Jan. 3, 1967 H. L. GENIER 3,295,678

MAGNETIC SEPARATOR FLOW CONTROL

Filed July 19, 1962 4 Sheets-Sheet 1

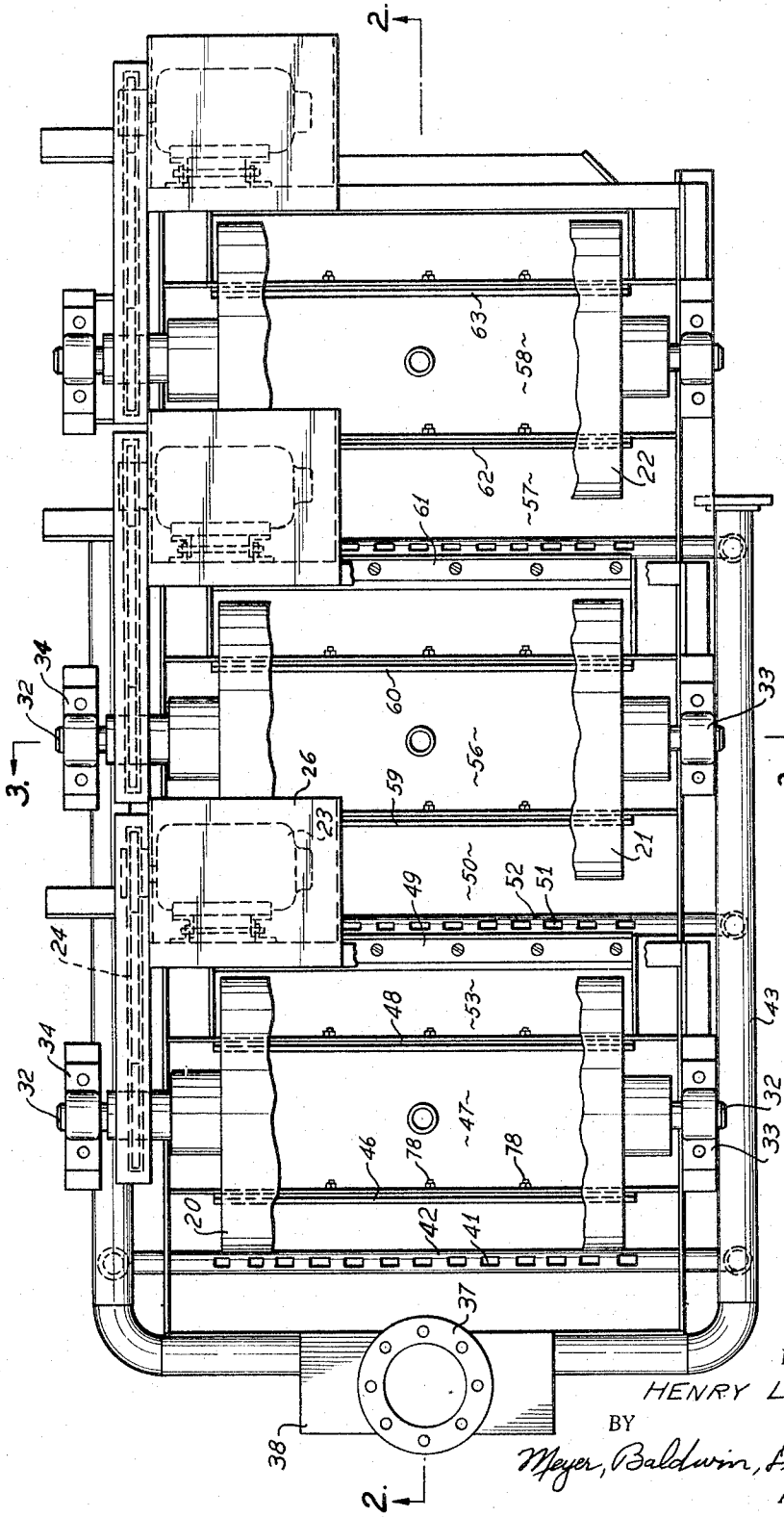


Fig. 1.

