

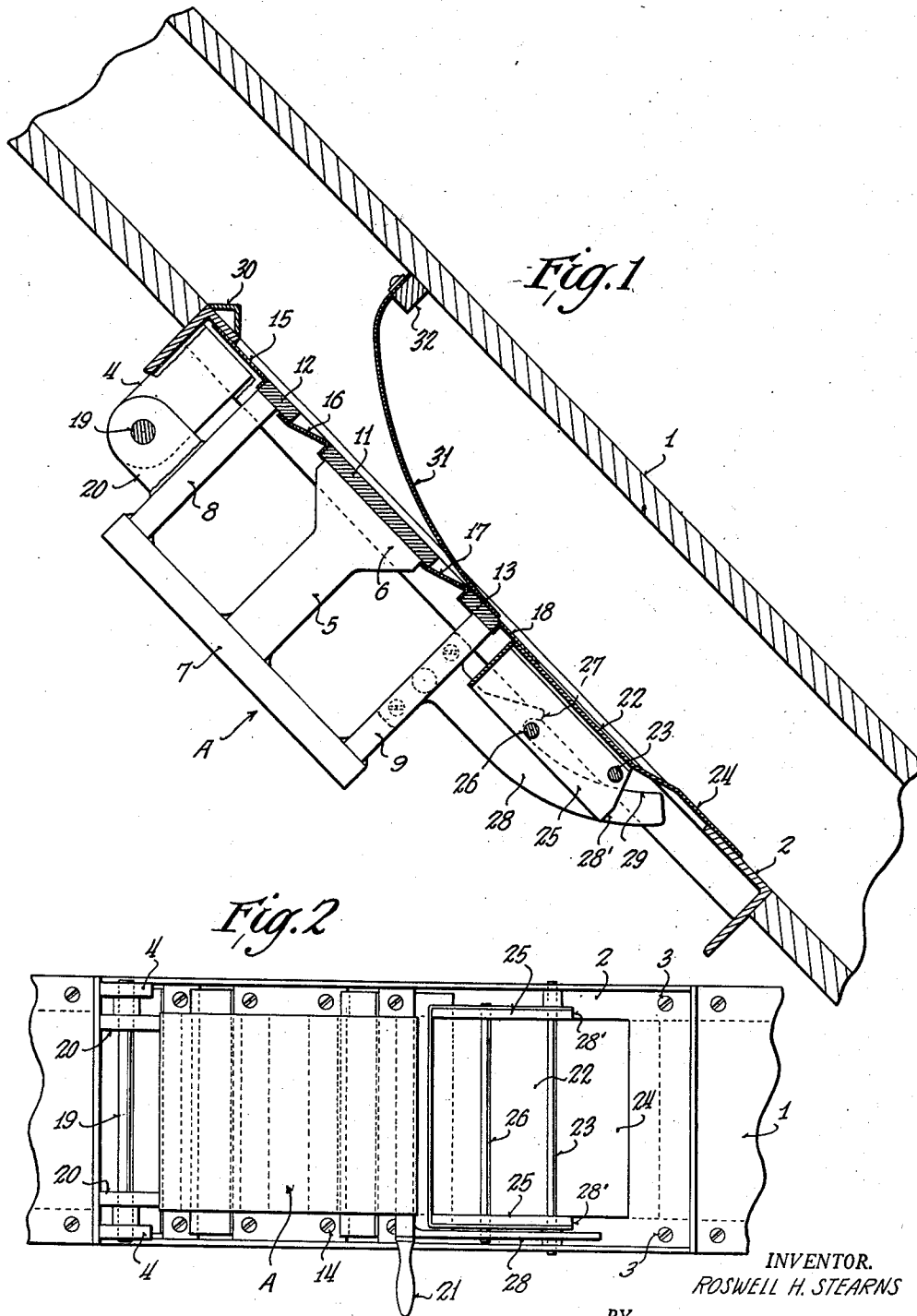
Feb. 8, 1949.

