Sept. 15, 1964 C. W. ROSS 3,149,066

MAGNETIC SEPARATOR

Filed Feb. 21, 1961

FIG. 1

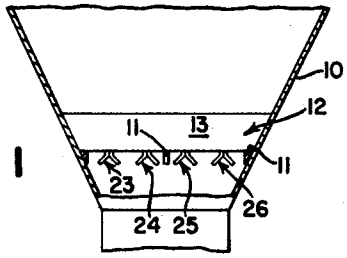


FIG. 2

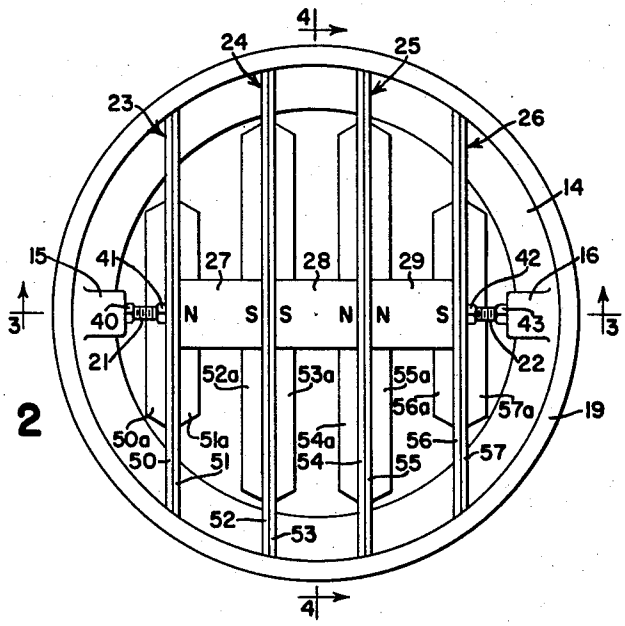


FIG. 3

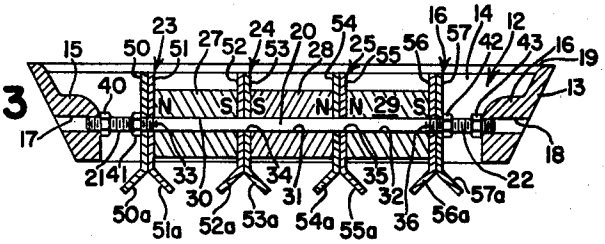
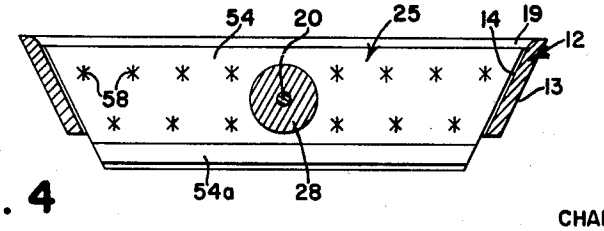


FIG. 4



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MAGNETIC SEPARATOR

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This invention relates to a magnetic separator for use in a stream of material and which operates to remove magnetically attractable materials from the stream. More particularly this invention relates to a magnetic separator having features which make it easily removable and also to features which make the separator more efficient in its separating operation.

It is a purpose of the present invention to provide a magnetic separator which will fit into a hopper having inclined sides. The main support for the separator will be a rigid member having outer inclined surfaces conforming to the shape of a section of the hopper so that the entire separator may be laid in the hopper and will retain its position therein due to the wedging action of the inclined surfaces.

It is also a purpose of the invention to provide a pole plate structure of a new and novel design which features a main portion with a leading edge in opposed relation to the stream of material and also a pair of diverging portions inclined to the main portion and downstream thereof. By diverging the downstream portions or ends of the pole plate structure, the air gap between adjacent plate structures will be narrowed to intensify the field between adjacent plate structures.

It is further proposed to provide a pocket between the diverging portions and on the downstream side of the portions whereby magnetically attracted material may slide or be driven around the edges of the diverging portions and into the pocket. In this manner the particles will no longer be affected by the material moving between the pole plate structures.

It is also a further object of the invention to provide a novel manner of mounting the pole plate structures in an annular cone-shaped member or support.

Other objects and advantages of the invention will become apparent to those skilled in the art as the nature of the invention is better understood from the following description and as shown in the accompanying drawings.

FIGURE 1 is a vertical sectional view of a portion of a hopper to show the location of a magnetic separator.

FIGURE 2 is a plan view of the magnetic separator.

FIGURE 3 is a sectional view taken substantially along the line 3—3 of FIGURE 2.

FIGURE 4 is a sectional view taken substantially along the line 4—4 of FIGURE 2.

Referring now to the drawings, the magnetic separator or device, in its preferred embodiment will sit in a cone-shaped hopper, here indicated in its entirety by the reference numeral **10**, which is typical of a material conduit having opposed inclined sides. Small lugs, such as at **11**, may be placed on the interior surface of the hopper **10** to limit downward movement of the magnetic separator.

