United States Patent

Williams

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[54] SCRAP MATERIAL PROCESSING APPARATUS

[72] Inventor: **Robert M. Williams,** Ladue, Mo.

[73] Assignee: **Williams Patent Crusher & Pulverizer Co., Inc.,** St. Louis, Mo.

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[52] **U.S. Cl.** **209/38,** 209/99, 209/223

[51] **Int. Cl.** **B03c 1/30**

[58] **Field of Search** 209/38, 2, 12, 223, 228, 393, 209/214, 216, 97, 99

[56] **References Cited**

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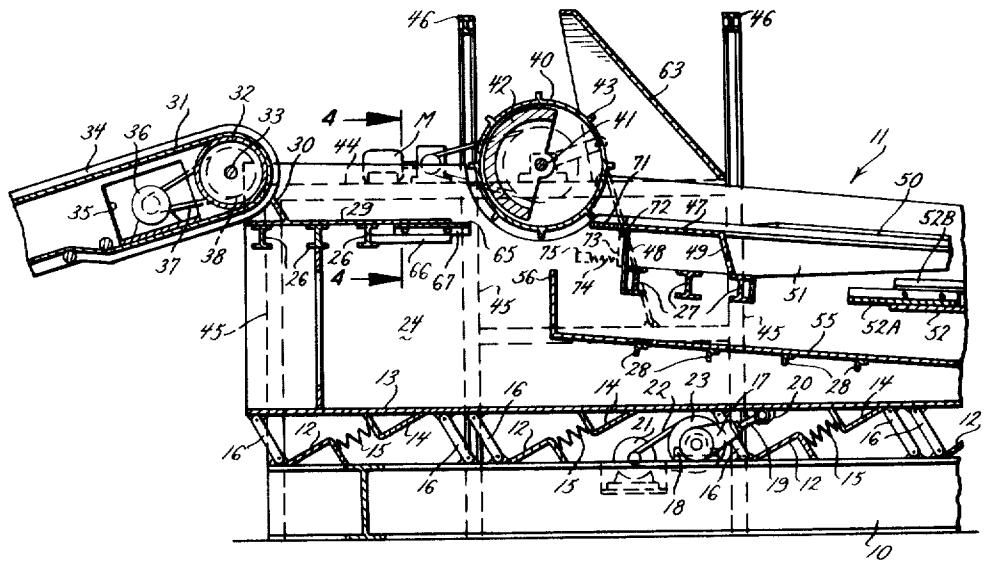
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Primary Examiner—Frank W. Lutter
Assistant Examiner—William Cuchlinski, Jr.
Attorney—Gravely, Lieder & Woodruff

[57] **ABSTRACT**

Apparatus for processing scrap material in a manner to separate magnetic from non-magnetic material and unusable foreign materials from the magnetic material, and to control the size of the final product of magnetic material such that oversize magnetic material may be collected and recycled for further reduction.

