Jan. 5, 1960 D. E. STEM 2,919,803

MAGNETIC SEPARATORS

Filed Dec. 21, 1956 2 Sheets-Sheet 1

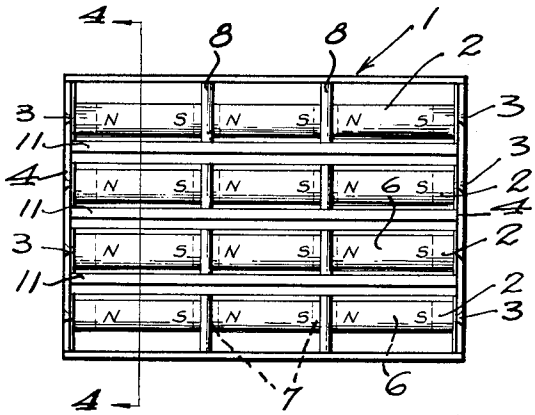


FIG. 1.

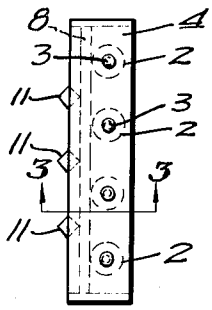


FIG. 2.

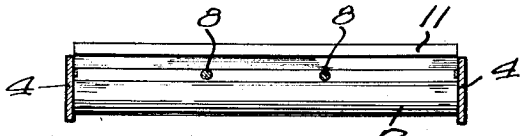


FIG. 3.

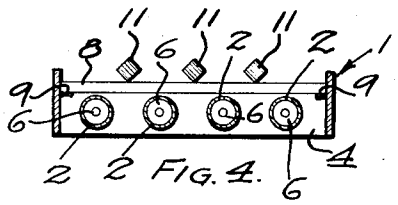


FIG. 4.

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Jan. 5, 1960 D. E. STEM 2,919,803

MAGNETIC SEPARATORS

Filed Dec. 21, 1956 2 Sheets-Sheet 2

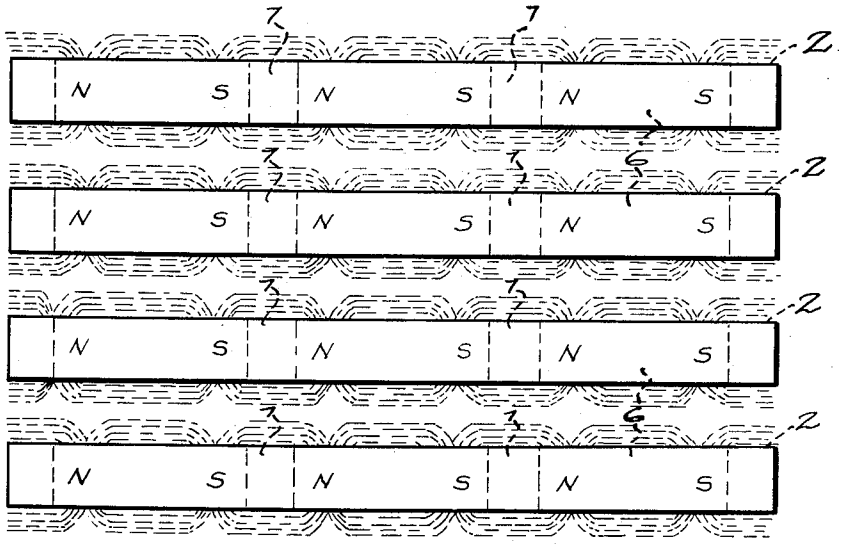


FIG. 5.

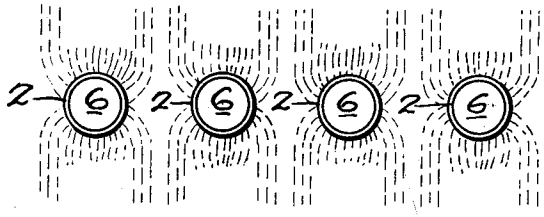


FIG. 6.

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MAGNETIC SEPARATORS

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Application December 21, 1956, Serial No. 629,978

8 Claims. (Cl. 209—223)

This invention relates to an improvement on the grate type of magnetic separators.