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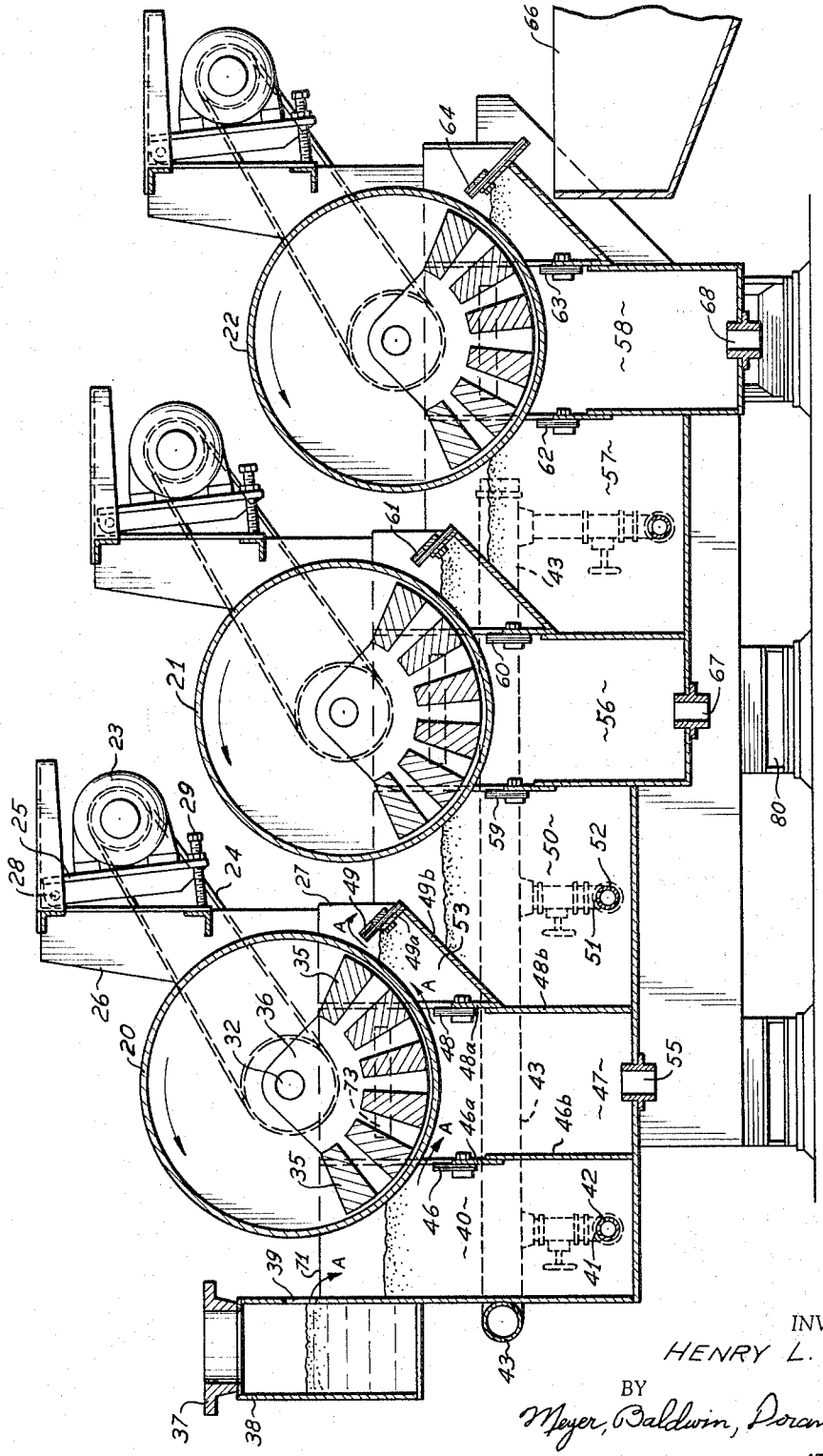


Fig. 2.