9 Claims, 5 Drawing Figures



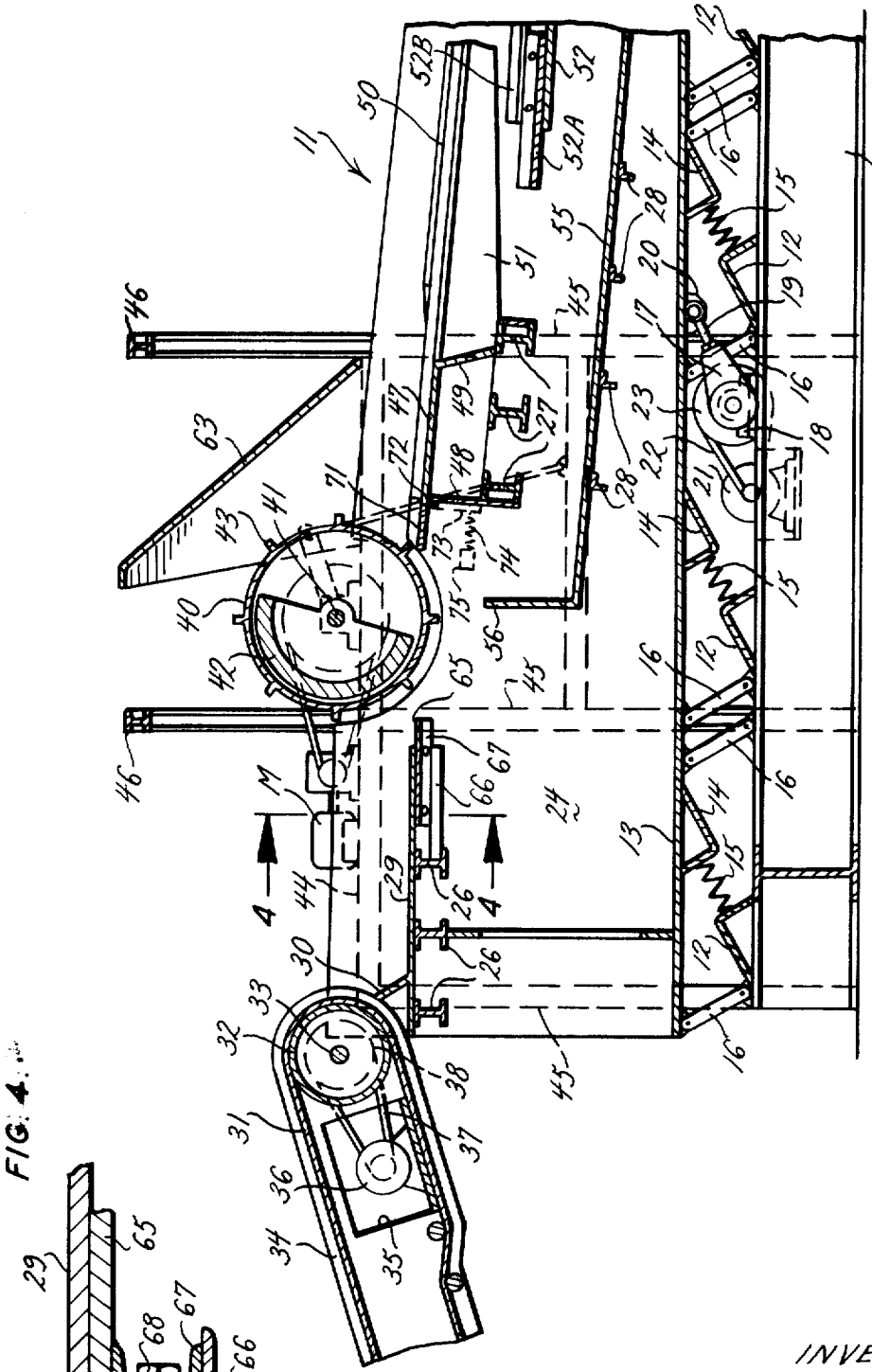


FIG. 1A.

FIG. 4.

