July 10, 1945. R. H. STEARNS ET AL 2,380,342

MAGNETIC SEPARATOR

Filed June 23, 1941 4 Sheets-Sheet 1

Fig. 1

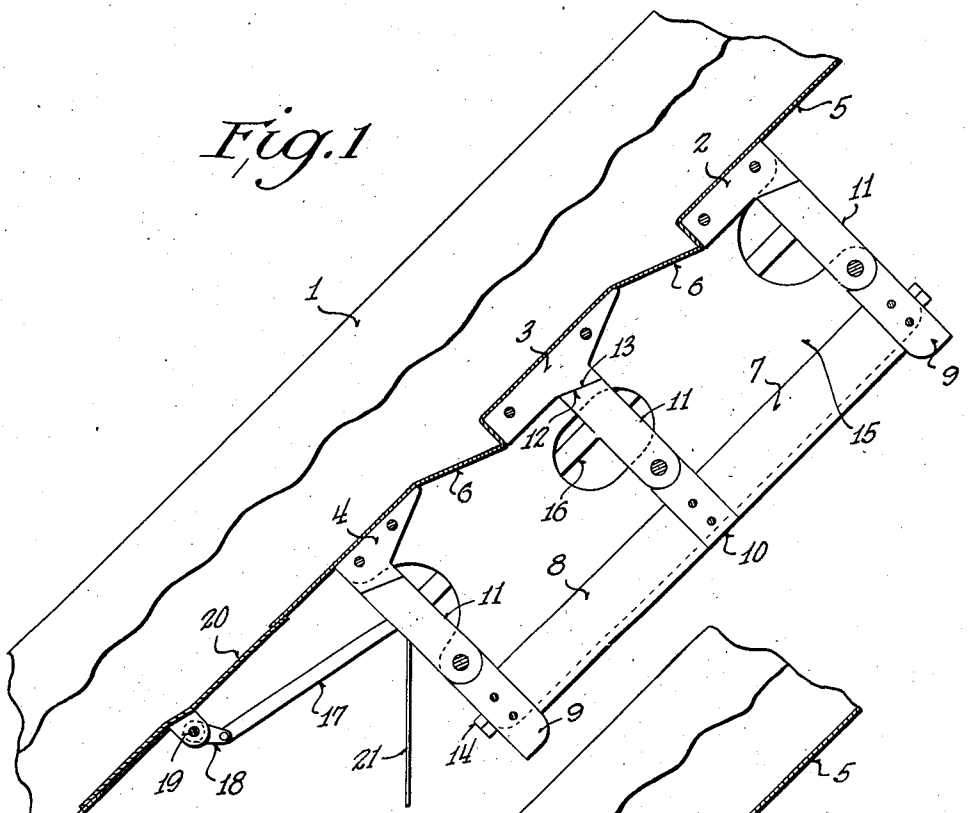
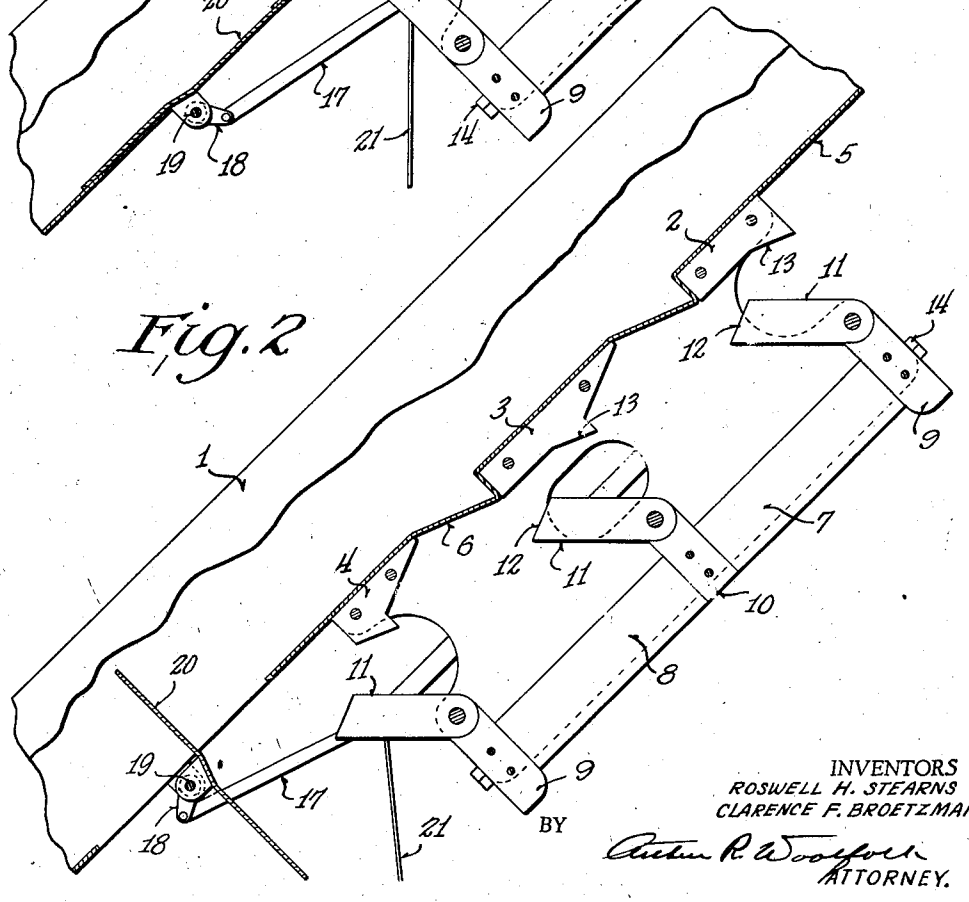


