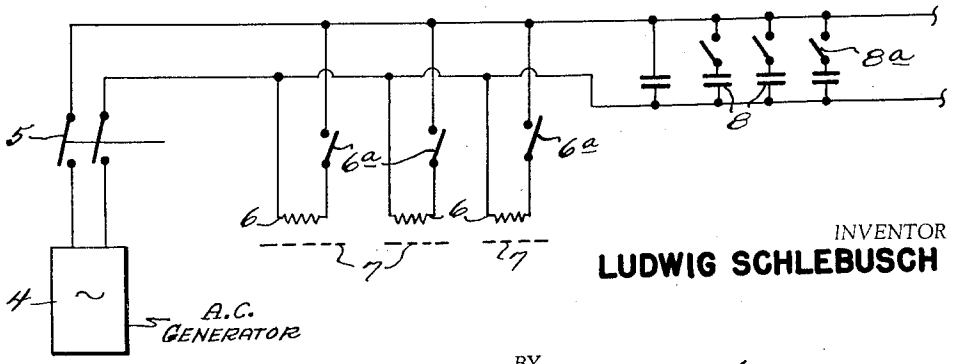


FIG. 3.



INVENTOR
LUDWIG SCHLEBUSCH

BY Adams + Bush
ATTORNEYS

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FIG. 4.

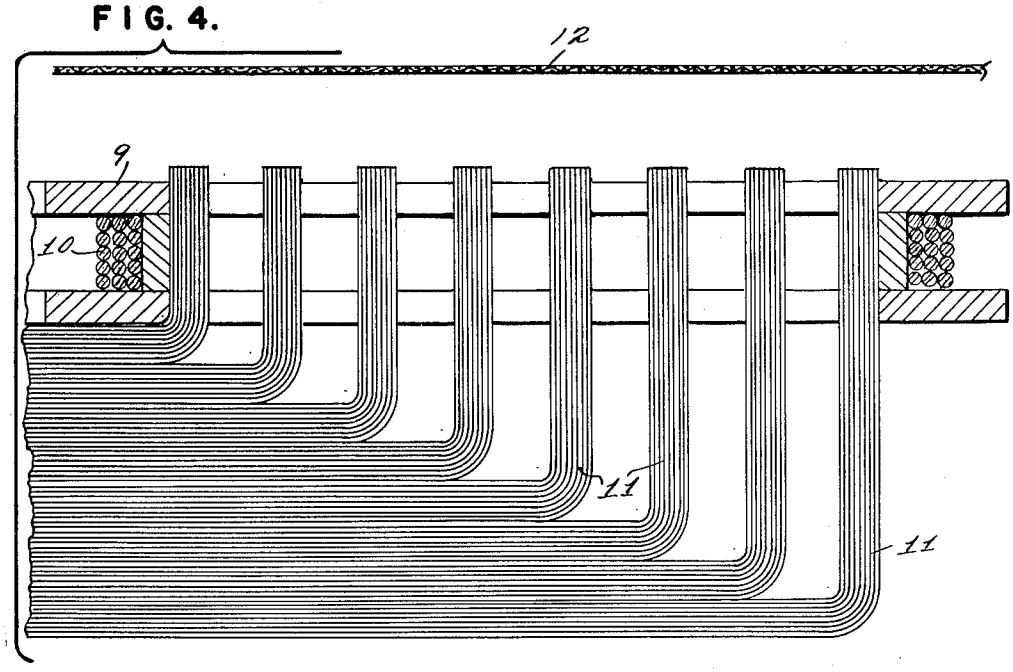


FIG. 5.