R. H. STEARNS
MAGNETIC SEPARATOR

2,461,008

Filed May 31, 1945

2 Sheets-Sheet 1



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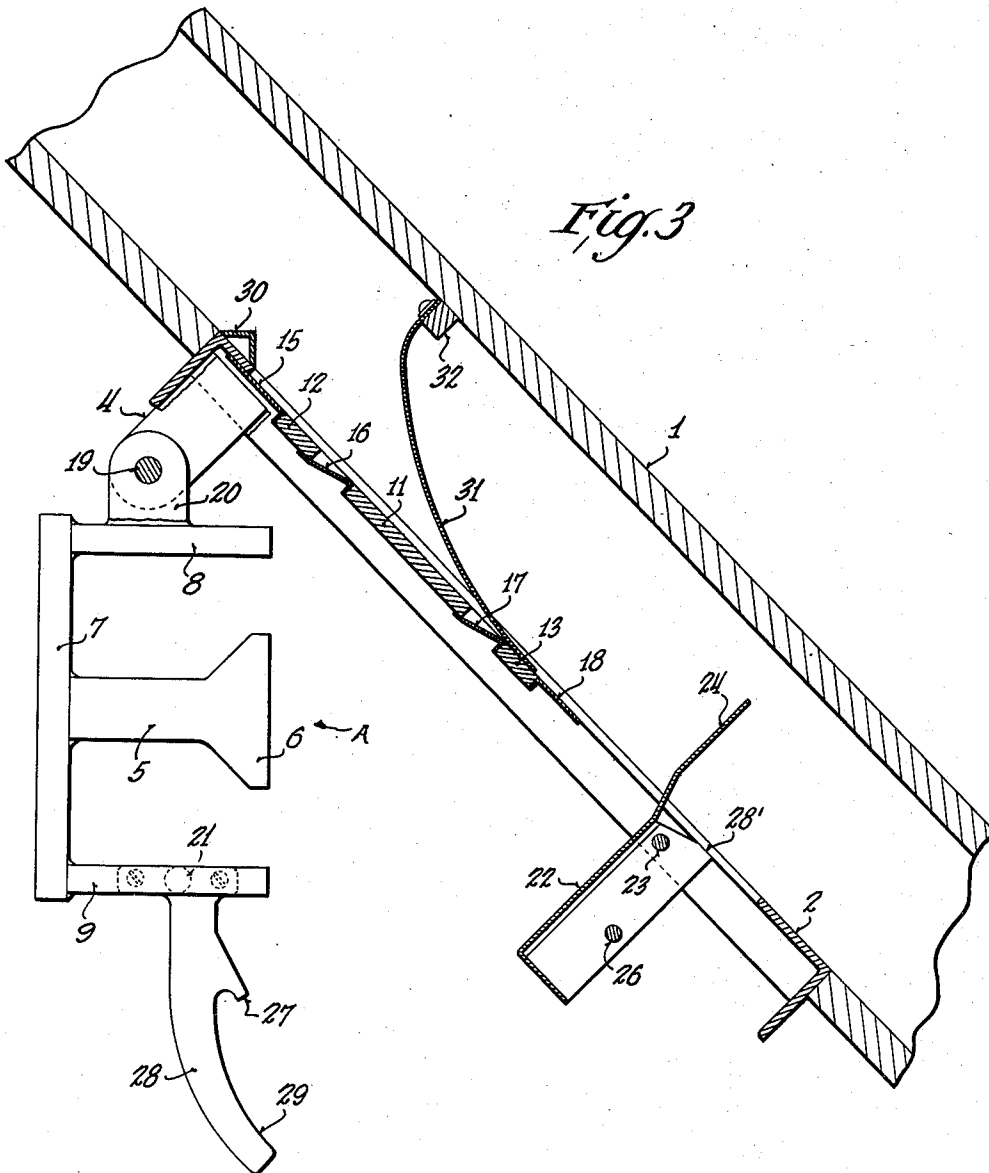
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MAGNETIC SEPARATOR

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3 Claims. (Cl. 209—228)

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This invention relates to magnetic separators and is particularly directed to permanent magnet spout type separators.