Fig. 2



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MAGNETIC SEPARATOR

Filed June 23, 1941 4 Sheets-Sheet 2

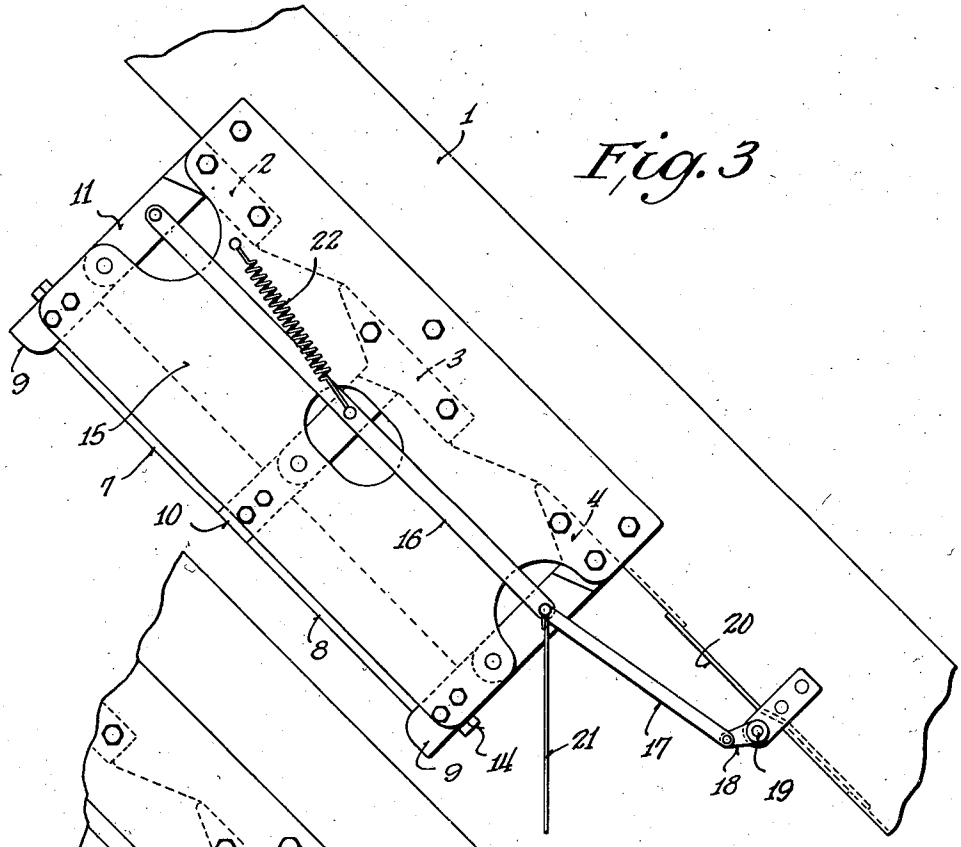

Fig. 3