INVENTOR

ROBERT M. WILLIAMS

BY Gravely, Lieder & Woodruff

ATTORNEYS

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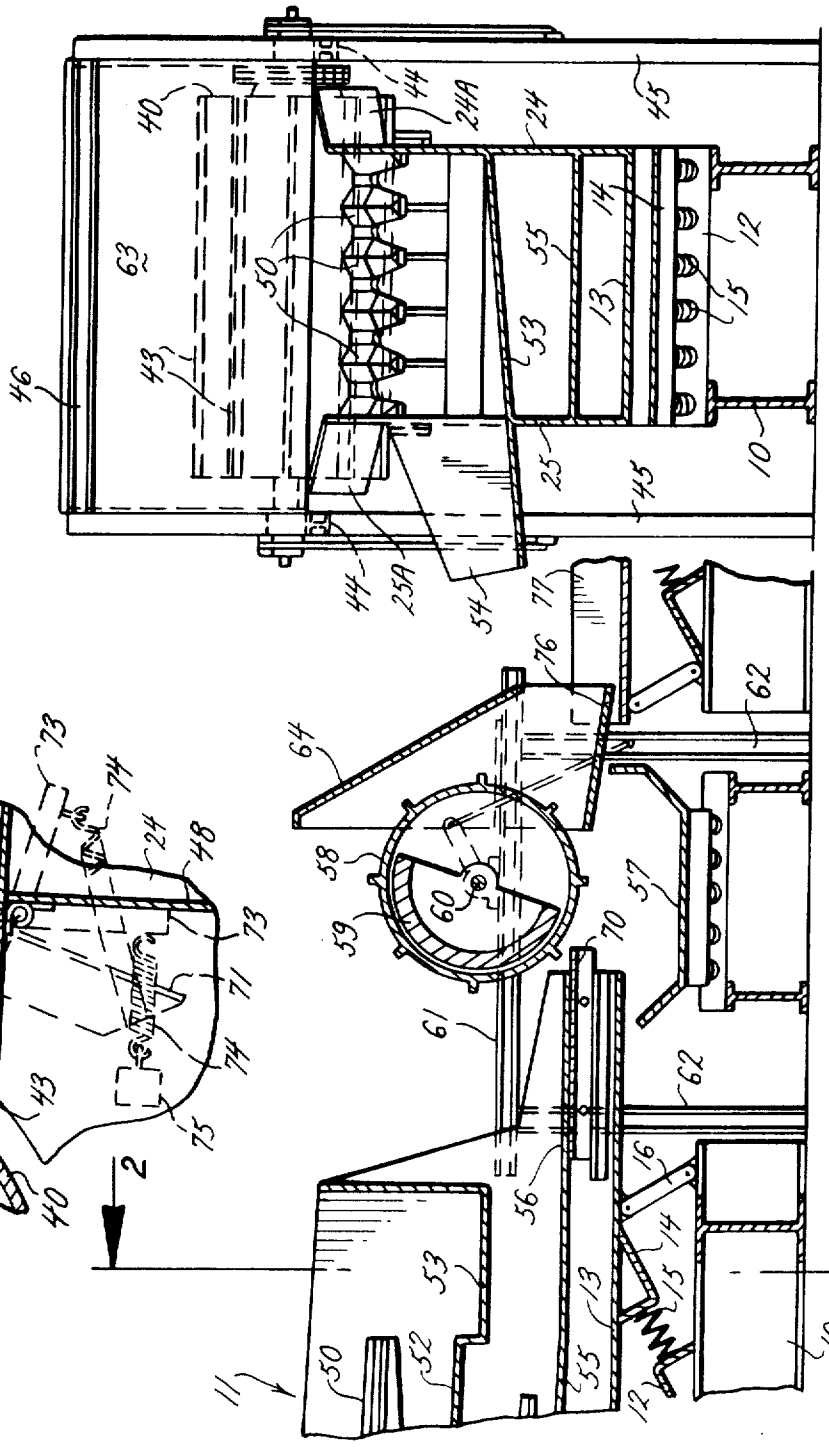


FIG. 2.

FIG. 1B.

FIG. 3.

INVENTOR

ROBERT M. WILLIAMS

BY Granby, Tieder & Woodruff

ATTORNEYS

SCRAP MATERIAL PROCESSING APPARATUS

BRIEF DESCRIPTION OF THE APPARATUS

This invention relates to scrap material processing apparatus, and is particularly directed to improved apparatus whereby magnetic scrap material may be separated from the non-magnetic materials and dirt, collected as to a predetermined size and passed on to a discharge station, while the over-size magnetic material may be collected at a discharge station and recycled.

The embodiment of apparatus herein disclosed is an improvement on similar apparatus heretofore disclosed in my prior application, Ser. No. 845,346, filed July 28, 1969 for "-Scrap Reducing and Refining Process and Apparatus Therefor."

The apparatus of this disclosure finds great utility in the conservation of natural resources and a lessening of the ever increasing number and size of graveyards for discarded objects of almost every kind of description. The disposal of the objects that have served a useful life is difficult and does not appear to be easily controlled due to the increasing volume of such objects. However, it is recognized that discarded objects contain a large percentage of metal which if reclaimable, can be recycled into channels for the production of new products. Automobile bodies are just one available source of usually high quality scrap metal which can be salvaged and mixed with virgin metal to produce a source of metal or alloys for fabricating new products.

The present apparatus finds great utility in assisting in the broad process of salvaging scrap metal objects which are capable of being reduced to easily handled size for transfer to the steel mills for conversion to a from that will be returned to the fabricating plants and made into new products. It is, therefore, an important object of this invention to provide apparatus for sizing and densifying scrap metal and for separating the magnetic or ferrous metal from non-magnetic scrap.

Another important object of this invention is to provide novel and improved apparatus which can be incorporated in scrap reclaiming machinery for improving the quality and uniformity of magnetic and ferrous scrap.