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MAGNETIC SEPARATOR FLOW CONTROL

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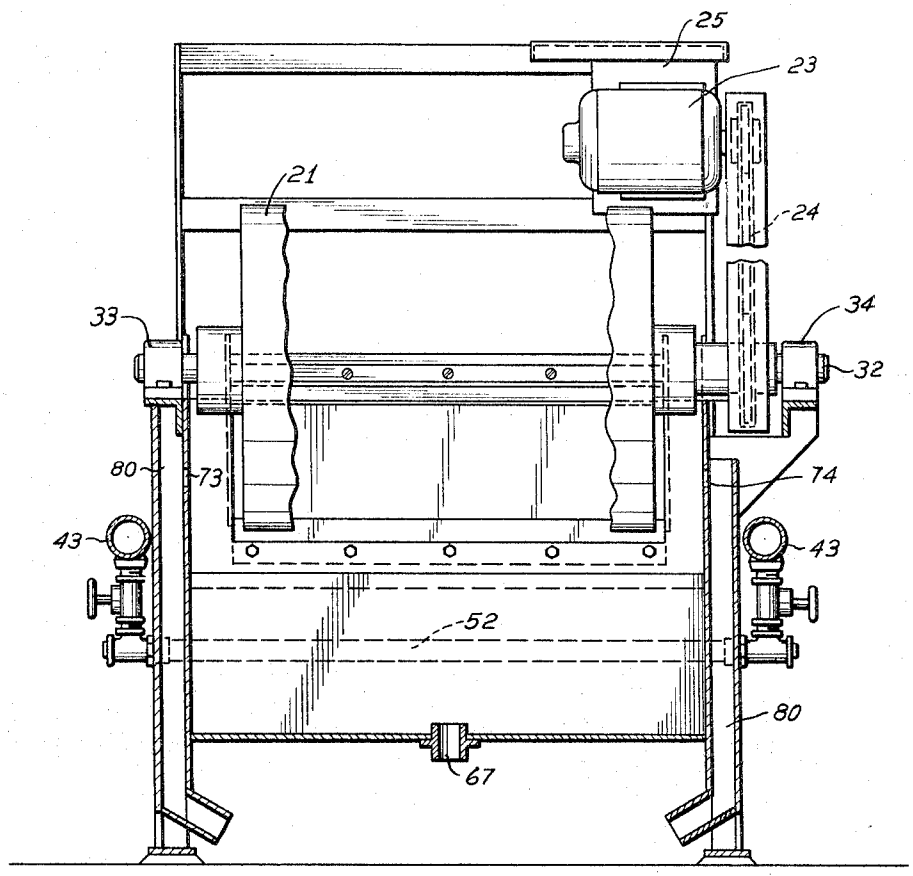


Fig. 3.

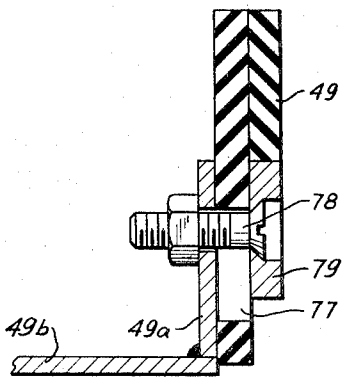


Fig. 6.

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MAGNETIC SEPARATOR FLOW CONTROL