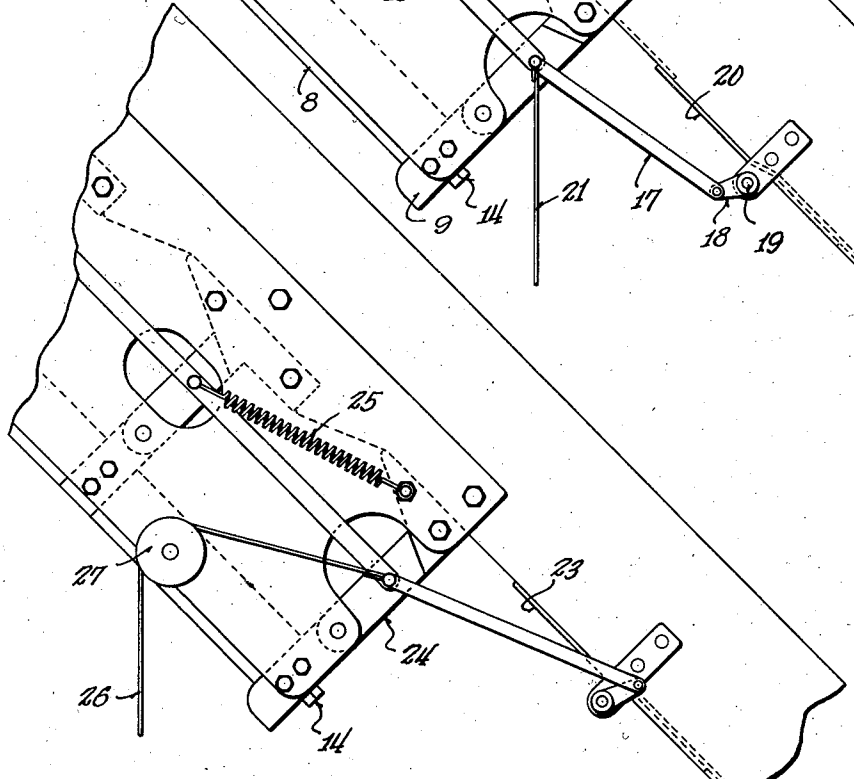

Fig. 4

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MAGNETIC SEPARATOR

Filed June 23, 1941 4 Sheets-Sheet 3

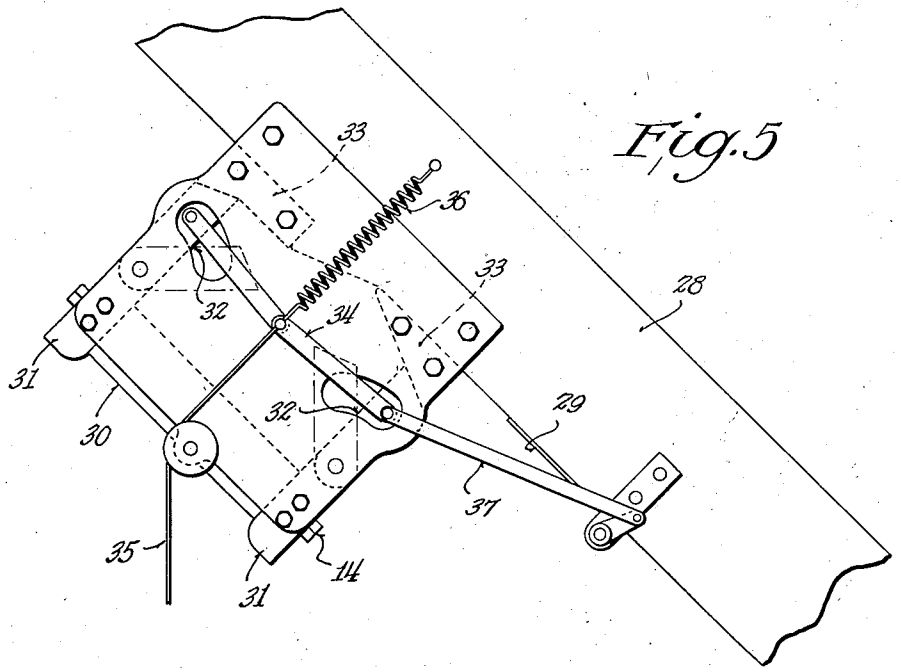

