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Kind et al.

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[54] SEPARATING DEVICE FOR SEPARATING METALLIC MATTER FROM NON-METALLIC MATTER

[72] Inventors: **Guntram Kind; Karl-Heinz Schroder,** both of Windhagen; **Rido Busse,** Oberelchingen, all of Germany

[73] Assignee: **Pulsotronic Merten KG,** Gummersbach (Rhld.), Germany

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[51] **Int. Cl.** **B07c 5/344,** B07c 3/02
[58] **Field of Search** 209/74, 111.8; 302/28; 193/16, 193/23

[56] **References Cited**

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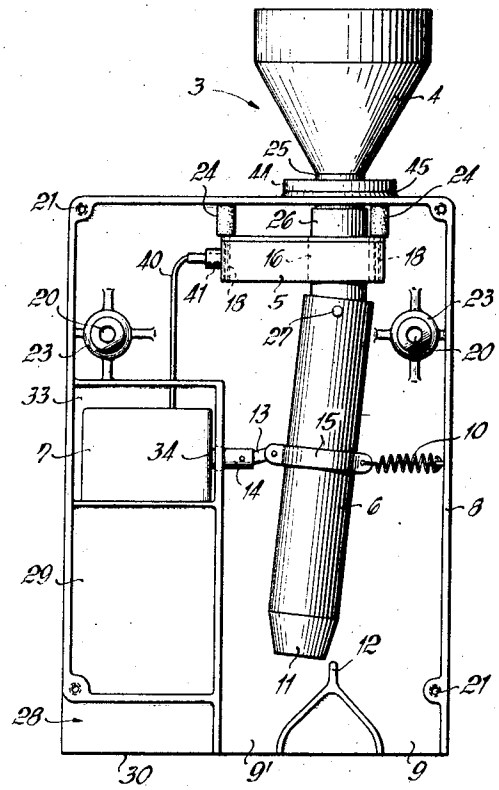
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Primary Examiner—Richard A. Schacher
Attorney—Michael S. Striker

[57] **ABSTRACT**

A funnel-shaped admitting hopper for material to be separated communicates with a tubular conduit which is swingably mounted so that its outlet, remote from the admitting hopper, can be placed into registry with one of two openings for discharging into them metallic and non-metallic matter, respectively. A metal detector is located proximal to the conduit for detecting metallic matter as the same passes through the conduit. Biasing means normally urges the conduit to a position where its outlet communicates with the opening into which non-metallic matter is to be discharged. An actuating device is associated with the conduit and is responsive to detection of the metal by the metal detector, whereupon it deflects the conduit so that the outlet thereof registers with the opening into which metallic matter is to be discharged. On deactivation of the actuating means the biasing means returns the conduit to its normal position.

