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ELECTROMAGNETIC SEPARATOR

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Fig. 1.

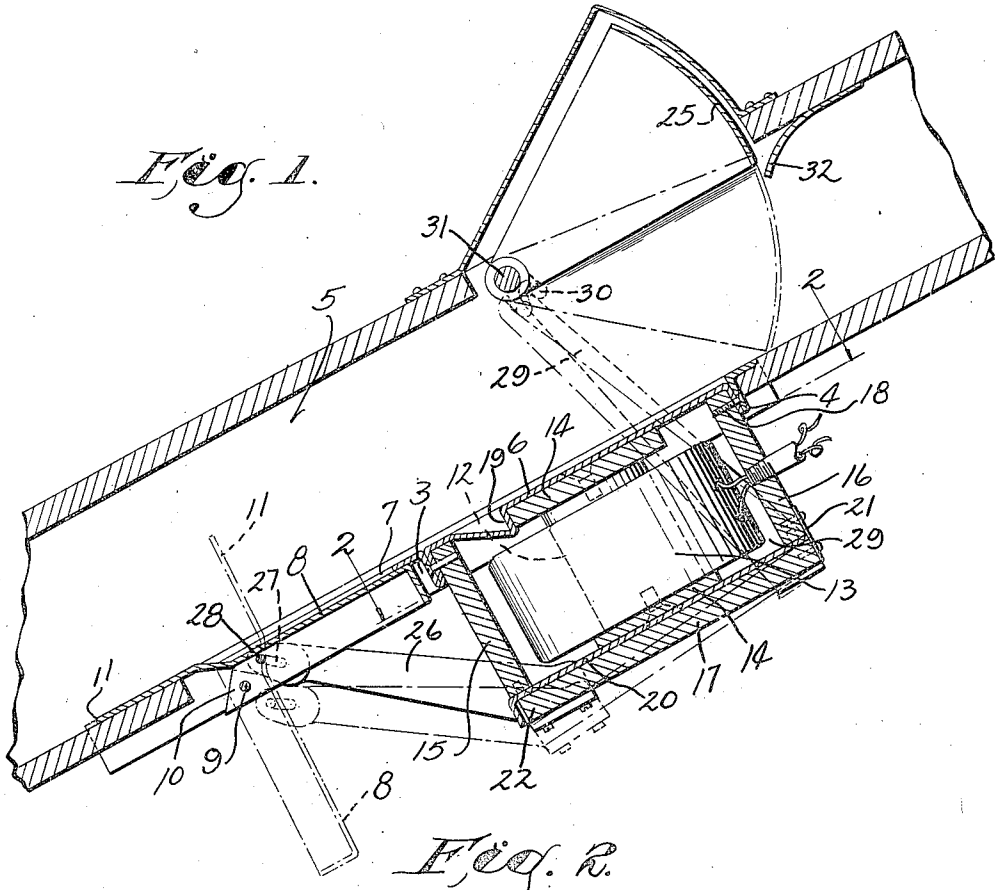
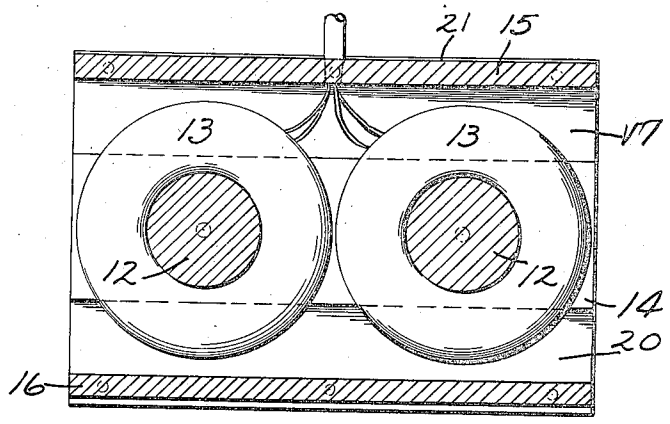


Fig. R.



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ELECTROMAGNETIC SEPARATOR

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4 Claims. (Cl. 209—228)

This invention relates to improvements in electromagnetic separators of the type adapted for spout use. The present application is a companion to our application No. 702,308, now Patent No. 2,089,138, dated August 3, 1937, and includes subject matter divisional with respect thereto.

It is the object of the present invention to provide an improved spout type magnetic separator with increased power, and an improved degree of positiveness in its action, and one which is fully automatic in providing a gate which stops the flow of grain when the current is cut off, and a trap door which releases the magnetizable material under such circumstances while at the same time serving as a second gate to prevent flow beyond the separator, the gates and door being automatically restored with a positive and abrupt movement to their normal positions when the electromagnet is energized.