Fig. 5

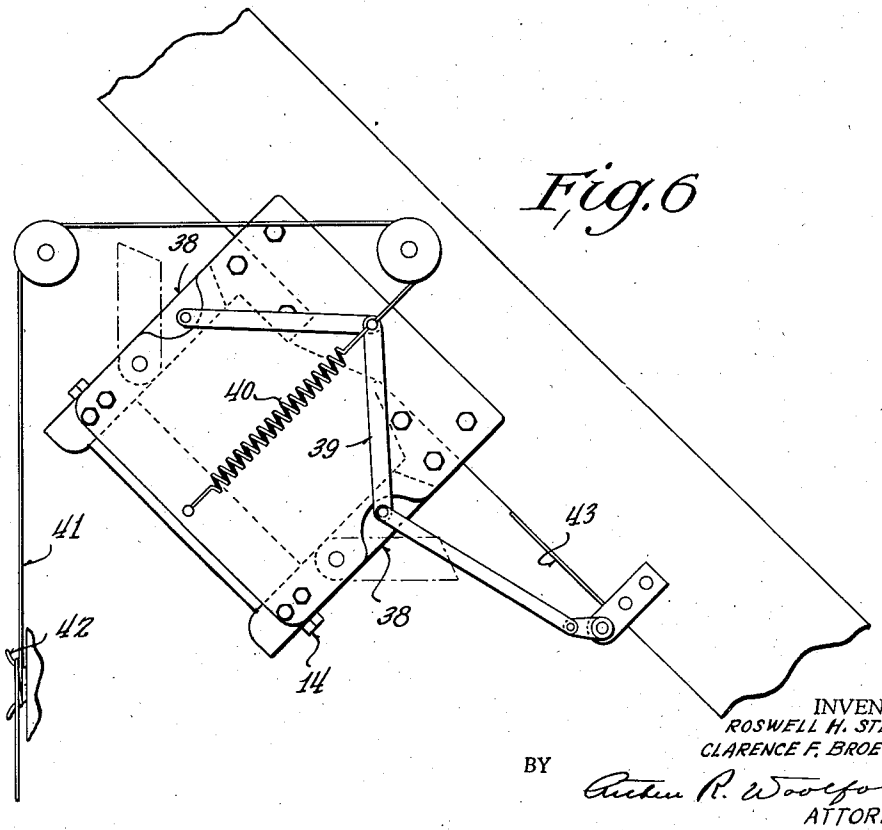

Fig. 6

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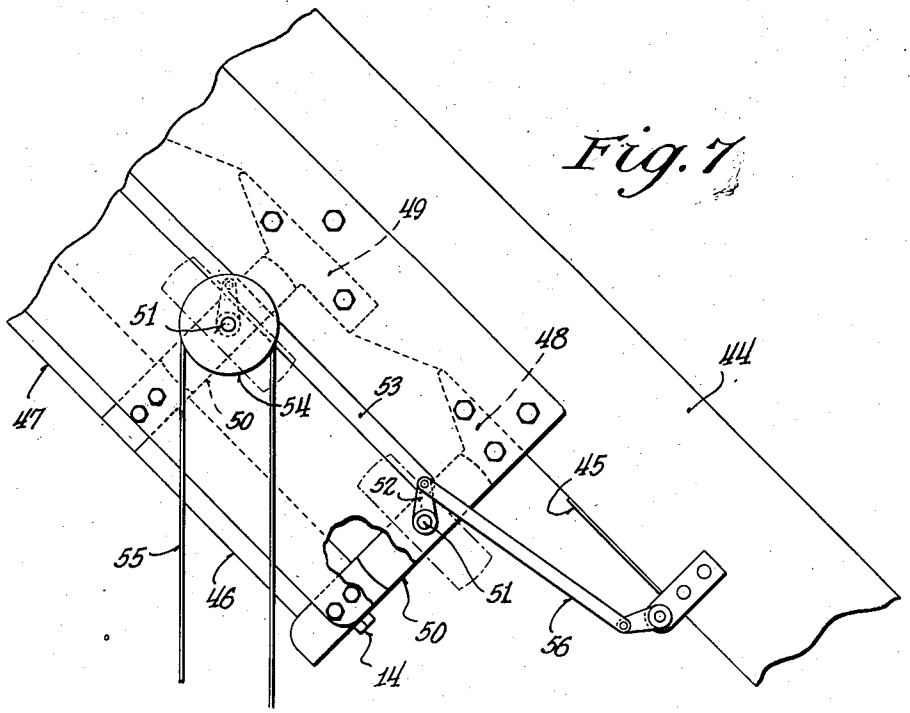
MAGNETIC SEPARATOR