27 Claims, 5 Drawing Figures

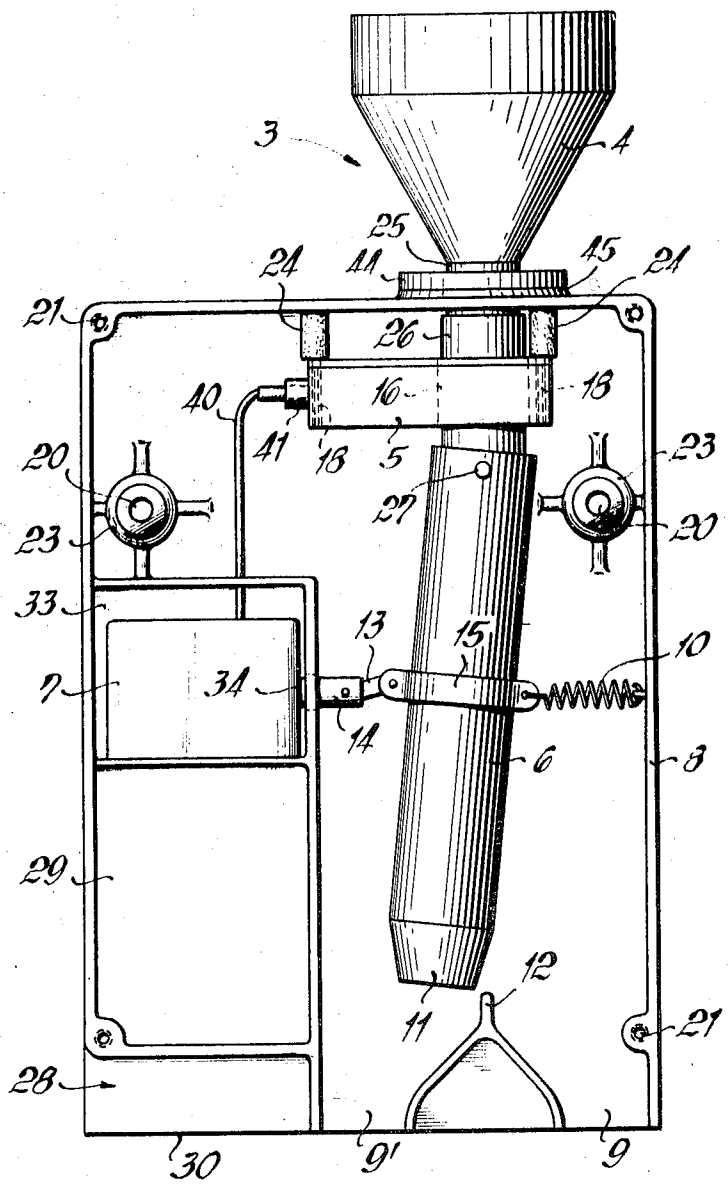


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SHEET 1 OF 3

FIG. 1



INVENTOR
GUNTRAM KIND
KARL-HEINZ SCHRÖTER
RUDI BUSSE

By: Michael S. Striker
Attorney

FIG. 2

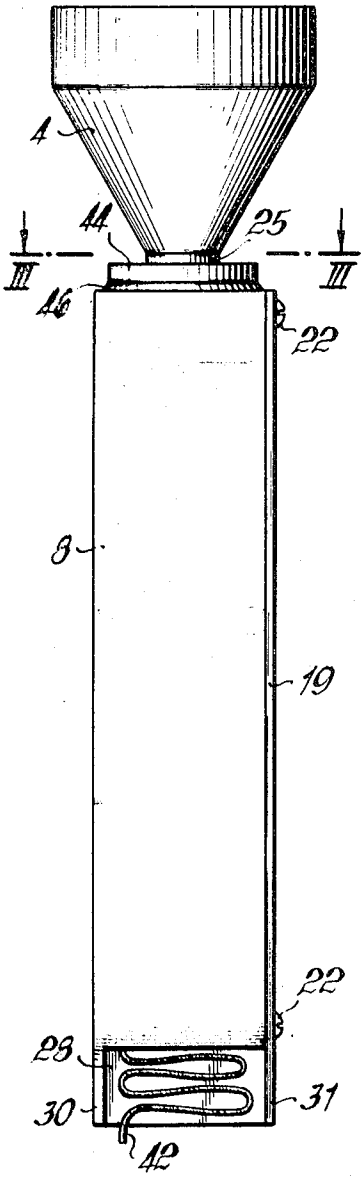
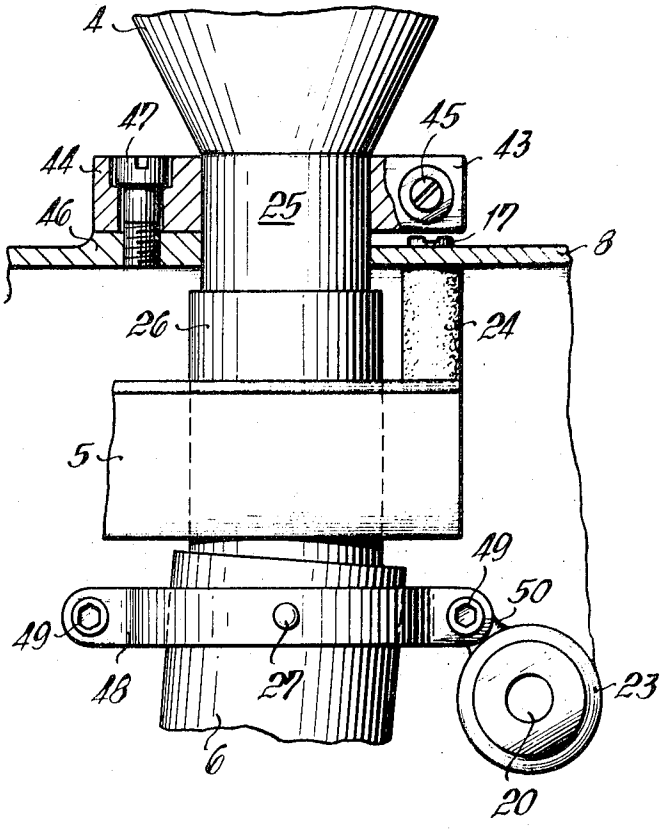