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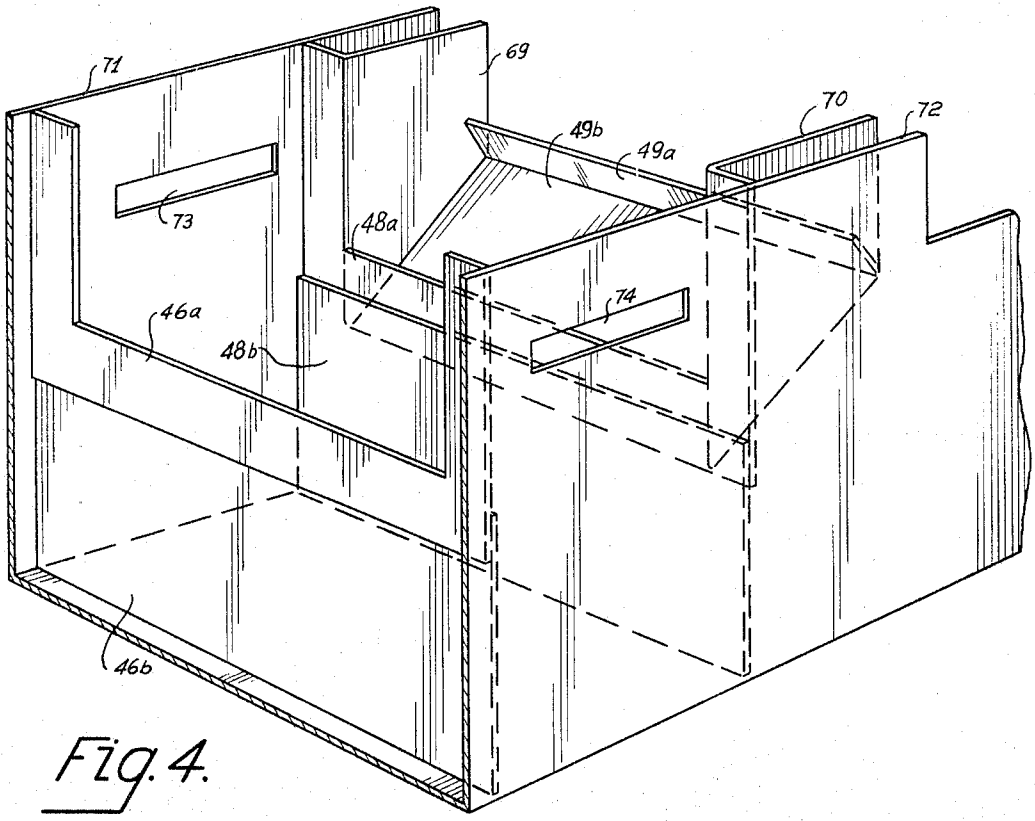


Fig. 4.

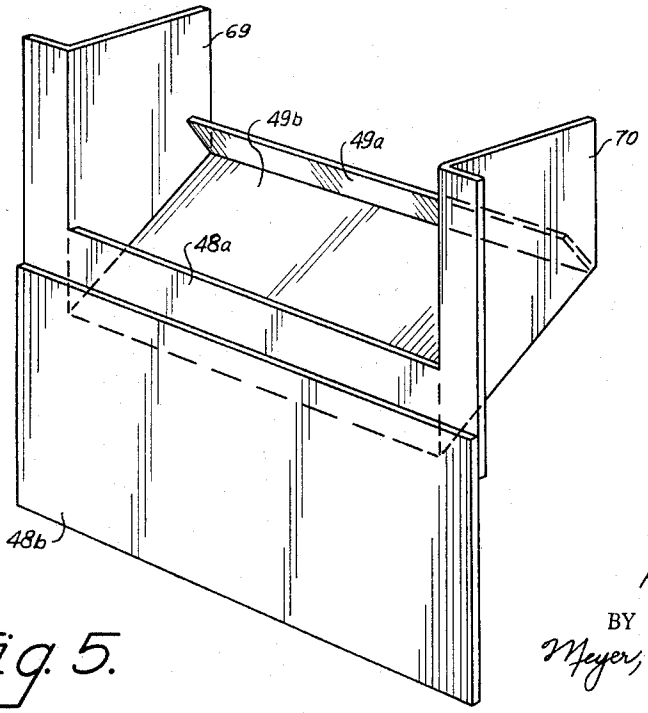


Fig. 5.

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3,295,678

MAGNETIC SEPARATOR FLOW CONTROL

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1 Claim. (Cl. 209—223)

The present invention relates to magnetic separators which are used for separating magnetizable material from a commingled slurry containing also non-magnetizable fractions normally termed gangue, tailings, or the like. The finely ground material, mixed with water, is fed past one or more magnets developing a fairly dense magnetic field whereupon the magnetic portion of the slurry is attracted towards the magnets and the non-magnetic material or tailings passes to a place of disposal.

The apparatus just mentioned may be one of several embodiments but will be herein shown and described as a drum separator assembly wherein one or more magnets are disposed within and adjacent to one wall portion of the drum, and the slurry flows past the drum, contacting said wall portion as it passes. The magnetizable fraction adheres to the drum wall and is carried out of the magnetic field by drum rotation, whereupon it drops off the drum and proceeds further, possibly to additional separating and concentrating means. A number of such drums may be used in tandem, the slurry flowing past each drum in sequence, losing more and more of the tailings as it progresses, and consequently becoming more and more concentrated in percentage of ferrous metal.