The magnetic separator is composed of a cone-shaped ring or annular member **12** which serves as the main frame for the separator. It has an outer cone-shaped surface **13** which conforms to the size and shape of the internal surface of the hopper **10** directly above the lugs **11** as well as an inner cone-shaped surface **14**. As may be seen in FIGURE 1, the ring **12** will normally wedge against the hopper surface and due to the inclined surfaces of the hopper and ring will not otherwise need to be attached to the hopper. The lugs merely operate as stops preventing too tight a wedging action.

Extending inwardly from the surface **14** is a pair of diametrically opposite bosses **15, 16** which have alined

bores **17, 18** therein. The entire support or ring **12** is composed of a non-magnetic material such as aluminum or a non-magnetic stainless steel.

A supporting rod **20**, tapped at opposite ends **21, 22**, extends diametrically across the cone ring **12** and has the ends **21, 22** normally inserted in the bores **17, 18** respectively. Carried on the rod **20** are four parallel pole-plate structures **23, 24, 25, 26** separated by permanent magnets **27, 28**, and **29**. The permanent magnets **27, 28, 29** have central bores **30, 31**, and **32** respectively therein which are in registry with openings **33, 34, 35**, and **36** in respective pole-plate structures **23, 24, 25**, and **26**. The rod **20** extends through the bores and openings. Suitable nuts **40, 41** and **42, 43** are provided on the threaded ends **21, 22** of the rod **20**. As may be seen from viewing FIGURES 2 and 3, the nuts **41, 42** may be tightened against the respective pole plate structures **23, 26** to provide a relatively rigid grillwork for the separator. The nuts **40, 43** may be tightened against the bosses **15, 16** to generally rigidify the grillwork in the ring **12**. Also, by proper threading of the nuts **40–43** along the threaded ends **21, 22** so as to remove the nuts, the entire rod **20** may be withdrawn from the bores **17, 18** and the entire separator grillwork may be dismantled.

Referring now to the specific pole plates **23, 24, 25, 26** they are composed of vertically disposed plates of magnetic material **50, 51; 52, 53; 54, 55**; and **56, 57** respectively which are placed back-to-back and are spot welded, as indicated at **58** in FIGURE 4, to one another. The plate structures **23–26** therefore provide leading or top edges in opposed relation to the normal flow of the stream of materials.

The plate structures **23–26** are parallel to one another and extend across the annular cone ring **12**. The individual plates **50–57** generally have their main portions vertically disposed and have lower inclined portions **50***a*, **51***a*, **52***a*, **53***a*, **54***a*, **55***a*, **56***a*, and **57***a*. Since the material is expected to flow from the top to the bottom of the hopper **10**, the main portions of plates **50–57** are therefore substantially parallel to the stream of material and the lower portions are inclined to the stream. Each pole plate structure therefore has a pair of lower portions which diverge from one another and away from the main vertical plane of the pole structure. Consequently, the air gaps between the lower edges of adjacent plate structures **23–26** are considerably narrower than the gap between the upper portions of the plate structures **23–26**.

The end edges of each of the pole plates **50–57** are inclined downwardly and inwardly and generally at the same angle to the vertical as the adjacent portion of the internal surface **14** of the cone ring **12**. Also, in some instances it will be desirable to have the outer edge conform arcuately with the adjacent surface **14** of the cone **12**. Such is clearly evident in FIGURES 2 and 4 of the drawings. In any case it is desirable to have the outer edges abut the surface of the cone ring or support **12**. By having the edges in contact with the cone ring **12**, the single rod **20** may be used to mount the entire grillwork rigid with the ring as well as mount the parts of grillwork rigidly with one another.

The permanent magnets **27, 28, 29** may be composed of any material, such as a high quality Alnico alloy. The magnets are so placed that similar poles are placed on opposite sides of the pole plates **23–26**, such being indicated by the conventional N's and S's on the drawings.

The magnetic separator operates in the following manner. Material, such as grain, food, or others, will pass downwardly in a stream between the pole plate structures **23–26**. Should a small piece of iron pass between the plate structures, the magnetic force of the plate structures will cause it to impinge against the face of one of the plate structures. Should a large iron particle pass be-

tween the plate structures, the magnetic field created by the upper vertical portions of the pole plates 50–57 may not be strong enough to attract it to one of the plate structures. However, at the lower end portions 50*a*–57*a*, the magnetic force will be considerably larger, due to the decreased gap between the lower ends of the respective plates, and the larger iron particles will be attracted at the lower ends. Consequently, the same size permanent magnets 27, 28, 29 will, in effect, create a stronger magnetic field than heretofore thought possible if used in conjunction with the type of pole-plate structure herein disclosed.

In normal operation of passing material between the pole-plate structures, the material itself will often operate to sweep the iron particles impinged against the plate structures downwardly until the particles reach the lower edges of the portions 50*a*–57*a*. By providing the lower portions 50*a*–57*a* to be inclined and diverging relative to adjacent portions, there are provided spaces or pockets beneath and between the adjacent diverging portions. The iron particles will normally be passed to the lower edges of the portions 50*a*–57*a* and will then pass around the respective edges and come to rest under and between adjacent diverging portions. Consequently, the iron particles will be more or less stored away from and outside of the flowing material so that they will not be accidentally driven off the surface of the plate structures to again move with the material.