FIG. 3



INVENTOR
GUNTRAM KING
HANS-HEINZ SCHOEPE
RENE PAISSE
By: Michael J. Striker

FIG. 4

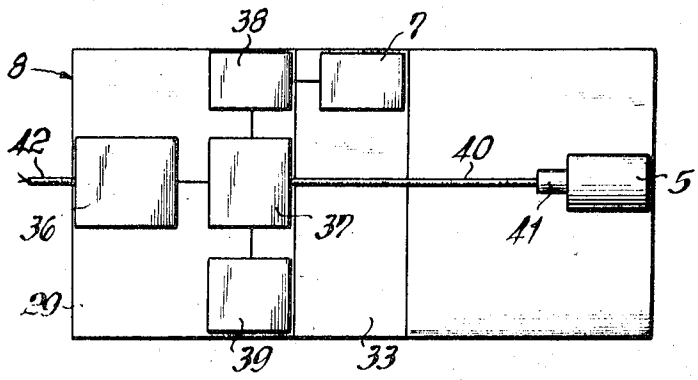
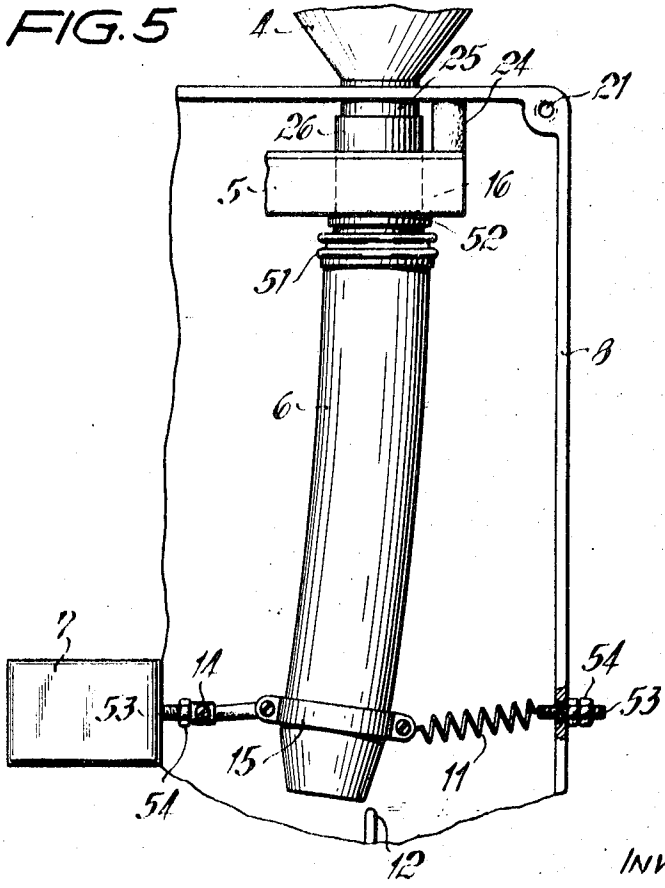


FIG. 5



INVENTOR
GUNTRAM KIND
KARL-HEINZ SCHROEL
RUDI RUSSE

SEPARATING DEVICE FOR SEPARATING METALLIC MATTER FROM NON-METALLIC MATTER

BACKGROUND OF THE INVENTION

The present invention relates generally to a separating device, and more particularly to a device for separating metallic matter from non-metallic matter. Still more specifically the invention relates to a device for separating metallic matter from synthetic plastic, especially comminuted synthetic plastic.

Such devices as a category are of course already known. They generally utilize a gate which is tilted through 90° and thereby closes an opening into which the metallic matter detected is not to be discharged. These devices are certainly capable of detecting and segregating metallic matter. However, they have the disadvantage that material which passes through them in free fall under the influence of gravity tends to accumulate on the gate while the same is closed and to thereby prevent its proper operation.

There has, therefore, existed a need in the industry to provide an improved device for separating or segregating metallic matter from non-metallic matter, particularly metallic matter which is included in synthetic plastic materials which are comminuted. The present invention aims to provide such an improved device.