There are other types of magnetic separators, such as the so-called belt type wherein the magnets are disposed behind an endless travelling belt but for simplicity the invention is described herein as adaptable to the drum type separator.

An object of the present invention is to provide novel and improved means for more efficiently directing the ore slurry to the field of the magnetic separator.

A further object of the invention is to provide improved restricted channel means through which the slurry must pass, said channel being immediately adjacent to the drum surface.

A further object of the invention is to provide, in the aforesaid restricted channel, adjustable weir means whereby the cross sectional area of the fluid carrying channel can be varied to compensate for other variables such as slurry stream velocity or slurry density.

A further object of the invention is to provide weir means as defined in the last preceding paragraph wherein the adjustable part of the weir is formed from flexible material to prevent jamming or entrapment of oversized pieces of ore or tramp metal between the weir and the drum, and consequent scoring of the drum surface.

Other objects and advantages will be apparent from a study of the following description of one embodiment of the invention, in conjunction with the accompanying drawings, in which:

FIG. 1 is a top plan view of a three-drum magnetic separator embodying my invention.

FIGS. 2 and 3 are sectional views taken respectively on the lines 2—2 and 3—3 of FIG. 1.

FIGS. 4 and 5 are perspective views showing details of weirs, partitions, etc., within the magnetic separator housing.

FIG. 6 is an enlarged sectional detail of one of the adjustable partitions, shown in smaller scale in FIG. 2.

Speaking first generally, with reference especially to FIGS. 1 and 2, I show a bank of magnetic separators assembled in tandem in a stepped tri-level housing, there being successive drums **20**, **21** and **22**, one to each level,

to constitute three separating units. The gradation in level facilitates gravity flow of the slurry. Since the three units are similar, a description of one will suffice.

The drum **20** is rotated by means of a motor **23** through a chain or belt **24**, the motor being carried on an adjustable frame **25** on an upright bracket **26** carried on the separator side wall **27**. The frame is pivotally carried on the pin **28**, and chain tension is maintained by means of the adjustable bolt **29**.

The drum rotates on a fixed shaft **32** journalled in opposed bearings **33** and **34** (FIG. 1) on the housing side walls.

Within the drum **20** is a cluster of magnets **35** carried in a frame **36** fixed on shaft **32** so that they maintain their position relative to the level of the slurry in which the drum is partially immersed. The magnets can be of the permanent type, made from "Alnico" or the like, or they could be electro-magnets. As a result of this construction, magnetic material in the slurry flowing past the lower portion of the drum (FIG. 2) will be attracted towards the drum periphery, and will adhere to said periphery until it passes out of the magnetic field established by the magnets.

The path of flow of the slurry which may contain a magnetic ferrous metal ore such as taconite will now be outlined. It enters an inlet fitting **37** in the top of a receiving trough **38** which has a side opening **39** to determine the level at which the slurry flows from trough **38** into a first chamber **40**. In this chamber the slurry is agitated and rendered relatively homogeneous by means of water jets directed upwardly through openings **41** in a cross pipe **42** which is in communication with a supply main **43**.

When the slurry in chamber **40** reaches the level of the top edge of a weir portion **46**, later to be more fully described, it flows over said edge into a second chamber **47**. In passing from chamber **40** across the weir into chamber **47** the slurry flows through a strong magnetic field generated by magnets **35**, and a substantial fraction of the magnetic material adheres to the drum surface and is carried over weirs **48** and **49** after which it leaves the magnetic field and drops into a third chamber **50**.

Returning briefly to chamber **47**, the non-magnetic portion of the slurry tends to drop towards the bottom of the chamber, where a substantial portion leaves through outlet **55**. The amount of slurry, mostly non-magnetic, leaving outlet **55** is less than the amount entering over weir **46**, so that flow continues over weir **48**. A valve control (not shown) can be supplied for outlet **55** to maintain any desired equilibrium between the slurry entering from trough **38**, the water entering from pipe **42**, and the slurry leaving over weir **48**. The inclined partition **49***b* defines a chamber **53** (FIG. 2) which retains magnetic particles accidentally dropped from the drum surface, and turbulence therein directs them back into the magnetic field.