The primary objects of this invention are to provide a permanent magnet spout type separator which is so constructed that tramp iron or other magnetic material is removed from nonmagnetic material as the mixture slides or flows down the spout, which holds the magnetic material until the magnet is moved to inoperative position, which operates a trap gate to open the trap gate when the magnet is moved to inoperative position and which closes the trap gate when the magnet is moved back to operative position, in which the action of the trap gate is positive and automatic and cannot be interfered with, and in which no latch or other similar means is required to hold the magnet in operative or inoperative position but in which the magnetic attraction of the permanent magnet itself is employed to positively hold the magnet in operative position and the trap gate closed and in which gravity is effective to hold the permanent magnet in inoperative position and the trap gate open.

A further and important object is to provide a permanent magnet spout type separator which is arranged to insure the automatic release and discharge of magnetic material when the permanent magnet is moved to inoperative position to thus avoid the necessity of manually removing the magnetic material.

It has been found that with permanent magnets, such as those composed of "Alnico" for instance, that when a piece of tramp iron comes into proximity to the magnet that there does not seem to be an immediate rearrangement of the lines of force or flux from the permanent magnet and consequently the pull or force acting on the tramp iron is not as effective or great and does not reach its maximum value as quickly as would be expected. This invention, however, has for its further objects provision of means for correcting this defect so that the pull or force acting on the tramp iron is enhanced and the effect is substantially instantaneous so as to insure the catching and retaining of the tramp iron as the mixture flows down the chute past the magnet.

Further objects are to provide a permanent magnet spout type separator which is of very simple construction, which may be cheaply manufactured, and which is easy to apply or install.

An embodiment of the invention is shown in the accompanying drawings in which:

Figure 1 is a sectional view through the device showing the magnet in operative position and the trap gate closed.

Figure 2 is a bottom view of the structure shown in Figure 1.

Figure 3 is a sectional view corresponding to

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Figure 1 showing the magnet in inoperative position and the trap gate in open position.

Referring to the drawings it will be seen that a spout or chute is indicated by the reference character 1, down which the material is adapted to flow, such material being a mixture of non-magnetic material such, for example, as grain or feed, and magnetic material such, for example, as tramp iron.

The separator is adapted to be installed in the bottom wall of the chute by cutting out a portion of the chute and securing an open angle iron welded frame 2 to the chute by means of screws or other suitable fastening means 3, such screws passing upwardly into the side walls of the chute or spout.

A pair of lugs 4 are rigidly carried by the frame adjacent its upper end and project downwardly therefrom. These lugs may be welded or otherwise secured to the frame.

The magnet structure indicated generally by the reference character A is composed of a permanent, centrally located magnet 5 which may be of any suitable permanent magnet material such as "Alnico." It is provided with a flared upper portion 6 and is welded or otherwise secured at its bottom end to a bottom plate or bar 7 of soft iron or soft steel. Two upright soft iron or soft steel bars or plates 8 and 9 extend upwardly from the bottom plate 7 and are welded or otherwise secured thereto. The upper faces of the portions 8, 8 and 9 are accurately ground or machined and adapted to come into intimate contact with the soft iron or soft steel magnetic pole pieces 11, 12, and 13 respectively. These pole pieces 11, 12, and 13 are secured in any suitable manner as by means of screws 14, see Figure 2, to the underside of the cut out frame 2.

Nonmagnetic sheets are provided for closing the spaces between the upper end and sides of the frame and between successive pole pieces. These sheets or plates may be formed of any suitable material, for example, nonmagnetic stainless steel. The upper plate or sheet is indicated by the reference character 15 and extends from the upper end of the frame and from the sides of the frame to the pole piece 12. It is welded to the frame and to the pole piece. The next sheet is indicated by the reference character 16 and extends from beneath the pole piece 12 to the upper edge of the pole piece 11 and is welded to such pole pieces and to the frame. The third sheet is indicated by the reference character 17 and is similarly welded to the underside of the pole piece 11 and extends upwardly to the upper edge of the pole piece 13 and is welded thereto and to the frame. The last sheet is indicated by the reference character 18 and is welded to the pole piece 13 and to the frame.