SUMMARY OF THE INVENTION

It is, accordingly, a general object of the present invention to provide an improved device for separating metallic matter from non-metallic matter.

More particularly it is an object of the present invention to provide such a device which is not possessed of the disadvantages of the known devices.

Still more particularly it is an object of the present invention to provide such a device which is relatively simple in its construction but highly reliable.

An additional object of the invention is to provide a device of the type in question which is highly versatile with respect to the manner in which it can be actuated and the manner in which it can be utilized.

A concomitant object of the invention is to provide such a device which significantly reduces the response time, that is the time required for the device to change from a position in which it channels material into one path to a position in which it channels material into another path.

In pursuance of the above objects, and others which will become apparent hereafter, one feature of the invention resides in a separating device for separating metallic matter from non-metallic matter which device comprises, briefly stated, admitting means for material to be separated, first and second opening means spaced from said admitting means for respectively receiving non-metallic and metallic matter, and conduit means having an inlet communicating with admitting means and an outlet. The conduit means is swingable between a first and a second position in which the outlet respectively communicates with the first and second opening means. Metal-detecting means is provided for detecting the presence of metallic matter in material passing through the conduit means, and for deflecting the conduit means to its second position in response to such detection. Restoring means restores the conduit means to its first position subsequent to separation of the detected metallic matter.

By resorting to the device according to the present invention the heretofore inescapable accumulation of material on the segregating gate of known devices, when the gate is closed, is avoided, and actuation of the separating portion or segregating portion of the device is no longer hindered by such accumulation. Actuation of the movement of the conduit means, which latter is advantageously swingably mounted for swinging movement about its end portion located proximal to the metal-detecting device, may be effected electromagnetically, by means of an electromotor, pneumatically or hydraulically. Thus, the device is highly versatile.

According to an advantageous embodiment of the invention the cross-sectional configuration of the conduit means is constant from the inlet towards the outlet, except for the outlet region where it is advantageously elliptical. The shorter axis of the ellipse is preferably coincident with the direction of movement to be performed by the conduit means between its first and second position, and this movement should be as short as possible to thereby reduce the time required for changing from a communication of the outlet with the first opening to a communication of the outlet with a second opening. It is advantageous that the cross-sectional area of the conduit be unchanged throughout, that is that it be the same at all portions of the conduit means including the portion of elliptical cross-section.

The device comprises a housing which is longitudinally subdivided and/or provided with a cover closing an open side of the housing. The actuating device which is associated with the metal-detecting device and responds to detection of metallic matter by the latter in that it thereby becomes actuated and deflects the conduit means from its first to its second position, advantageously engages the conduit means either substantially midway between the inlet and outlet thereof, or in the region of the lower or outlet end of the conduit means.

According to a preferred embodiment the metal-detecting device and the actuating device, particularly a solenoid, are arranged in a common chamber in the interior of the housing. The housing is mainly intended for protecting the solenoid and the metal-detecting device against damage and according to further characteristics of the invention it is substantially box-shaped and its open side is closable by the aforementioned cover which is removable so as to facilitate access to the various components for inspection, servicing and/or replacement. It is preferable to effect electrical connection between the metal-detecting device and the solenoid within the confines of the housing. The rear wall of the housing is provided with suitable means, such as bores or the like, through which or by the use of which the housing may be mounted on a support. The housing further includes an interior chamber which becomes accessible upon removal of the cover and which accommodates a switching device, the latter according to a preferred embodiment being connected within the confines of this chamber with an external source of electrical power, such as an electrical supply net.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a somewhat diagrammatic plan view showing a device according to the present invention with the cover removed;

FIG. 2 is a side view of the device shown in FIG. 1, with the cover in place;

FIG. 3 is a fragmentary section taken on the line III—III of FIG. 2;

FIG. 4 is a block-type wiring diagram for the device according to the present invention; and

FIG. 5 is a fragmentary plan view analogous to FIG. 1, with the cover removed, showing a further embodiment of the device according to the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Discussing now the drawing in detail, and firstly FIG. 1 thereof, it will be seen that reference numeral 8 identifies a substantially box-shaped housing having an open side which may be closed by the removable cover 19 (compare FIG. 2). The device per se is identified with reference numeral 3 and comprises admitting means in form of a substantially funnel-

shaped admitting hopper 4. A metal detector 5 of known construction is located in the housing 8 and a tubular conduit 6 of synthetic plastic material or of metal, such as steel, is also located in the housing 8 arranged swingably in such a manner that its outlet portion 11 may respectively be brought into registry with the openings 9 or 9' which are separated from one another by the member 12. The opening 9 in this embodiment is assumed to be intended to receive only non-metallic material whereas the opening 9' is assumed to be intended to receive metallic material. Of course, each of the openings 9, 9' communicates in suitable manner with a separate receptacle or the like.