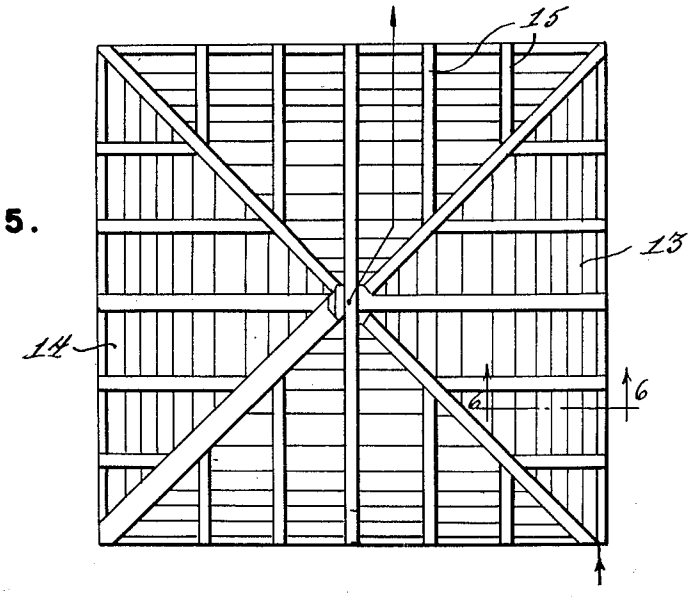
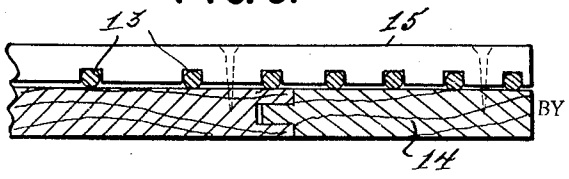


FIG. 6.



INVENTOR
LUDWIG SCHLEBUSCH

BY

Adams & Bush
ATTORNEYS

Dec. 30, 1958 L. SCHLEBUSCH 2,866,551

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FIG. 7.

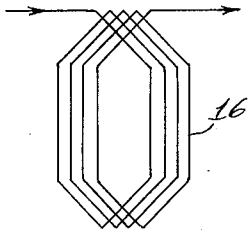
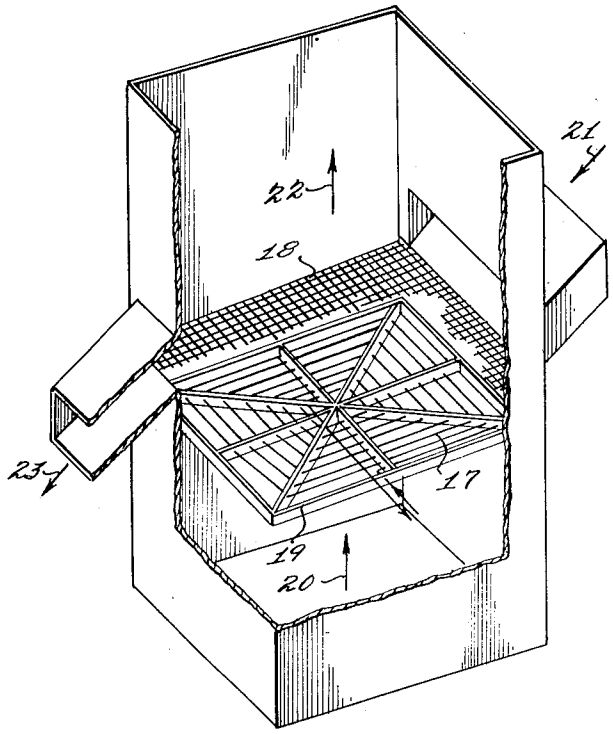


FIG. 8.



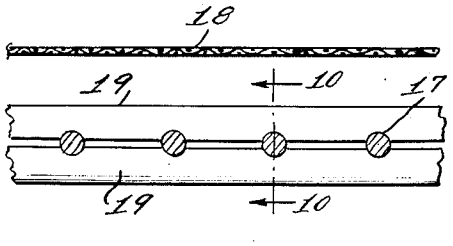
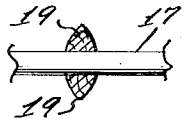


FIG. 9.

FIG. 10.



INVENTOR
LUDWIG SCHLEBUSCH

BY

Adams & Bush
ATTORNEYS

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INDUCTION INFLUENCED SCREENING APPARATUS

Ludwig Schlebusch, Palenberg, Germany

Application May 24, 1954, Serial No. 431,945

2 Claims. (Cl. 209—238)

The present invention relates to heated or electrically inductively influenced screening devices for the screening of comminuted material, especially non-magnetic comminuted material, such as small coal, principally for products smaller than 1 mm. diameter, wet raw coal, coke waste, and other similar products.

The application of this invention to rotating cylindrical screening drums or separators is also possible.

It is known that small coal is easier to screen when the screening surface is heated, so that the screen and the product in immediate contact with it are dry, and the smaller particles do not adhere to the metal cloth of the screen and cannot clog the mesh.