In like manner the slurry passes in succession through chambers **56**, **57**, and **58**, over successive weir portions **59**, **60**, **61**, **62**, **63** and **64**. From the previous description of what occurs at drum **20**, it will be understood that additional gangue or tailing is removed at outlets **67** and **68**, and that the remaining slurry becomes more enriched in magnetic material as it passes each of the drums **21** and **22**, and passes over the last weir **64** into a receptacle **66** from whence it is directed to further separating apparatus and/or processes, or to a filter for removal of excess water.

FIGS. 4 and 5 show more clearly, in perspective, the wall arrangement which bounds chamber **47**. The adjustable portions **46**, **48** and **49** along the top edges of the transverse partitions (FIG. 2) are not shown in FIGURES 4 and 5, but the respective supporting parti-

tions themselves are shown, being designated respectively 46*a*, 48*a* and 49*a* and these in turn are fixed at the respective tops of walls 46*b*, 48*b* and 49*b*. The inset side wall parts 69 and 70 lie closely adjacent to the drum end walls to confine slurry flow to the channel immediately adjacent to the cylindrical operating surface of the drum. The outer walls 71 and 72 have respective overflow slots 73 and 74 to maintain the slurry at the predetermined optimum working level.

Systems generally similar to those just described have heretofore been known. In the operation of such a system it sometimes happens that an oversized piece of hard ore, or a piece of tramp metal such as a fragment of a rod from a rod mill, was carried along with the slurry and jammed in the channel slot between the top of a partition (such as 48*a* in FIG. 5) and the rotating drum, badly scoring the drum surface or forcibly stopping drum rotation. The scoring may be deep enough to puncture the cover, whereupon slurry enters the drum and shorts out the magnetic field. A channel slot of fixed height does not accommodate properly to varying rates of flow or densities of slurry so as to yield predictable results.

I have found that both of the disadvantages mentioned in the last preceding paragraph are avoided by supplying adjustable edge or weir portions 46, 48, 49, 60, 61, 62, 63, 64 along the top edge of the fixed weir partitions 46*a*, 48*a*, etc. The structure is best seen in section in FIG. 6 wherein the fixed weir edge part 49*a* carries the resilient strip 49. The strip is slotted at 77 to permit upward and downward movement on the bolt shank 78. The bolt clamps the strip 49 (which is doubled in thickness at the upper portion) between part 49*a* and the washer 79.

When using a weir of this type oversized pieces of material or tramp metal will not jam in the slots indicated by the arrows A because the resilient strip yields, and does not afford sufficient backing to result in scoring of the drum. The resilient weir edge parts 46, 48, etc., can be raised or lowered to any desired position to regulate the rate of flow. FIG. 3 shows side passages 80 for carrying away excess overflow liquid which leaves the housing by control slots such as 73.

The injection of water jets sets up turbulence in compartments 40, 50, and 57 to keep solid particles in suspension so that all solid matter is directed past and through the effective part of the magnetic field.

What is claimed is:

Apparatus for the removal of a magnetically separatable fraction from a slurry of commingled ferrous metal ore and non-magnetic tailings, said apparatus comprising an enclosure, a compartment in said enclosure, means for directing a stream of said slurry through said compartment, means for maintaining a liquid level in said compartment, means providing a surface movable through said stream with one side thereof in contact with said stream, means for establishing a magnetic field closely adjacent to said surface on the opposite side of said surface from said stream whereby magnetic material entrained in said stream is attracted towards said surface, unidirectional flow through said compartment being maintained with respect to said magnetically separatable fraction and said non-magnetic tailings and said liquid, means for confining said stream to a zone adjacent said opposite side of said surface, said last named means including a weir for controlling the fluid and solids passage capacity of said zone, and means carried by said weir to automatically permit passage of oversized solids between said weir and said surface whereby to prevent scoring of said surface.

References Cited by the Examiner

UNITED STATES PATENTS

2,426,352	8/1947	Johnson	209—332
2,627,976	2/1953	Stearns	209—223
2,698,685	1/1955	Newton	209—233

FOREIGN PATENTS

531,814	10/1956	Canada.
732,229	2/1943	Germany.
416,534	9/1934	Great Britain.

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