Filed June 23, 1941 4 Sheets-Sheet 4

Fig. 7



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Patented July 10, 1945 2,380,342

UNITED STATES PATENT OFFICE

2,380,342

MAGNETIC SEPARATOR

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Application June 23, 1941, Serial No. 399,248

3 Claims. (Cl. 209—228)

This invention relates to magnetic separators for use in separating magnetic material such as tramp iron from other material. In feed mills, for instance, the presence of tramp iron in the grain often causes serious accidents. Magnetic separators have heretofore been made for feed mills in which electromagnets were employed which collected the tramp iron. At intervals the current was cut off and the tramp iron was discharged.

This invention has for its objects the provision of a magnetic separator in which permanent magnets are employed, in which provision is made for interrupting or diverting the magnetic flux so as to allow the tramp iron to discharge, and in which means are provided for automatically diverting the tramp iron upon interruption of the magnetic flux furnished by the permanent magnets.

Further objects are to provide a permanent magnet separator which may be attached to a feed chute of a mill, which will collect and hold tramp iron, which is provided with means for interrupting the magnetic flux to release the tramp iron and simultaneously moving a gate so as to divert the released tramp iron from the chute.

Further objects are to provide a magnetic separator which may be attached to a feed chute of a mill, which is provided with a permanent magnet and with means for providing a collecting space for the tramp iron, such means being so arranged that upon cessation of the magnetic flux immediately adjacent the chute the tramp iron will automatically discharge.

Embodiments of the invention are shown in the accompanying drawings, in which:

Figure 1 is a view of one form of the invention showing the device applied to a chute with a part of the apparatus in section.

Figure 2 is a view corresponding to Figure 1 showing the movable members in position to interrupt the magnetic flux from the permanent magnets to the pole pieces.

Figure 3 is a view of the parts shown in Figure 1, such view being taken from the opposite side.

Figures 4, 5, 6 and 7 show further forms that the invention may take.

Referring to the drawings, particularly Figures 1, 2 and 3, it will be seen that a feed chute for a mill has been indicated by the reference character 1. The magnetic separator comprises a plurality of pole pieces 2, 3 and 4. Any number of these pole pieces may be used. It is preferable that the pole pieces be arranged in proximity to each other and that the lower face of the upper pole piece 2, for instance, be rather abrupt and the upper face of the lower pole piece 3 be tapered, the lower end of the pole piece 3 and the upper end of the pole piece 4 being similarly arranged.

It is to be noted that the sheet metal 5 forming the bottom of the chute is depressed to form a pocket portion 6 between each pair of poles with the bottom portions thereof slanting for a purpose hereinafter to appear. The pole pieces are magnetized by means of permanent magnets indicated generally at 7 and 8. Like poles of the magnets 7 and 8 are located adjacent each other so as to make the pole piece 3 a consequent pole.