It is a further object of the invention to use for the actuation of the said gates and trap door, a portion of the core or magnetic flux path of the device which is permanently within the intense field of the magnet and which moves but slightly in the energization of the magnet to a position in which it serves as part of the closed flux path or core during the continued use of the magnet.

It is a further object to provide a novel and improved assembly of the parts wherein the relatively fixed core portions are permanently anchored by sheet metal sufficiently heavy to short circuit the residual magnetism but inadequate to short circuit any appreciable amount of the flux produced when the core is energized.

Other objects will appear from the following description.

Fig. 1 is a view in longitudinal section through an electromagnetic separator device embodying this invention as it appears applied to a spout or chute.

Fig. 2 is a view taken in cross section on the line 2—2 of Fig. 1.

Like parts are identified by the same reference characters throughout the several views.

Our improved magnetic separator is mounted as a unit in a frame comprising side members like that shown at 3 and at least one angle iron end member such as that shown at 4. The frame is arranged for unitary handling and mounting in a spout or chute 5 cut away at its bottom to receive the frame and associated parts. When the frame is properly mounted in position, a plate 6 spanning the frame extends the bottom of the spout to an opening 7 which may be closed by trap door 8 preferably hinged intermediate its ends and preferably having its uppermost end opening downwardly so that its lowermost end will become erect in the spout as a gate to obstruct further passage of material through the spout beyond the separator when the trap door is open.

It will be noted that in the closed position of the trap door 8 as shown in full lines in Fig. 1, its upper end is overlapped by the lower margin of plate 6 which serves as a stop. At the same time the lower end of the door 8 overlaps the uncut bottom of spout 5 beyond the hinge or fulcrum. The fulcrum may conveniently comprise a rod 9 carried by the frame member 3 and extending through the flanged portions 10 of the trap door 8. When the trap door 8 is in the full line position as shown, it will offer no obstruction to the flow of grain or other nonmagnetic material through the spout. When the trap door moves to the position in which it appears in broken lines in Fig. 1, it is open to permit the discharge through the port 7 of any electromagnetic material which may have been accumulated on the magnet while at the same time the portion 11 is elevated to obstruct any further flow beyond the trap door through the spout.

The electromagnet, in this preferred embodiment of our invention, preferably has an E-shaped core. In the particular device illustrated the central cylindrical poles 12 which are encircled by the windings 13 are two in number, due to the width of the spout for which the device is adapted. The poles 12 are connected at top and bottom by the pole pieces 14 which span the spout and the mounting frame from one side to the other. The complementary poles 15 and 16 comprise heavy plates or bars set on edge and likewise spanning the frame and spout from one side to the other. The magnetic circuit between the poles 15 and 16 and the bottom pole piece 14 is completed through a bottom core plate 17 during the functioning of the magnet.

The several core members are maintained in assembly in the proper relative positions by relatively light steel plates sufficient to short circuit the residual magnetism in the parts, but sufficiently light to be saturated with a very minute portion of the total energy of the magnet. The plate 6 serves as one of the sheet metal connectors which hold the core parts in their proper relation. It will be noted in Fig. 1 that the bottom plate 6 is flanged over the core plate 16 and the fastening means, such as the screw at 18,

passes through the angle iron 4 and the flanged end of plate 6 into the core plate 16.

Below the pole piece 14 the plate 6 is bent at right angles and is then reversely bent to provide a pocket 19 between the upper pole piece 14 at the center of the magnet and the lower core plate 15 thereof. This pocket 19 in the intense field of the magnet facilitates the catching and holding of such relatively elusive magnetic foreign matter as steel balls, nuts, etc.

Below the lower core plate 15 the plate 6 is bent at right angles and then folded back upon itself to provide a flange screwed to the pole plate 15, thus maintaining the pole plates 16 and 15 in their proper relative positions.

A plate of similar weight is screwed as indicated in dotted lines to the lower margins of the pole plates 15 and 16 as shown at 20, to hold these margins in their proper relative positions.

The lower core plate 17 is physically connected with the pole assembly of the electromagnet at one end only. In lieu of a more conventional hinge, we prefer to use a strap 21 of resilient spring steel secured to the pole plate 16 and to one end of the bottom core member 17. This leaves the opposite end 22 of the bottom core member 17 free for a limited degree of movement away from the lower core or pole 15, but its range of movement is such that it is always within the more powerful zone of influence of the electromagnet so that when the windings 13 are energized the lower core member 17 will snap into the full line position shown in Fig. 1 and thereafter, during the continued energization of the windings 13, it will remain a part of the closed flux path of the electromagnet.