Such screens are known in which heating is effected by steam, by gas, or by electric current flowing through the electric resistance of the vibrating metal cloth itself. These devices present the disadvantage of coal having a high percentage of volatile matter being subject to the possibilities of explosion and, also, the disadvantage of being applied only with difficulty to already existing screening installations.

For this reason, the use of electric induction heating has been proposed. The practical application, however, of this type of heating, has been found to present difficulties for which no practical solution had been found.

The object of the present invention is to provide apparatus to apply electrical induction to both heating of metal screens and to screen vibration employing frequencies in the intermediate range ordinarily employed in practice for such mechanical vibrations, such as the range from 200 to 20,000 cycles. The screens are of metal and may be ferrous or non-ferrous, according to requirements.

According to the present invention, for heating with alternating currents of 200 to 2,000 cycles frequency, the inductors have magnetic lines of induction which are almost completely closed in iron, and for higher frequencies between 2,000 cycles and the range of high frequencies, the inductors are constituted as coils with an air or equivalent core without iron core.

The invention will be understood by reference to the following description, taken with the accompanying drawings, wherein:

Fig. 1 is a diagrammatic top plan view of an inclined classifying screen with electrical inductor units placed thereabove;

Fig. 2 is a side elevation of an inclined classifying screen with inductor units thereabove, showing the unclassified material coming in onto the screen;

Fig. 3 is a diagram of a circuit for supplying electrical energy to the inductors;

Fig. 4 is a detail of the structure of a laminated iron core inductor for frequencies from 200 cycles to 2,000 cycles;

Fig. 5 is a detail plan view of the structure of a spiral type of winding for an inductor for frequencies above 2,000 cycles, having no iron in the core, and having uneven spacing of the turns of the winding along its diameter to improve the magnetic field distribution;

Fig. 6 shows a cross sectional detail of the winding of Fig. 5, taken on line 6—6 of Fig. 5;

Fig. 7 shows a loop or lap winding with air core which may be used instead of the spiral winding of Fig. 5;

Fig. 8 shows a pneumatic type of separator with a spiral wound inductor whose winding is supported on stream-lined rods;

Fig. 9 shows a detail of the winding of Fig. 8 and the supporting rod; and

Fig. 10 is a cross section on line 10—10 of Fig. 9.

The range between 2,000 and 20,000 cycles has been found to be particularly advantageous. These frequencies cause magnetic induction inside the cross section of the wire which provides a production of heat without sparks. Further, these frequencies may be economically produced with generators of considerable power. In this range of frequencies and for the temperatures which exist in the inductors, the losses taking place are so small that cooling of the windings of the inductors by water, which is generally necessary in the prior art, becomes superfluous.

According to the invention, the spacing between the turns of the winding is preferably designed to be non-uniform so that the higher concentration of turns is in the center part of the coil diameter and decreases at first on going toward the edge, to increase once more at the outer edge itself. In this way, an even distribution of the magnetic field and the heating can be obtained. An appreciable increase of the screening efficiency is obtained by means of the higher frequency of the induction magnetic field as compared to that of the usual vibration which has been applied mechanically, selected in such a way that it adds to the applied mechanical vibration of the screen, a superposed additional vibration strongly increasing the screening effect. The result is a considerable saving of heating power. The mechanical vibration may be applied to the screen in any conventional manner known to the art.

In pneumatic type separators, as heretofore used, a clogging of the air admission holes in the screening surface also takes place owing to the accumulating moisture extracted from the untreated coal. To prevent this clogging, according to the invention, the screening surfaces, generally made of perforated metallic sheets, are inductively heated. In order that air may pass freely, the inductors used must be of open-work type and the free wires of the inductors are only supported by a rod frame. The shape of the rods will be stream-lined so as not to oppose any strong resistance to the air stream.

Induction heating as provided in the present invention, presents the great advantage that the fields of intermediate values of frequency used produce heat inside the cross section of the wires of the screen, thus avoiding any danger of explosion caused by sparks.

Another advantage consists in the possibility of applying the device to any existing installation without any modification of the screening device itself, as ordinarily provided.

The accompanying drawings give, as examples, a number of embodiments of devices for applying induction heating and screen vibrations to such apparatus.