It is preferable to bolt end magnetic members 9 and an intermediate magnetic member 10 in place as shown. These magnetic members forming a portion of the field structure pivotally carry magnetic bridge pieces 11 each of which has an upper slanting face 12 which normally contacts with the slanting lower face 13 of the corresponding pole piece as shown. The permanent magnets 7 and 8 are made of highly magnetized steel many special forms of which are on the market. These permanent magnets are held tightly clamped against the members 9 and 10 in any suitable manner, as by means of the longitudinally extending bolts 14. Suitable side frames or plates 15 of non-magnetic material may be secured to the members 2, 3, 4, 9 and 10 and to the chute 1 to thereby hold the device in place. Any other suitable means of mounting may be employed as the particular form of mounting forms no portion of this invention.

The pole pieces 2, 3 and 4, the magnetic bridge pieces 11, and the members 9 and 10 are all formed of low carbon or mild steel. The members 11 are connected together by means of a connecting rod 16 which is connected by means of a link 17 with a small lever 18 fast on the rock shaft 19 of a diverting gate 20. This gate normally forms a portion of the bottom wall of the chute and normally occupies the position shown in Figures 1 and 3. However, when the rod or rope 21 is pulled downwardly, the magnetic bridge members 11 and the gate 20 are rocked into the position shown in Figure 2. This interrupts or diverts the magnetic flux which normally passes from the permanent magnets to the pole pieces and thus causes the pole pieces to become demagnetized, thereby releasing any tramp iron that has collected in the pocket 6

or adjacent the pole pieces. It is to be noted that the pockets 6, as stated, have slanting bottom surfaces so that when the tramp iron is released, it will slide downwardly from the pockets and will be diverted by the gate 20 outwardly through the bottom of the chute.

After the tramp iron is discharged, the rope 21 is released and the spring 22, see Figure 3, draws the connecting rod 16 upwardly, thereby rocking all of the magnetic bridge members 11 back into their initial position. Simultaneously the diverting gate 20 closes the bottom opening of the chute. Thereafter the grain or other material may again be allowed to flow down the chute until a quantity of tramp iron is collected adjacent the poles of the magnet.

The invention may take many other forms, a few of which have been illustrated.

Substantially the same idea is embodied in the form of the invention shown in Figure 4. The gate 23 is operated simultaneously with the bridge members 24 when the rope 26 is pulled downwardly, and a spring 25 is employed so as to cause the magnetic bridge members 24 and the gate 23 to close when the rope 26 is released. The rope 26 is passed over a pulley 27 so that it pulls upwardly against the magnetic bridge members 24, the spring and gravity both assisting in closing the bridge members 24.

In the form of the invention shown in Figure 5, the chute is indicated by the reference character 28 and the automatically operated gate by the reference character 29. In this form of the invention the permanent magnet is indicated at 30. This magnet has bolted thereto the end members 31 which pivotally carry the magnetic bridge members 32. These bridge members have reversely slanting upper faces which engage the slanting faces of the magnetic pole members 33. The magnetic bridge members 32 normally occupy their full line position but may be rocked towards each other into the dotted line position by means of the toggle link mechanism 34 when the rope 35 is tightened. A spring 36 is provided for producing the return motion of the magnetic bridge members 32. The automatic gate is connected to one of the bridge members 32 by means of the link 37.

The form of the invention shown in Figure 6 is very similar to that shown in Figure 5 except for the fact that the magnetic bridge members 38 are caused to move outwardly to interrupt the magnetic flux by means of the toggle link mechanism 39. This toggle link mechanism is so arranged that the spring 40 will move the magnetic bridge members outwardly unless restrained by means of the rope 41. When the rope is released from the hook 42 about which it is secured, the spring 40 will cause the bridge members 38 to rock to their dotted line positions. When the rope is tightened, the bridge members are rocked back to their full line position. The device is provided with an automatic gate 43 operated in exactly the same manner as that previously described.

In the form of the invention shown in Figure 7, the chute is indicated by the reference character 44 and the automatic gate by the reference character 45. The permanent magnets are indicated by the reference characters 46 and 47. The pole pieces are indicated at 48 and 49.

The bridge members 50 are pivoted so as to rock about their centers and are carried on rock shafts 51 each of which is provided with a small rock arm 52 connected by means of the connecting rod 53. One of the shafts 51 is provided with a pulley 54 about which the belt or rope 55 passes. This belt or rope is suitably manipulated either by pulling on one or the other side thereof, or in any other suitable way, so as to cause simultaneous rotation of all of the bridge members 50 from their full line position to their dotted line position and to cause the automatic operation of the gate 41 through the medium of the connecting link 56.