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Means are provided for pivotally supporting the magnet so that it may be rocked from operative position, as shown in Figure 1, to inoperative position as shown in Figure 3 or back to operative position as shown in Figure 1. This means consists of a pintle pin or shaft 19 which passes through a pair of lugs 20 rigid with the magnet structure A and through the lugs 4 to thus pivotally join the magnet to the frame adjacent the upper side or end of the magnet structure. Suitable spacers as shown in Figure 2 may be employed and positioned between the lugs 20 and 4.

No latches are required for retaining the magnet in either its operative position or in its inoperative position. In its operative position, as shown in Figure 1, the magnetic attraction between the magnet structure and the pole pieces firmly and positively holds the magnet in operative position. When the magnet is pulled down to the inoperative position, as shown in Figure 3, gravity retains the magnet in this position. Any suitable means such, for example, as a handle 21 projecting from one side of the magnet may be provided for rocking the magnet to either position.

A trap gate indicated by the reference character 22 is provided and is preferably of channel shape and is pivotally mounted on a pintle pin or shaft 23 carried by the frame 2.

This trap gate when in closed position has its upper end positioned beneath the plate or shield 18. It is provided with a normally downwardly projecting member 24 which normally lies on the upper side of the frame 2 and which when the trap gate is in its open position, as shown in Figure 3, extends upwardly and constitutes a barrier for arresting the downwardly traveling released tramp iron so that the tramp iron will be discharged through the opening adjacent the trap gate. The trap gate is preferably weighted by means of a pair of bars of iron or other heavy material indicated by the reference character 25 which may be welded or otherwise secured to the inner sides of the trap gate. A pin or bar 26 extends transversely across the trap gate and projects beyond one side thereof as shown most clearly in Figure 2. This pin or bar is adapted to be engaged by a projecting finger or member 27 when the magnet structure is rocked downwardly to inoperative position to thus positively rock the trap gate to open position. The weight of the trap gate will hold the trap gate in open position as shown in Figure 3. The corner portions or lower end portions 28, see Figure 3, of the trap gate abutting the side flanges of the frame 2 constitute stops to hold the trap gate in the position shown in Figure 3. The finger or member 27 is an integral part of a bracket or arc-shaped portion 28 rigidly secured to one side of the magnet structure. This bracket is provided with a cam portion 29 which is arranged to engage the pin 26 when the magnet is rocked from its inoperative position shown in Figure 3 to its operative position shown in Figure 1 to thus close the trap gate and hold the trap gate in its closed position.

It is preferable to provide a small barrier 30 which extends transversely across the chute in accordance with the usual practice to cause the material to bound slightly to insure agitation thereof as it approaches the pole pieces. In order to prevent any material from bouncing over the pole pieces, a rubber sheet 31 is secured to a transverse portion 32 adjacent the upper side of the chute and loosely bears against the

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plate 18. It has been found that the curvilinear rubber sheet 31, in conjunction with the barrier or baffle 30, causes the material to fall directly downwardly on the face of the magnet and materially slows up the flow of material temporarily at the magnet poles. By actual observation it has been found the material substantially stops at the magnet poles for a brief instant, and thus allows sufficient time for the magnetic forces to grip and hold all of the magnetic material while the nonmagnetic material is allowed to pass.

In using the separator the material is allowed to flow down the chute while the magnet is in its operative position as shown in Figure 1 and the tramp iron or other magnetic material comes in direct contact with the pole pieces 11, 12 and 13 and is retained thereby. Such magnetic material may be swept downwardly slightly by the oncoming material but, nevertheless, it will lodge in the spaces just above the plates 16 and 17 even if it is not securely held against the face of the pole pieces.

It is to be noted that the pole pieces 11, 12, and 13 are relatively thick and insure adequate magnetic material to allow substantially instantaneous shifting of the lines of force or flux as the tramp iron approaches these magnetic poles and to thus enhance the force or pull on the tramp iron and also secure substantially instantaneous response. Substantially no shifting of the lines of force or magnetic flux takes place in the permanent magnet 5 but by means of the construction hereinabove set forth provision is made to allow substantially instantaneous shifting of flux or lines of force as required and as has been explained hereinabove.