The cross-sectional configuration of the conduit 6 is constant except for the outlet portion 11 which is of elliptical cross-section with the short axis of the ellipse extending in the direction of movement of the conduit 6. The cross-sectional area, however, is unchanged throughout the entire length of the conduit 6.

In the embodiment of FIGS. 1 and 2 the conduit 6 is mounted for pivotal movement about a pivot pin 27 located immediately below the metal-detecting device 5 of known construction. Approximately midway intermediate the opposite ends of the conduit 6, a biasing spring 10 engages the same for instance by means of a bracket 14 or the like, and urges it to the right-hand position in which it normally communicates with the opening 9. Reference numeral 7 identifies an actuating device of known construction, such as a conventional solenoid whose plunger 34 is connected via its bifurcated end portion 14 with a linkage member 13 which in turn is connected with the bracket 14. FIG. 1 shows that the connection of the linkage member 15 with the portion 14 and the bracket 15 is pivotable. Possibilities for adjustment exist between the portion 14 and plunger 34 on the one hand, and between the spring 10 and the housing 8 on the other hand.

In accordance with the invention the narrowest cross-section of the path defined within the device is in the hopper 4, in order to assure that no backing-up or damming of material occurs in the remainder of the system and that the material passes through the system in free flow.

The metal-detecting device 5 illustrated is of substantially rectangular outline and provided with an eccentrically located circular through passage 16. It further has two bores 18 for mounting screws 17. The corners of the housing 8 are provided with four interior eyes with tapped bores 21 for mounting screws 22 by means of which the cover 19 can be removably mounted. The metal detector 5 is secured in place by two resilient members 24, for instance consisting of swing metal.

The tubular portion 25 of the funnel-shaped hopper 4 is received threadedly in an opening of the housing 8 and communicates with a tubular intermediate member 26 located in the through opening 16 of the metal detector 5, with which member 26 the conduit 6 also communicates. The member 26 and the conduit 6 are tightly connected so that matter of dust-like or analogous characteristics cannot escape at their juncture. The sealing means provided for this purpose may be in form of a bellows-shaped or otherwise configurated member of elastomeric material connecting the members 6 and 26, or the conduit member 6 may be in form of a metallic or synthetic plastic hose which is directly or indirectly connected to the member 26.

The solenoid 7 and the metal-detector 5 are both located within the confines of the housing 8 as shown. The housing 8 is further provided with a chamber 29 and with a chamber 33, with the latter accommodating the solenoid 7. The rear wall of the housing 8 is provided in its upper region with two bores 20 with eyes 23 which are reinforced by interior ribs, for mounting of the housing 8 on a support such as a wall or the like. The circumferential wall of the housing 8 defines an inwardly extending recess in the corner 28 which in the drawing is the left-hand corner. In this recess there is provided a cut-out which is overlapped and shielded by a portion 30 of the rear housing wall and/or a portion 31 of the cover 19. Through this cut-out cables, cable nipples or the like, can enter the housing 8.

As mentioned before, the metal-detector device 5 is of conventional construction. It may operate in accordance with the principle of influencing a magnetic field, a high-frequency oscillation or the like by metallic matter included in non-metallic matter, that is in non-metallic raw materials, semi-finished materials or finished materials, particularly comminuted materials. A conventional and well known power supply 36 and a switching device 37 with a relay outlet 38 and, if desired, a time-delay unit 39, are located in the chamber 29 as shown in FIG. 4. The metal-detector device 5 is connected via a cable 40 and a male-female plug connection 41 within the housing 8 to the solenoid 7, via the switching device 37. Of course, it will be understood that other types of metal detectors than the one illustrated are fully suitable. The device is connected with an external source of electrical energy, that is with an energy net, via a cable 42 which passes through the cutout in the recess 28 as shown in FIG. 2.