Other objects and advantages of this invention will appear in the following description of a presently preferred embodiment of scrap material processing apparatus.

BRIEF DESCRIPTION OF THE DRAWINGS

The preferred apparatus is shown in the accompanying drawings, wherein:

FIG. 1A is a longitudinal sectional elevational view of a portion of the apparatus of this invention;

FIG. 1B is a longitudinal sectional elevational view of the remainder of the apparatus seen in FIG. 1A;

FIG. 2 is a transverse sectional elevational view of the apparatus as seen at line 2—2 in FIG. 1B;

FIG. 3 is a fragmentary view of a detail of the apparatus, the view being taken in FIG. 1A; and

FIG. 4 is a further fragmentary view seen at line 4—4 in FIG. 1A.

DESCRIPTION OF THE APPARATUS

A commercial application for the present apparatus is described in my prior application Ser. No. 845,346, and reference is made to the installation of the densifier unit of said prior application. This apparatus is an improvement on said densifier unit.

FIGS. 1A and 1B the apparatus is seen to include a base frame **10** composed of suitable structural members to support the vibratory superstructure of the material separator and densifier **11**. The base frame **10** is provided with angularly shaped base cleats **12** secured crosswise of the frame **10**. The superstructure is provided with a wide bottom deck plate **13** which extends lengthwise of the base frame. The under side of this bottom deck plate is provided with angularly shaped cleats **14** in spaced alignment with the first mentioned cleats **12**, and a plurality of substantial coil springs **15** are suitably captured in end-on abutment with both sets of cleats **12** and **14**. A series of control links **16** are pivotally connected to the base frame **10** and to the underside of the bottom deck plate **13**. Mid-way of the length of the base frame **10** there is operatively mounted a rotary eccentric unit **17** having suitable end bearings **18**. The operating arm **19** of the eccentric unit **17** is pivotally connected by bearing means **20** to the deck plate **13** to vibrate the deck plate and the entire super structure **11**. Motor means **21** in the base frame **10** is connected by belt means **22** to the drive pulley **23** of the eccentric unit **17**. The unit **17** operates to vibrate the bottom deck plate **13** in a cycle that causes the loose material on the upper surface to travel rightwardly.

The bottom deck plate **13** supports vertical side walls **24** and **25** (FIG. 2) and a plurality of series of transverse beams **26** and **27** and angle members **28** are secured to the side walls. The series of beams **26** located at the inlet end of the apparatus support a scrap receiving platform **29** between side walls **24** and **25**. A deflector board **30** extends across the platform receiving deck **29** at a position adjacent the scrap feeding belt **31**.

The feeding belt is carried on a suitable drum pulley **32** mounted on an axle **33** which is carried by a side wall frame **34** attached to the inner sides of the walls **24** and **25**. The frame **34** is cut out at **35** for access to a drive motor **36** which drives belt **37** which is connected to a pulley **38** on the axle **33** of drum pulley **32**.

Spaced from the scrap feed belt **31** and in line with the scrap receiving platform or deck **29** there is mounted a primary drum **40** rotatable on an axle **41**. The drum **40** is hollow to enclose a semi-circular magnet **42** which remains stationary and extends about the drum to a point just beyond the top center of the drum. Cleats **43** on the exterior of the drum assist in lifting the magnetic portions of the scrap material up and over the drum. The drum axle **41** is supported at its ends on a horizontal beam **44** extending between vertical members **45** of an exterior frame having cross members **46** spanning the width of the apparatus. The side walls **24** and **25** are cut away at the drum location, and the deck **29** stops short of the drum so that a gap space is provided for the gravity discharge of dirt and non-magnetic material.

The rotary drum, driven by a suitable motor M discharges the magnetic scrap upon a sloped deck **47** having side wall portions **24A** and **25A** (FIG. 2). The deck **47** is spaced from the receiving deck **29** and supported by the series of transverse beams **27** and connecting structure **48** and **49**. The rightward end of the deck **47** is connected to a material size discriminator means consisting of a series of tines **50**, each of which is tapered and provided with slanted surfaces as seen in FIGS. 1A and 2. Each tine is supported by a vertical bracket **51** which is cantilevered from one of the transverse beams **27** and the structure **49**. The tapered shape of the tines **50** forms a scrap sizing deck in which the spaces between tines diverge from the deck **47**.