It is to be noted that the bridge members and the adjacent portions of the apparatus have curved faces so that this rotary motion of the bridge members is permitted. When the bridge members are rocked about their transverse axes to the dotted line position, they introduce a considerable air gap in the field structure and thus interrupt or divert the magnetic flux and demagnetize the pole pieces.

It will be seen that novel forms of magnetic separators have been disclosed in which permanent magnets are employed, in which means have been shown for interrupting or diverting the magnetic flux to allow the trap iron to be discharged, an automatic gate simultaneously operating to divert the discharged magnetic material from the chute.

It is preferable to form pockets so that the trap iron which is swept along by the downwardly flowing grain or other material will, in the majority of cases, be carried into the pockets and will thus be somewhat removed from the direct stream of the downwardly flowing grain or other material.

It is preferable to form the bottom portion of the chute adjacent the magnet poles of non-magnetic material, though magnetic material may be employed for the bottom portion of the chute provided such magnetic material is thin.

It will be seen that this invention provides a magnetic separator which though it uses permanent magnets, nevertheless has means to permit the removal of the collected tramp iron. It is to be noted also that the magnetic separator does not require any energy for its operation as is required by electro-magnetic separators and also that it may be constructed at a comparatively small cost.

Although this invention has been described in considerable detail, it is to be understood that such description is intended as illustrative rather than limiting, as the invention may be variously embodied and is to be interpreted as claimed.

We claim:

1. A magnetic separator comprising a downwardly slanting chute for conducting a mixture of magnetic and non-magnetic material downwardly under the influence of gravity, a pair of pole pieces located on the outer side of and in close proximity to said chute, a permanent magnet having its poles spaced from the said pole pieces, movable magnetic bridge members for normally magnetically connecting said pole pieces with the poles of said permanent magnet, whereby magnetic material in said mixture will be retained in said chute adjacent said pole pieces, said magnetic bridge members being movable to interrupt the magnetic connection between the poles of the permanent magnet and said pole pieces, whereby the magnetic material will be released from adjacent said pole pieces and will flow downwardly in said chute, a diverting member having a normal position and a discharge position, and manually operable means mechanically connecting said bridge members and said

diverting member for simultaneously moving said bridge members to interrupting position and the diverting member to discharge position.

2. A magnetic separator comprising a downwardly slanting chute for conducting a mixture of magnetic and non-magnetic material downwardly under the influence of gravity, a pair of pole pieces located on the outer side of and in close proximity to said chute, a permanent magnet having its poles spaced from the said pole pieces, movable magnetic bridge members for normally magnetically connecting said pole pieces with the poles of said permanent magnet, whereby magnetic material in said mixture will be retained in said chute adjacent said pole pieces, said magnetic bridge members being movable to interrupt the magnetic connection between the poles of the permanent magnet and said pole pieces, whereby the magnetic material will be released from adjacent said pole pieces and will flow downwardly in said chute, mechanism mechanically actuated independently of said magnet for mechanically moving said bridge members, and a diverting member operated by said mechanism and movable simultaneously with the movement of said magnetic bridge members for diverting the released magnetic material, said chute having a pocket adjacent said pole pieces for the magnetic material, said pocket having a slanting bottom to facilitate the discharge of magnetic material when the magnetic flux is interrupted.

3. A magnetic separator comprising a downwardly slanting chute along which a mixture of magnetic and non-magnetic material is adapted to slide, said chute having a depressed portion adapted to collect magnetic material, said chute having pole pieces located on opposite sides of said depressed portion and arranged to be permently out of contact with the mixture passing along said chute, a plurality of permanent magnets arranged closely adjacent each other and in parallel relation to each other and connected by magnetic members with said pole pieces, whereby the flux from a plurality of permanent magnets is conducted to said pole pieces and extends across the depressed portion of said chute and whereby magnetic material held in said depressed portion by said pole pieces does not come into contact with said pole pieces, said separator having means for moving the magnetic members relatively to the pole pieces.

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