FIG. 3 shows that the tubular portion 25 of the funnel-shaped hopper 4 is located in an opening of the annular flange 44 which latter is provided with a radial slot 43 bridged by a tangentially extending screw 45. Turning of the screw 45 in requisite sense narrows the slot and thereby clamps the portion 25 tightly in the opening of the flange 44. The latter is in turn connected with screws 47 to a flange 46 which is provided on the housing 8, for instance of one piece therewith. The flange 44 is first connected with the portion 25 and thereupon with the flange member 46.

The pivot pin 27 is journalled in the housing 8 at one end and its other end at a bracket 48 which is mounted on two supports 50 via respective screws 49, with the support 50 adjacent the eye 23 being of one piece with the latter.

It should be understood from the block-type wiring diagram of FIG. 4 that as a metal particle included in non-metallic matter passing through the device will cause a current impulse in the concentric coil of the detectors 5 as it moves through the opening 16 of the latter. This impulse passes through the cable 40 and the plug connection 41 into the switching device 37 where it is amplified and used to control the solenoid 7 via the relay output 38. The device 39 is used for adjusting the relay release time delay in accordance with the speed at which the particle descends. If the conduit means 6 is in a position where its outlet end 11 communicates with the opening 9 (see FIG. 1 for the openings) all material passing through the conduit means 6 enters the opening 9. If, now, a metal particle is detected by the detector 5, then the solenoid or analogous means is energized, causing the conduit means to pivot to the position where its outlet end 11 communicates with the opening 9' —this position being illustrated in FIG. 1—so that the detected metallic particle enters the opening 9'. Thereupon, the solenoid 7 is deenergized and the conduit means 6 returned to its normal position in which its outlet end 11 communicates with the opening 9, by the action of the biasing spring 10.

The embodiment illustrated in FIG. 5 differs from the preceding embodiment in that the conduit means 6 is configurated as a metallic or synthetic plastic hose which is connected to the intermediate conduit member 26 via a bellows-shaped connecting member 51. Such connection takes place through a clamping collar 52, or else by means of bonding or in any suitable manner. In the embodiment of FIG. 5 the solenoid 7 is connected with the lower end portion of the hose-type conduit means 6 and in this manner the distance to be traversed by the movable portion of the solenoid 7 is longer with the required force being concomitantly smaller. The spring 10 and the bifurcated portion 14 of the solenoid are each associated with a screw 53 and nut 54 for adjustment purposes, particularly for adjusting their respective length.

It is again emphasized that the metal detector 5, the solenoid 7 and the associated electrical components are of conventional construction and that other analogous means may be substituted for them. They are not claimed as being novel in accordance with the present invention.

It will be understood that each of the elements described above, or two or more together, may also find a useful applica-

tion in other types of constructions differing from the types described above.

While the invention has been illustrated and described as embodied in a metal detector and separator, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims:

1. A separating device for separating metallic matter from non-metallic matter, comprising admitting means for material to be separated, including a funnel-shaped hopper having a tubular outlet portion, an annular flange member tightly accommodating said tubular outlet portion and provided with a radial slot, and screw means bridging said slot and operative for decreasing the width of the same to thereby change said tubular outlet portion; housing means having an intake opening bounded by an external annular flange; securing means securing said flange member to said flange in registry therewith; first and second opening means spaced from said intake opening for respectively receiving non-metallic and metallic matter; conduit means in said housing means and having an inlet communicating with said intake opening and an outlet, said conduit means being swingable between a first and a second position in which said outlet respectively communicates with said first and second opening means; metal detecting means in said housing means for detecting the presence of metallic matter in material passing through said conduit means, and for deflecting said conduit means to said second position in response to such detection; and restoring means for returning said conduit means to said first position subsequent to separation of the detected metallic matter.

2. A separating device for separating metallic matter from non-metallic matter, comprising a housing; admitting means for material to be separated; first and second opening means spaced from said admitting means for respectively receiving non-metallic and metallic matter; conduit means in said housing and having an inlet and an outlet, said conduit means being swingable between a first and a second position in which said outlet respectively communicates with said first and second opening means; metal detecting means including a metal detector device having a passage located between and communicating with said admitting means and said inlet, respectively, said metal detector device being operative for generating a signal upon detecting the presence of metallic matter in material passing through said passage and said metal detecting means further including an actuating device engaging said conduit intermediate said inlet and said outlet and being operative for receiving said signal and for thereupon deflecting said conduit means to said second position; resilient means mounting said metal detecting means in said housing; and restoring means in said housing for restoring said conduit to said first position subsequent to separation of the detected metallic matter.