Figs. 1 and 2 show, diagrammatically, a top plan view and side elevation of an apparatus for the application of electric induction to a dust removing screen. The surface inductors 1 are in this case located in such a manner above and spaced from the vibrating surface 2 of the screen, that the untreated product 3, as supplied to the screen, may easily pass between the inductor and the screen. Inductors 1 are mounted separately from the screen. The screen is of metal and, if it is desired that the magnetic field shall cause mechanical vibration of the

screen as well as heating, the screen should be of ferrous metal.

Fig. 3 shows a circuit arrangement for a heating installation by electric induction. The generator **4** of an intermediate value of frequency which may be varied, feeds, by means of a main line switch **5**, a set of line conductors to which a plurality of inductors **6**, acting on metal cloth **7** of the screen, are connected. To compensate for the inductor's resistance, condensers **8** may be connected as needed by switches *8a*. Each inductor has its own switch *6a*.

Fig. 4 is a section of an iron core inductor having nearly all of its magnetic circuit closed in iron for use in the range of 200 to 2,000 cycle frequencies, showing one-half of an inductor. The body of the coil **9** carries the individual winding turns **10**. The highly permeable laminated grouped steel sheets **11** form the magnetic circuit. The other corresponding part of the coil is symmetrically located on the opposite side. The metal screen cloth **12** is in front of and adjacent to the inductor **10**.

Fig. 5 shows an inductor unit with an air core for a frequency range above 2,000 cycles. To obtain an even distribution of the magnetic field and the heat, the turns of the winding are unevenly spaced along its diameter, and the concentration of the turns of the winding is at its highest in the center of the coil **13**, and the spacing of the coil winding turns increases to start with in the direction of the outer edge, and decreases again when closely approaching the edge itself, as shown in Fig. 5. The base **14** (Fig. 6) may be of wooden boards with tongue and groove joint. The turns of the coil winding are maintained in spaced relation as by notched wooden strips **15**.

The coils are wound on a solid or latticed frame. The mounting of air core inductors of this type adjacent to a screen is shown in Fig. 1.

Instead of the spiral type of winding of Fig. 5, a loop or lap winding with an air core may be used, as diagrammatically shown at **16** in Fig. 7.

Fig. 8 shows a latticed coil inductor intended for a pneumatic type separator. The rigid latticed inductor **17** may be located above or below the vibrating surface **18**, but close enough to be in magnetic relation thereto. The free rigid wires of the inductor coil are supported by a framework of stream-lined rods **19** to decrease the resistance to currents of air.

Fig. 9 shows a section of an inductor coil of the type **17** of Fig. 8, and its position with respect to the screening surface **18**.

The applied air blast **20** (Fig. 8) necessary for the separation, passes through the latticed inductor **17** from the bottom, so that the screen cloth **18** is prevented from clogging. The screen cloth **18** may alternatively consist of a perforated plate. The untreated material is fed in at **21**. The smaller particles contained in the untreated coal

are carried upward by air blast **20** and the mixed stream of air and coal leaving the separator in the direction shown by the arrow **22** is separated afterwards in a centrifuge. The larger particles are conveyed by the vibrating screen and discharged through a chute in the direction indicated by the arrow **23**. In apparatus of the prior art, in spite of the air draft, the mesh and holes of the screening surface **18** always clogged when the untreated coal supplied was very wet. In the present invention, the heat and inductive vibration applied by the electric induction prevent this clogging and also enable separation for these high moisture contents.

It will be apparent to those skilled in the art that my invention is susceptible of modifications to adapt the same to particular conditions, and all such modifications which are included within the scope of the appended claims, I consider to be comprehended within the spirit of my invention.

What is claimed is:

1. In screening apparatus for comminuted materials, a metal screen, means for feeding comminuted material thereto, and electromagnetic induction means mounted adjacent to but spaced from said screen in magnetic relation thereto and comprising an energizing winding wound spirally and whose core has a magnetic permeability substantially the same as that of air, the spacing between adjacent turns of said spiral winding being relatively small near the center of said winding and therefrom at first increasing along the diameter from the center of said winding toward its outer edge, and then decreasing again as said outer edge is closely approached.

2. In screening apparatus for comminuted material, an inclined metal screen; means for feeding comminuted material thereto; electro-magnetic induction means for heating the screening surface of said metal screen including an energizing winding in the form of a flat coil mounted on a lattice frame adjacent to said screen and so positioned relative thereto that the direct action of the magnetic field emanating from said winding will heat said screen by inducing an electric current therein; and pneumatic means for directing a current of air through said screen.

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