Aug. 12, 1969 C. A. STUMPF 3,460,294

MAGNETIC DIRT COLLECTOR

Filed Sept. 28, 1967 2 Sheets-Sheet 1

FIG-1

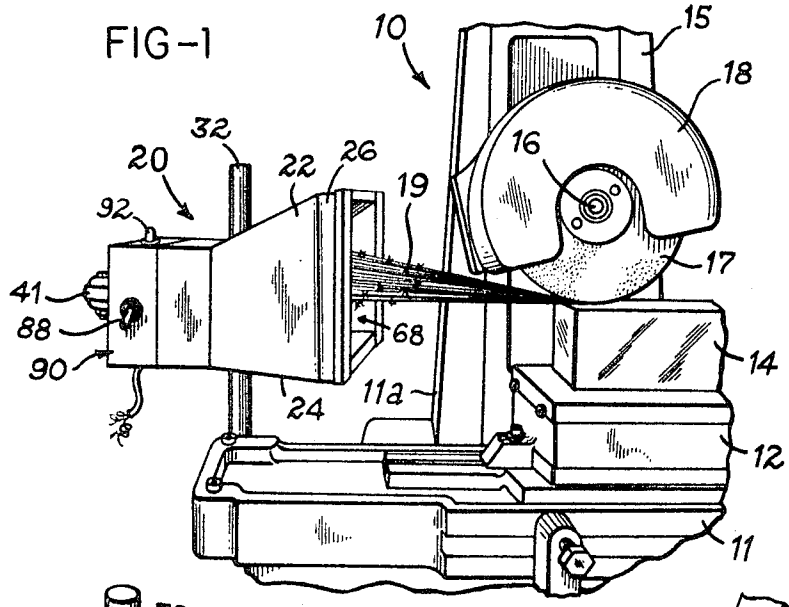


FIG-2

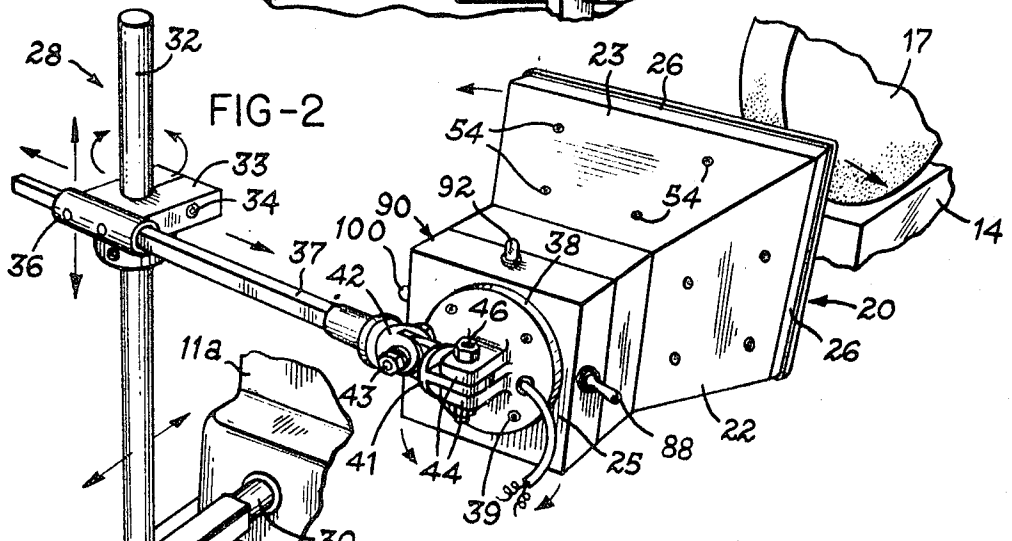
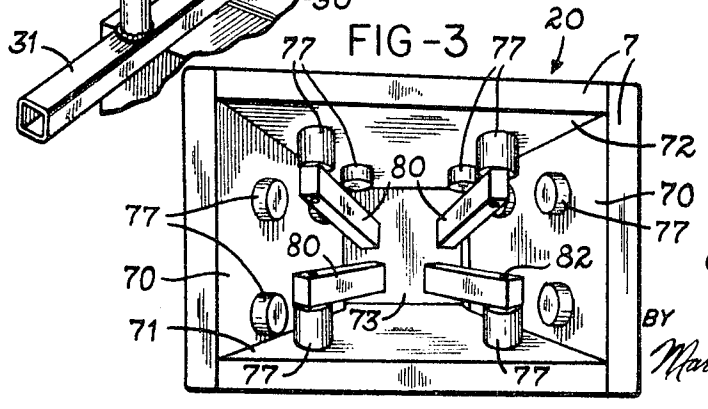