In many types of processing industries it is desirable to have a magnetic grate type of separator installed in the floor or in a vertical chute. However, in past types of magnetic grates the problem of bridging has caused considerable difficulty. When the magnet was made strong enough to actually hold back the particles that bridged between the magnetic rods of the grate, this caused an interruption of flow and many times caused the loss of some particles due to the velocity of the grain or the like falling on these particles which formed a bridge between the grate. Many attempts have been made to remove this objectionable feature from magnetic grates by having the bars rotate or other means of taking the metal particles to another position. However, with the rotating bars it will be noted that the flux lines stay the same, and therefore, the particles tend to jump back into a bridged condition due to the North and South Poles of the adjacent bars being of different polarity.

It is the object of my invention to overcome the objection of bridging in the magnetic grate by the magnetization of the poles with like poles across from each other in adjacent tubes or rods and adjacent unlike poles along the length of the rod. This method of magnetization causes the particles to lay flat along the rod and be repelled to either the bottom or the top of the rods whichever is the farthest distance from the adjacent rod, thereby eliminating bridging and removing any particles that might be right along or around the rod to a position in back of the rod with respect to flow through the grate where the magnetic force can hold them out of the direct line of the flow. The importance of being held out of the flow may be readily seen when one realizes that covering the magnetic element with a piece of very fine or thin stainless steel can cut down the holding power of the magnet by a great amount, even as much as 65%, when a 16-gauge piece of stainless steel is placed over the magnet. It is, therefore, imperative that the fine particles be taken out or held out of the direct flow of the material to prevent being wiped off the rod.

I am aware that some changes may be made in the general arrangements and combintions of the several devices and parts, as well as in the details of the construction thereof without departing from the scope of the present invention as set forth in the following specification, and as defined in the following claims; hence I do not limit my invention to the exact arrangements and combinations of the said device and parts as described in the said specification, nor do I confine myself to the exact details of the construction of the said parts as illustrated in the accompanying drawings.

With the foregoing and other objects in view, which will be made manifest in the following detailed description, reference is had to the accompanying drawings for the illustrative embodiment of the invention, wherein:

Fig. 1 is a top plan view of the grate magnet constructed in accordance with my invention.

Fig. 2 is an end view of my grate magnet.

Fig. 3 is a sectional view of my grate magnet, the section being taken from lines 3—3 of Fig. 2.

Fig. 4 is a cross-sectional view of my grate magnet, the section being taken on the lines 4—4 of Fig. 1.

Fig. 5 is a diagrammatic plan view showing the magnetic flux lines along the tubular rods of my grate magnet.

Fig. 6 is a diagrammatic end view showing the magnetic flux lines around the tubular rods in my grate magnet.

In the illustrative embodiment of the invention herein a non-magnetic frame is provided. Preferably this frame is made of austenitic material or stainless steel so as to prevent its magnetization and thereby prevent bridging by trapped particles between the adjacent magnetic band and the members of the frame 1.

A plurality of tubes or tubular rods 2 are extended lengthwise in the frame 1 and are secured by suitable studs 3 into the end plates 4 of the frame 1.

In each tube 2 are arranged end to end a series of individual magnets 6 so that in each series unlike poles are adjacent to one another. In other words, the series of magnets 6 in a tubular rod 2 are arranged so that the respective poles of each magnet point in the same direction.

It is also important that the series of magnets in the adjacent tubes 2 be generally symmetrical and be so related that like poles of individual magnets are always directly across from the like poles of magnets in the adjacent tubular rods 2 along the entire length of the tubes so as to create repelling force on trapped particles between the tubes and prevent such particles from bridging the gap between the adjacent tubes.

The individual magnet bars 6 in each series in each tube 2 have unlike poles at their adjacent ends, and a non-magnetic spacer 7 is provided between the adjacent ends of the individual magnet bars 6 to create an air gap.

A plurality of supporting bars 8 are extended across the frame 1 and rest upon suitable ledges 9. On the supporting cross bars 8 are welded or otherwise held grate bars 11 of rectangular cross section so spaced that each grate bar 11 extends generally midway between and above the space between adjacent tubes 2. The cross-sectional arrangement of the grate bars 11 is such that it generally directs the flow and the particles over the respective tubes 2.

The magnetic flux lines as shown in Fig. 6 tend to push away from adjacent tubes 2, causing the flux lines to return to the South Pole in the same tube and create the desired strong magnetic field around the tube 2.