The widely spaced ends of the discriminator tines **50** extend above a collecting deck **52** supported between the side walls **24** and **25**, whereby too large scrap material may be collected and vibrated onto a transversely sloped chute **53** which opens at one side of the apparatus in a discharge station **54**. The deck **52** is provided with an adjustable end portion **52A** movable in slide ways **52B** so that the size of product reaching the deck below may be selected. Below the collecting deck **52** and extending from below the primary drum **40** is an intermediate deck **55** having a vertical end wall **56** below the drum **40**. The deck **55** is carried by the series of angle members **28** and the side walls **24** and **25**. This intermediate deck **55** is sloped for a portion of its length, and the discharge end **56** opens adjacent a second drum separator **58** and laterally directed vibratory conveyor **57**.

A drum **58** is a secondary magnetic separator similar to the primary drum **40** in that it has a magnet **59** within the drum **58** to separate magnetic from non-magnetic scrap in a second

stage separation operation. The drum **58** has its axle **60** supported by horizontal members **61** carried on vertical members **62**. Suppression of flying scrap particles at the primary magnetic separator drum **40** is obtained by a suitable hood **63**, and a similar hood **64** is mounted at the second drum **58**.

As may be seen in FIGS. 1A and **4**, the scrap receiving platform or deck **29** (while non-magnetic) has an adjustable non-magnetic plate **65** slidably mounted under the end of the deck. The mounting of the plate **65** (FIG. **4**) at the inner side of wall **24** is effected by a bracket **66** fixed to the side wall **24**. A slide shoe **67** fixed to the plate **65** slides on the bracket **66**, and a locking member **68** engages the shoe and moves in a slot **69** in the wall **25**. A similar support is provided at side wall **25** so that the plate **65** may be adjusted to increase or reduce the gap space at the primary drum **40** to control the gravity discharge of the dirt and non-magnetic scrap onto the bottom deck **13**. The intermediate deck **55** is non-magnetic, at least in the portion adjacent the drum **58**, and has an adjustable non-magnetic plate **70** at its discharge end to vary the size of the gap space relative to the secondary drum **58**. This second gap space controlled by adjustable plate **70** is made as small as possible since the scrap material moving on the intermediate deck **55** is mostly the end product desired to be recovered. However, some non-magnetic material and dirt will unavoidably be carried over by the primary drum **40** to the deck **47** and move out to fall through the tapered spaces between tines **50**. Thus, it is important to provide a second place for gravity separation of this unwanted material.

The deck **47** at the discharge from primary drum **40** is provided with a flop gate **71** mounted on a pivot axis **72**. An operating arm **73** is fixed to the flop gate at one or both ends of the gate axis, and springs **74** connected between each arm **73** and a fixed bracket **75** on the side walls **24** or **25**, or both side walls, resiliently holds the flop gate up. Should scrap material cling to the drum **40** it will strike the flop gate **71** and depress the gate so as not to jam and stop the drum rotation. The material released through the flop gate **71** moves down the deck **55** to be subjected to magnetic separation at the secondary drum **58**. The magnetic product carried over by the drum **58** falls into a chute **76** and is picked up by a discharge vibratory conveyor **77** shown only in fragmentary section in FIG. **1B**.

OPERATION OF THE APPARATUS

The feed of scrap material from a reducing or shredding mill is conveyed by conveyor belt **31** to the receiving deck **29** of the vibratory separator and densifier **11**. The material is moved by vibratory action toward the primary drum **40** and the magnetic portions are raised and carried over the deck **47**. A large percentage of non-magnetic material and dirt remains on deck **29** and falls off the end of the adjustable deck plate **65** onto the bottom-most deck **13**. The material carried over to deck **47** is vibrated rightwardly onto the tines **50** where the discriminating or material sizing operation takes place. The smallest material will fall through onto intermediate deck **55**, and as the material moves over wider spaces between tines **50** it, too, will fall through, until the leading edge of the collecting deck **52** catches the material that is deemed too large. This large material is conveyed out of the apparatus at chute **53** and may be recycled to the reducing or shredding mill for return at the conveyor **31**.