When it is desired to discharge the magnetic material the feed is stopped in any of the usual ways, not shown, and the handle is grasped and forced downwardly thus rocking the magnet structure A from its operative position as shown in Figure 1 to the inoperative position as shown in Figure 3. During the first portion of this rocking motion the finger 21 positively moves the trap gate 22 to its open position as shown in Figure 3. Gravity retains the magnet A and the trap gate in their respectively inoperative and open positions. When it is again desired to place the magnet in operative position the handle 21 is pulled upwardly until the magnet structure A intimately contacts the pole pieces 11, 12, and 13. During the latter portion of this motion the cam part 29 of the bracket 28 engages the pin 26 and positively rocks the trap gate 22 to closed position, as shown in Figure 1, and holds the trap gate in closed position. It is to be noted particularly that no latches whatsoever or similar devices are employed to retain either the magnet or the trap gate in closed position. The magnetic attraction of the magnet is employed to positively hold the magnet in operative position and the trap gate closed and gravity is relied upon to hold the magnet and trap gate in their respectively inoperative and open positions.

It will be seen that a novel permanent magnet spout type separator has been disclosed which is of very simple and effective construction and which may be cheaply made and readily installed.

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.

I claim:

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1. A permanent magnet spout type separator comprising a downwardly slanting spout down which a mixture of magnetic and nonmagnetic material is adapted to slide, a plurality of soft steel pole pieces of magnetizable material permanently mounted in said spout in position for the material to pass thereover, a magnet structure comprising in combination a permanent magnet and a U-shaped yoke of magnetizable material hingedly supported from and below said spout and bodily movable as a composite unit upwardly into and out of contact with said pole pieces to respectively energize and deenergize said pole pieces, a trap gate carried by said spout for discharging magnetic material, and means for mechanically connecting said magnet structure and said trap gate to positively close and open said trap gate when said magnet structure is respectively moved into and out of contact with said pole pieces, the weight of said magnet structure being temporarily overcome by the magnetic attraction of said magnet structure to thereby hold said magnet structure temporarily in position against the action of gravity.

2. A permanent magnet spout type separator comprising in combination a magnet structure having a center pole of permanent magnetic alloy steel and end poles of soft steel affixed to a common bridge bar of soft steel to thereby provide twin fields of unlike magnetic polarity, a downwardly slanting spout down which magnetic and nonmagnetic material is adapted to slide, said spout comprising a structural frame of nonmagnetic material, a plurality of soft steel pole pieces permanently located in said spout and arranged to have the mixture pass over said soft steel pole pieces, said soft steel pole pieces being inductively magnetized when the magnet is in operable position and demagnetized when in nonoperable position, a swinging trap gate mounted in said spout, said trap gate when in the open position arranged to arrest and discharge magnetic material and when in closed position to permit nonmagnetic material to flow through said spout, said magnet being hingedly mounted to said spout and arranged to be rocked to operative or inoperative position, and means comprising a trap gate trip attached to said magnet to positively force said

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trap gate to open position when the magnet is moved to inoperative position for discharge of magnetic material, said trap gate trip having a curved arc-shaped portion arranged to positively close said trap gate by sliding contact with said trap gate when the magnet is returned to its normal operating position.

3. A permanent magnet spout type separator comprising a downwardly slanting spout down which a mixture of magnetic and nonmagnetic material is adapted to slide, a plurality of soft steel pole pieces of magnetizable material permanently mounted in and arranged to have the mixture pass over said soft steel pole pieces, and a magnet structure comprising in combination a permanent magnet and a U-shaped yoke of magnetizable material hingedly supported from said spout and movable into and out of contact with said soft steel pole pieces, said hingedly supported magnet structure being held in operative position in contact with said soft steel pole pieces until manually released solely by the magnetic attraction of said hingedly supported magnet structure, said spout having in combination a projecting baffle to cause material to bound upwardly, and a curvilinear sheet member located above the magnetic field to cause material to strike said sheet and drop directly on the face of said magnet pole pieces to thereby slow down the speed of flowing material momentarily, thus allowing sufficient time for the magnetic forces to grip and hold all magnetic material, while the nonmagnetic material is allowed to pass.

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