The top view of Fig. 5 shows the flux lines emanating from the end of one of the individual magnet bars 6 of the tube 2 and proceeding to the other end and then crossing over the non-magnetic material 7, as an air gap and to the adjacent end of the next magnet bar 6 in the same tube 2.

As a contrast in the operation of previous type grates such as the magnetic grate shown in U.S. Patent No. 2,733,812, granted February 7, 1956 to Ronald C. Hoff, the magnetic flux lines are not only along the length of the tube, but also transversely across from one tube to the next, creating magnetic fields extending across the space between the adjacent tubes thereby causing magnetic particles to bridge the space between the tubes of the grate. The secondary air gap between the opposite poles in the adjacent tubular rods of these previous grates aligns the particles between the grate or rectangular bars and the tubular rods which is objectionable because it tends to off-center the trapped particles which then will be swept down into a bridging and obstructing position. In contradistinction in the herein invention the weak secondary bridge formed around the rectangular grate

bars slows down the particles which are then swept down and then oriented directly to one tube 2, and are swept around the magnetic field of said tube 2.

In the arrangement of the magnets as above described in the parallel tubes or tubular rods so that all magnets are in the same direction and like poles are across and opposite to one another in adjacent tubular rods, the disadvantage of bridging by magnetic particles and thereby clogging the grate is entirely obviated. The repelling action on the magnetic particles in the space between the adjacent tubes causes the particles to adhere to only one of said tubes and then be swept downwardly through the grate and freely through the spaces between the grate bars, leaving the space unobstructed, and ultimately the ferrous particles are swept down and around the smooth cylindrical peripheries of the tubes 2 to the underside of the tubes 2 and out of the flow line, and thereby accidental freeing of trapped particles from the tubes is prevented. The rectangular grate bars are substantially in registry with and superimposed above the middle of the spaces respectively between the tubes so as to direct the flow toward the respective tubes.

I claim:

1. A magnetic separator comprising a frame including two end members, spaced tubes extending between said end members, and a series of permanent magnets disposed in each of said tubes, said magnets being disposed with opposite poles adjacent each other in each tube.

2. A magnetic separator comprising a frame made of austenitic material including two end members, spaced tubes extending between said end members and permanent magnets disposed in said tubes, said magnets being disposed with unlike poles adjacent each other in each tube, the series of magnets in adjacent tubes being alike to one another so that the respective poles in adjacent tubes are in substantial alignment across said frame.

3. A magnetic separator comprising a frame including two end members, spaced tubes extending between said end members, and a series of permanent magnets disposed in each of said tubes, said magnets being disposed with opposite poles adjacent each other in each tube, the series of magnets in adjacent tubes being alike to one another so that the respective poles in adjacent tubes are in substantial alignment across said frame, said tubes having generally cylindrical and smooth outer periphery.

4. A magnetic separator comprising a plurality of series of axially aligned magnets disposed in spaced

rows, and means to support said magnets in said spaced rows, said magnets in each row being disposed with unlike poles adjacent each other, the poles of said magnets in each row being directly across like poles of corresponding magnets in adjacent rows whereby the magnetic fields produced by said magnets are substantially limited to each row without crossing from one row to the other.

5. A magnetic separator comprising a frame having two end members, spaced tubes disposed in proximate spaced relation and extending between said ends, permament magnets disposed in each of said tubes, said magnets being disposed of unlike poles adjacent each other in each tube, said magnets having magnetic fields generally parallel to the respective tubes, the space between said tubes being clear of obstructions to permit non-magnetic material to freely follow therebetween, and a grate disposed over the top of said magnetic separator to direct flow of material toward said tubes.

6. A magnetic separator comprising a plurality of series of axially aligned magnets disposed in spaced rows and means to support said magnets in said spaced rows, said magnets in each row being disposed with unlike poles adjacent each other, the poles of said magnets in each row being directly across like poles of corresponding magnets in adjacent rows whereby the magnetic fields produced by said magnets are substantially limited to each row without crossing from one row to the other, and a non-magnetic separator between the adjacent ends of the magnets in each row to form an air gap.

7. The magnetic separator recited in claim 5 wherein said frame and end members being made of an austenitic material.

8. The magnetic separator recited in claim 5 wherein said frame and end members being made of an austenitic material, and a non-magnetic separator between the adjacent ends of the magnets in each row to form an air gap.

References Cited in the file of this patent

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