While only one form of the invention has been shown, it should be recognized that other forms and variations will occur to those skilled in the art. Therefore, it should be understood that while the present structure was shown and described in detail for purposes of clearly and concisely illustrating the principles of the invention, it was not the intention to limit or narrow the invention beyond the broad manner set forth in the appended claims.

What is claimed is:

1. A magnetic separator for a cone-shaped hopper comprising: a cone-shaped annular support having an outer cone surface conforming to the shape of the inner surface of the hopper and an inner cone surface; a series of parallel spaced apart plate structures extending across the annular support with opposite end edges inclined to substantially conform to an adjacent portion of the support's inner cone surface, each of the plate structures being composed of a pair of plates having vertically disposed back-to-back upper portions and lower portions flaring outwardly and in diverging relation to one another and defining a pocket under and between the lower flared portions in which magnetically attracted particles may gather; a series of alined permanent magnets between the plate structures for inducing a magnetic field between adjacent plate structures; and at least one rod extending through the plate structures, permanent magnets, and the annular cone-shaped support for maintaining rigidity of the aforesaid relative to one another.

2. A magnetic separator for use in a material-transferring structure including a housing in which the walls converge from a large upstream end to a relatively small downstream end, said separator comprising: a support having an outer surface conforming to the shape of the inner surface of the housing and to the angle of convergence of the walls; a series of parallel spaced apart plate structures extending across the support, each of the plate structures being composed of a pair of plates having vertically disposed back-to-back upper portions and portions flaring outwardly and in diverging relation to one another and defining a pocket between the lower flared portions in which magnetically attracted particles may gather; a series of alined permanent magnets between the plate structures for inducing a magnetic field between adjacent plate structures; and means rigidly connecting the plate structures, permanent magnets, and the support.

3. Pole plate structures for use in a magnetic separator adapted for disposition in a stream of material and including a support for carrying at least a pair of plate structures in substantial parallel relation and a permanent magnet extending between the structures for inducing a magnetic field therebetween, each of said pole plate structures comprising: plate means having its major portion rectangular in shape with an upper edge in opposed relation to the stream of material and transverse to the direction of the movement of the stream, and a pair of diverging portions rigid with and continuing downstream from and on opposite sides of the aforesaid major portion, said diverging portions defining a pocket therebetween for receiving magnetically attracted particles moving adjacent the edges of the diverging portions, and means on the major portions for connecting the permanent magnet thereto.

4. A magnetic separator in a material conduit comprising: a separator support carried in the conduit; a series of parallel spaced apart pole plate structures mounted on the support means, each of the plate structures being disposed to lie in a stream of material flowing in the conduit, each structure being composed of a pair of plates having main portions thereof in back-to-back relation and extending from an upstream edge to downstream flanged edge portions flaring outwardly in diverging relation to opposite sides of the main portions with the adjacent downstream edge portions of adjacent structures being relatively closely adjacent to one another in comparison to the spacing between the adjacent main portions of the structures; and permanent magnet means extending between adjacent structures and abutting against the faces of the main portions to thereby induce magnetic fields therebetween and in a greater strength between the edges of the downstream portions of adjacent structures than between the upstream portions.

5. A magnetic separator for use in a material transferring structure including a housing extending from an upstream end to a downstream end, comprising a separator support adapted for mounting in the housing; a series of parallel spaced apart pole plate structures carried on the support, each of the plate structures being composed of a pair of plates having main portions thereof disposed in back-to-back relation and extending from an upstream edge in opposed relation to the normal flow of material to downstream flanged edge portions with each of the latter portions extending outwardly from its respective main portion in diverging relation to the other flange portion to define a pocket therebetween in which magnetically attracted particles may gather; and permanent magnet means extending between the main portions of adjacent plate structures inducing a magnetic field therebetween.

6. A magnetic separator in a material conduit comprising: a separator support means carried in said conduit; a series of parallel spaced apart pole plate structures mounted on the support means, each of the plate structures being disposed to lie in a stream of material flowing in the conduit, each structure having an upstream portion rectangular in shape with an upstream edge in opposed relation to the material, and a pair of downstream portions thereof flaring outwardly in diverging relation to opposite sides of the upstream portion and defining a pocket between the downstream portions and on the downstream side thereof where magnetically attracted particles may gather and be shielded from the material flowing through the conduit; permanent magnet means extending between adjacent upstream portions for inducing a magnetic field between adjacent plate structures; and means interconnecting the plate structures, permanent magnet means, and the support means.

7. Pole plate structures for use in a magnetic separator adapted for disposition in a stream of material and including a support for carrying at least a pair of plate structures in substantial parallel relation and a permanent magnet extending between the structures for inducing a magnetic field therebetween, each of said pole

plate structures comprising: a pair of substantially identical plates having major rectangular shaped portions rigidly joined together in back-to-back contacting relation and disposed in said stream and having upstream edges in opposed relation to the stream of material, and a pair of downstream diverging portions continuing from and extending from the respective major portions to define a pocket between the diverging portions for receiving magnetically attracted particles moving along the surfaces of the plates and around the edges of the diverging portions, and means on the major portions for connecting the permanent magnet thereto.

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