FIG-3



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FIG-4

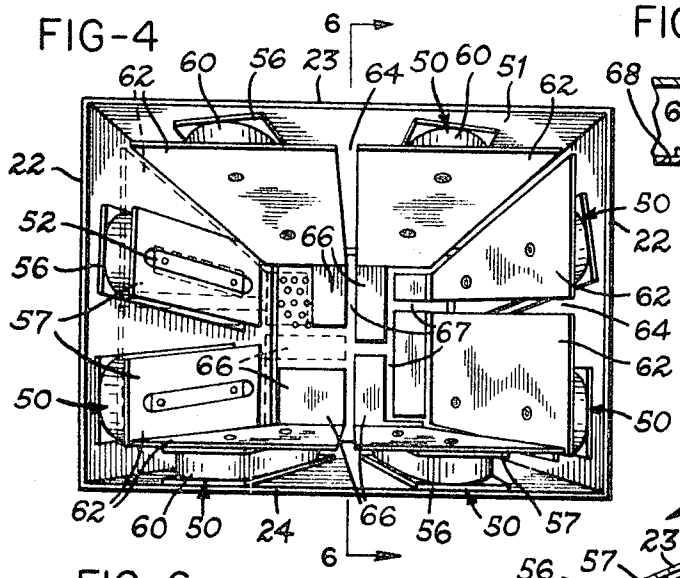


FIG-5

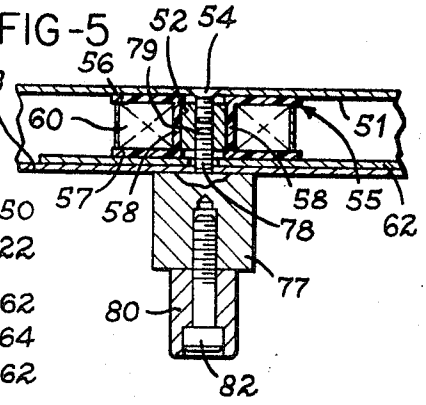


FIG-6

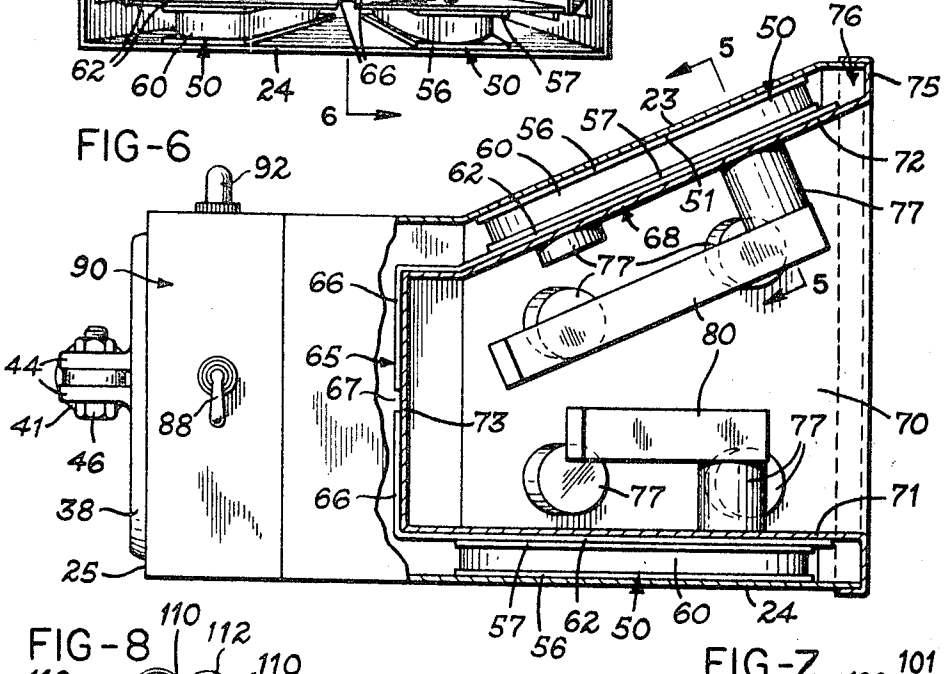


FIG-8

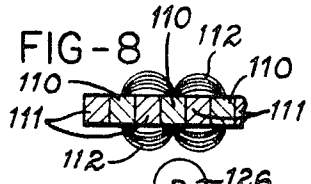


FIG-9

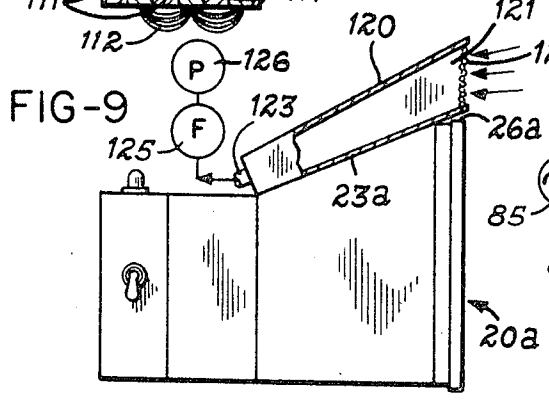
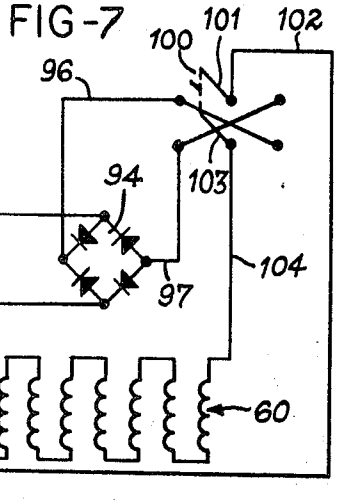


FIG-7



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MAGNETIC DIRT COLLECTOR

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Int. Cl. B24b 55/06
U.S. Cl. 51—270 12 Claims

ABSTRACT OF THE DISCLOSURE

A tubular housing having the inner surfaces thereof magnetized for depositing the magnetizable dirt particles which are produced when a grinding wheel machines a piece of metal. The housing can be easily adjusted to position its opening to receive the stream or dirt, and baffles or projections can be used to increase the area on which the particles can be deposited, to vary the pattern of the magnetic lines of force, and to create turbulence to insure that the particles are deposited in one of the surfaces in the housing. When an electromagnet is utilized, a phase reversing switch is provided to facilitate removal of the metal particles from the housing.

Background of the invention

It is necessary to collect and dispose of the dirt produced when a grinding wheel is utilized to smooth and machine a piece of metal. For the purpose of this disclosure, this dirt includes about 90% magnetizable metal particles removed from the workpiece and about 10% of the non-metallic materials removed from the grinding wheel. If the dirt were not collected, it would become entrained in the air around the machine and be damaging to the health of the operator when inhaled. It would be deposited both on the workpiece and the precision machine elements of the grinding machine making it difficult or impossible to maintain the necessary tolerances for high precision grinding.

The prior art devices utilize vacuum systems to draw the dirt into a conduit. These vacuum systems include two types, to wit, the individual type wherein the vacuum system is provided for each grinding machine, and the central system wherein a large vacuum pump is provided for a plurality of grinding machines. In any case, both of them are expensive and very noisy which decreases the efficiency of the operators. In addition, the individual system is space consuming since it must be located or mounted in close proximity to the machine. The central system usually ejects the dirt into the atmosphere outside of the building causing air pollution and decreasing the effectiveness of the air conditioning system since the air within the building containing the grinding machines is being pumped to the outside. Moreover, the central system limits the flexibility in the physical location of the machinery since the outlets were usually provided at precise positions when the building was constructed.

Summary of the invention

Accordingly, the invention provides a small housing having the inside surfaces magnetized so that, when the dirt is thrown into this housing, the magnetic particles are deposited on the magnetized surfaces. The device is noiseless, more efficient than the vacuum system, easily cleaned, and considerably less expensive than the prior art devices. In one embodiment of the invention a vacuum system is utilized to collect the non-magnetic dirt produced during the grinding operation.