3. A separating device for separating metallic matter from non-metallic matter, comprising admitting means for material to be separated; first and second opening means spaced from said admitting means for respectively receiving non-metallic and metallic matter; conduit means having an inlet and an outlet, said conduit means being swingable between a first and a second position in which said outlet respectively communicates with said first and second opening means; biasing means permanently biasing said conduit means toward said first position; and metal detecting means including a metal detector device having a passage located between and communicating with said admitting means and said inlet, respectively, said metal detector device being operative for generating a signal upon detecting the presence of metallic matter in material passing through said passage, and said metal detecting means further including an actuating device engaging said conduit means intermediate said inlet and said outlet and being operative for receiving said signal and for thereupon deflecting said conduit means temporarily to said second position counter to the action of said biasing means.

4. A device as defined in claim 3, wherein said conduit means is of constant cross-sectional area.

5. A device as defined in claim 4, wherein said conduit means is of elliptical cross-sectional configuration in the region of said outlet, and of other-than elliptical cross-sectional configuration from said inlet to said region.

6. A device as defined in claim 5, said conduit means being swingable in a predetermined direction during movement between said first and said second position, and said elliptical cross-sectional configuration having a major and a minor axis; and wherein said minor axis coincides with said predetermined direction.

7. A device as defined in claim 3, said conduit means being mounted for pivotal movement about a pivot axis located in the region of said inlet.

8. A device as defined in claim 3, and further comprising a housing having an open side; and a cover plate closing said open side.

9. A device as defined in claim 3, said actuating device comprising engaging means engaging said conduit means substantially midway between said inlet and outlet thereof.

10. A device as defined in claim 3, said actuating device comprising engaging means engaging said conduit means in the region adjacent said outlet thereof.

11. A device as defined in claim 3, said device comprising an aperture spaced from said admitting means, and a guide member located in said aperture subdividing the same into said first and second opening means.

12. A device as defined in claim 3, said admitting means and said conduit means forming with said passage a path for material to be separated; and wherein said path has a smallest cross-sectional area upstream of said metal detecting means.

13. A device as defined in claim 12, wherein said smallest cross-sectional area is within the confines of said admitting means.

14. A device as defined in claim 3, said admitting means including a stationary tubular member having a discharge opening; and further comprising sealing means sealingly connecting said inlet of said conduit means with said discharge opening of said tubular member with freedom of said conduit means for movement between said first and second positions thereof.

15. A device as defined in claim 3, said conduit means being a tubular element of metallic material.

16. A device as defined in claim 3, said conduit means being a tubular element of synthetic plastic material.

17. A device as defined in claim 3; and further comprising connecting means connecting said conduit means and said admitting means with freedom of movement of the former between said first and second positions.

18. A device as defined in claim 17, said connecting means comprising a bellows-shaped tubular connecting member.

19. A device as defined in claim 3; further comprising a housing subdivided longitudinally and accommodating at least said conduit means, metal detecting means and restoring means.

20. A device as defined in claim 19; further comprising chamber means within the confines of said housing for accommodating auxiliary components of said device.

21. A device as defined in claim 19; further comprising a plurality of mounting apertures provided in said housing for mounting the latter on a support.

22. A device as defined in claim 3; further comprising a housing including a circumferential wall having a portion defining a recess extending in direction inwardly of said housing, an open side provided with a cover, and a transverse wall

opposite said open side, at least one of said cover and transverse wall including a section overlapping said recess.

23. A device as defined in claim 22, said circumferential wall being provided in said portion thereof with a cut-out located within said recess; and further comprising an electrical conductor extending through said cut-out from the exterior to the interior of said housing.

24. A device as defined in claim 3; further comprising a housing; and wherein said metal detector device and actuating device are conductively connected with one another within the confines of said housing.

25. A device as defined in claim 24; further comprising an electrically conductive cable, and mating male and female electrical connectors on said cable and said detector and actuating devices, respectively.

26. A device as defined in claim 3; further comprising a housing defining a plurality of interior chambers; said metal detecting means comprising a metal detector device, an actuating device responsive to detection of metal matter by said metal detector device, and a switching device; and wherein said actuating device and said switching device are accommodated in a pair of adjacent ones of said chambers.

27. A device as defined in claim 3; further comprising a housing having a pair of longitudinal sides extending in substantial parallelism with said conduit means, and a pair of transverse sides; and wherein said actuating device is located in the region of one of said transverse sides.

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