The movement of the lower core element 17 is employed to operate the trap door 8 and also the grain cut-off gate 25 in unison on the energization and de-energization of the magnet. The movement of the core member 17 is transmitted to gate 8 through an arm 26 fastened to the bottom of the core member 17 and slotted at 27 for engagement with a pin 28 carried by the flange 10 of trap door 8. When the core member 17 is seated against the core poles 14, 15 and 16 as shown in Fig. 1 in full lines, the door 8 will be closed. When the core member 17 drops to its broken line position the door 8 will be open but the gate 11 will be elevated to closing position.

Movement of core member 17 is similarly transmitted through an arm 29, lever 30, and rock shaft 31 to the oscillatory drain gate 25. The rock shaft 31 about which the gate 25 moves in an arcuate path, is located near the top of the spout 5 so that as the gate 25 moves toward its closed position it has the component of movement in the direction of grain flow. We have found that without this arrangement the gate will not be closed automatically or opened automatically within any range of weights and magnetic attraction which is feasible for a device of this character. The magnet must be able to lift whatever weight is imposed on gate 25 for the closing thereof so that when the core member 17 snaps shut to its full line position the gate 25 will immediately be lifted out of the way as shown in full lines. On the other hand, when the magnetic windings 13 are de-energized, the weight of the core member 17 and gate 25, and the upper end of the trap door 8 must be adequate to move the several parts to their dotted line positions, whereby automatically to cut off the flow of grain to release such magnetic material as may have been held by the magnet. We prefer to employ at 32 a baffle somewhat restricting the depth of the grain flow as it approaches the gate 25 to facilitate the opening and closing movement of the gate.

As will be apparent from the foregoing description, the operation of our improved device is entirely automatic. The form of magnet illustrated is such that great magnetic power is exerted across the narrow flux gaps between the core members 15 and 16 and the upper pole plate 14. Thus a magnet of this type is extremely effective to catch and hold magnetic material pending de-energization of the windings 13.

So long as the windings 13 are energized, the movable core element 17 will be held electromagnetically with great force in its full line position whereby its arm 26 will hold the trap door 8 closed, and its arm 29 will hold the gate 25 open. When the windings 13 are de-energized the residual magnetism remaining in the core elements will be short circuited through the plates 6 and 20 which provide flux paths of restricted capacity. Thus there is absolutely nothing to hold the core element 17 in its full line position and it will drop by gravity, thereby occasioning the automatic closing of gate 25, the opening of the trap door 8, and the closing of the lower gate 11. This will immediately interrupt the flow of grain through the spout 5 toward the separator and will immediately release all material held on the separator for discharge through the opening 17 exposed by the dropping of the trap door 8. If the windings 13 be re-energized, however, the powerful electromagnetic force tending to shorten the flux paths through the core elements will draw the core member 17 upwardly with a snap, thereby sharply closing the trap door 8 and at the same time opening the gate 25. Thereafter, so long as the windings 13 remain energized, the core member 17 will comprise a part of the closed flux path through the magnet core.

We claim:

1. In an electromagnetic separator, the combination with a plurality of polar core elements, of means permanently connecting said elements and having a limited flux carrying capacity just sufficient to short circuit the residual magnetism in said elements, a winding on one of said elements, an armature core member movable to and from one side of the several elements to complete the flux path therethrough when the winding is energized, and a gate connected to said armature core member to be actuated thereby.

2. An electromagnetic separator comprising the combination with a frame, of a spout plate spanning the frame and having limited flux carrying capacity, a center polar core element connected to an intermediate portion of said plate, terminal polar core elements connected to said plate in spaced relation to said center core element, a second plate connecting the opposite ends of the several polar core elements and having limited flux carrying capacity, and an armature core element movable to and from said second plate and adapted when engaged therewith to complete a flux path between the several polar core elements.

3. An electromagnetic separator comprising the combination with a frame, of a spout plate spanning the frame and having limited flux carrying capacity, a center polar core element connected to an intermediate portion of said plate, terminal polar core elements connected to said plate in spaced relation to said center core ele-

ment, a second plate connecting the opposite ends of the several polar core elements and having limited flux carrying capacity, and an armature core element movable to and from said second plate and adapted when engaged therewith to complete a flux path between the several polar core elements, said armature core element being pivoted to one of said polar core elements.

4. An electromagnetic separator comprising the combination with spaced terminal polar core elements and a plurality of intermediate polar core elements arranged in transverse series therebetween, of a pole piece connecting said intermediate polar core elements at each end, means of limited flux carrying capacity connecting said terminal polar core elements with the respective pole pieces, and an armature core element pivoted to one of said terminal polar core elements and oscillatable through a limited range within the immediate field of the other terminal polar core element, and gate means connected with said armature core element to be actuated thereby, said gate means being operatively connected to limit the range of movement of said armature core element.

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