The material of predetermined acceptable size is moved on intermediate deck **55** to the zone of the secondary separator drum **58**, and concurrently the dirt and trash falling onto bottom deck **13** is moved to the discharge chute **57** and is conveyed in a different direction from the apparatus than is the material to be recycled or the final product. The slopping side surfaces of the tines **50** prevent material wedging therein. The material sizing may be selected by the amount the end **52A** projects from the deck **52** under the tines. Each time the material reaches a magnetic drum separation of magnetic and non-magnetic material occurs, and dirt and trash carried along is vibrated out so that the non-magnetic material along with the dirt ans trash is collected, first below drum **40**, what remains is collected next on intermediate deck **55** and all thereof is collected finally below drum **58** in chute **57**.

The flop gate **71** avoids jams at the drum **40**, such as might happen when magnetic material does not let go because of the magnet **42**. When this happens the gate opens and the material is scraped off by the plate **65** which is better able to perform this function.

What is claimed is:

1. In scrap material processing apparatus, the combination which includes: scrap material feed means bringing magnetic and non-magnetic material into the apparatus; a first separator station including means for separating magnetic from non-magnetic material; a first receiving deck for magnetic material located adjacent said first separator station; a second receiving deck for non-magnetic material, said second deck being gravitationally spaced from said first separator station and from said first receiving deck; a second separator station including material sizing means in said first receiving deck, said sizing means comprising elongated tines having progressively increasing spaces therebetween in the direction of material flow; means gravitationally below a portion of said tines to receive material of a predetermined large size and prevent it mingling with smaller material passing gravitationally through said tines; an intermediate deck below and first deck and said tines to collect the smaller sized material, said first, second and said intermediate decks being stacked one above the other and in longitudinally off-set relation, and means operatively connected to the apparatus to vibrate said decks and cause flow of the scrap material.

2. The apparatus set forth in claim **1** wherein said second station includes means for subjecting said smaller sized material to magnetic separation; and means adjacent said second magnetic separation to direct the magnetically separated material out of the apparatus.

3. In scrap material processing apparatus, the combination which includes: a first deck extending longitudinally in the apparatus; a scrap material receiving deck above said first deck; a second deck longitudinally spaced from said receiving deck; an intermediate deck between said second deck and a portion of said first deck; means in the space between said receiving and second decks operative to separate magnetic from other materials and move the magnetic materials onto said second deck, said receiving deck having a discharge for said other materials adjacent said magnetic separator means and above said first deck; means adjacent said second deck to discriminate between acceptable and unacceptable sizes of magnetic material; a collecting deck between said discriminating means and said intermediate deck to collect the unacceptable material independently of the material collected by said intermediate deck; and means to vibrate said decks to cause the material to flow along said decks.

4. The apparatus set forth in claim **3** wherein said magnetic separating means includes a rotary drum at the space between said receiving and second decks, and each of said receiving and second decks having means adjacent said drum to vary the spacing with said drum.

5. The apparatus set forth in claim **3** wherein said receiving deck has a material discharge adjacent said magnetic separator means, and an adjustable plate is operatively mounted adjacent said discharge from said receiving deck, said plate being movable toward and away from said separator means.

6. The apparatus set forth in claim **3** wherein said second deck includes a flop gate adjacent said magnetic separator, and means resiliently supporting said gate to engage magnetic material released onto said second deck and to yield to material magnetically retained on said magnetic separator.

7. In scrap material processing apparatus, the combination which includes: a material receiving deck and a first deck spaced therefrom in substantially the same elevational plane; magnetic separator means at said space between said decks to lift magnetic material from said receiving deck and drop it on

said first deck; material size discriminating means adjacent said first deck including elements arranged in spaced outwardly diverging relation to allow progressively larger magnetic scrap material to pass through with distance travelled from said first deck; a second deck gravitationally spaced from said discriminating means to catch smaller magnetic material dropping through said diverging spaces; means between said discriminating means and said second deck and located under the spaced elements to cut-off gravitational passage of predetermined larger sizes of magnetic scrap material onto said second deck, and means operatively connected to the apparatus to vibrate said decks and cause the material to flow.

8. The apparatus of claim 7 wherein said last named means is adjustable to predetermine the size of the scrap material to be discriminated by the apparatus.

9. The apparatus of claim 7 wherein a third deck extends below said receiving deck and said second deck to receive non-magnetic material from said receiving deck, said third deck and said second deck extending into a substantially common discharge station, and means adjacent said discharge station to separate magnetic material from non-magnetic material and release the same into separate discharge paths.

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