Brief description of the drawings

FIG. 1 is a perspective illustration of a grinding machine utilizing the magnetic dirt collector in accordance with the invention;

FIG. 2 is another perspective view showing the adjustable support for the dirt collector;

FIG. 3 is a front elevation view of the dirt collector;

FIG. 4 is a view similar to FIG. 3 with the inner liner removed;

FIG. 5 is a sectional view taken along the line 5—5 of FIG. 6;

FIG. 6 is another sectional view taken along the line 6—6 of FIG. 4;

FIG. 7 is a diagrammatic illustration of the electrical circuitry for the invention;

FIG. 8 is a sectional view of a modified form of the sole plates; and

FIG. 9 is a side elevation view, partially in section, of another embodiment of the invention.

Detailed description of the drawings

Referring to FIG. 1, the conventional grinding machine **10** is illustrated including a table **11** having the horizontally reciprocating chuck **12** thereon with the metal workpiece **14** secured in place thereon by a magnetic chuck or its equivalent. The upstanding portion **15** of the frame **11** supports the rotating shaft **16** having the grinding wheel **17** thereon which is suitably driven at high speed in the usual manner. The protective guard **18** extends around the grinding wheel **17** except the lower portion thereof which contacts the workpiece.

As the chuck **12** reciprocates, the workpiece **14** is moved into contact with the grinding wheel **17** which removes a portion of the workpiece and creates the high speed stream **19** of dirt particles consisting approximately of 90% magnetizable metal particles from the workpiece and 10% of the non-magnetic particles from the grinding wheel. While this is the usual content of the dirt, it is in no way intended to be a limitation on this invention. It is also possible that a grinding wheel **17** may be composed partially or entirely of a material which is magnetizable so that the entire content of the dirt can be collected by this invention.

The magnetic dirt collector **20** in accordance with the invention is mounted on the frame **11***a* in position to receive the stream **19** of dirt as it is propelled at high speed tangentially of the wheel **17** from the area of contact between the wheel **17** and workpiece **14**. The collector **20** includes the tubular housing having the outer side walls **22**, the top and bottom walls **23** and **24**, and the rear wall **25**. The rear portion of these walls is square whereas the forward potrion of the walls taper outwardly to the edges **26**.

Referring to FIG. 2, the mounting apparatus **28** for the collector **20** permits adjustment of the housing in substantially any direction. This apparatus includes an elongated pin **30** secured to the frame **11** and adapted to receive the horizontal sleeve **31** for back and forth adjustment of the vertical rod **32** rigidly secured to the sleeve. The vertical rod **32** has a bracket **33** received thereon adapted to be clamped onto the rod by tightening the screw **34** and loosening to permit vertical as well as angular adjustment. The bracket **33** also has the horizontal sleeve **36** thereon adapted to receive the horizontal support rod **37** extending to the bracket **38** mounted on the rear wall **25** of the housing **20** by the screws **39**.

The bracket **38** includes an intermediate member **41** pivotally secured to the end member **42** on the support rod **37** by the screw **43**, and this intermediate member is secured between the horizontal fingers **44** by another

screw 46. Thus, the collector housing 20 can be adjusted away from the grinding wheel 17 by the sliding movement between the pin 30 and sleeve 31, in a vertical direction by moving the bracket 33 on the vertical rod 32, in a horizontal direction transverse of the face of the wheel 17 by sliding the horizontal rod 37 into the sleeve 36, as well as the minor angular adjustments effected by rotating the bracket 38 and the housing 20 about the axis of the screws 43 and 46.

A pair of electromagnetic coil devices 50 is secured on the inside surface 51 of each of the walls 22, 23 and 24, as shown in FIGS. 4–6, for the purpose of generating a magnetic field. Each of these devices includes an elongated metal core 52 in the form of a metal bar secured to the surface 51 by the machine screws 54. Surrounding the bars is a coil retainer 55 of non-magnetic material, e.g. a phenolic plastic, having the spaced arms 56 and 57 formed integrally with the center wall 58 to enclose a plurality of windings 60 of electrical wire having an insulation on the outside surface thereof. The windings are made from a continuous wire so that when direct current is applied to the wire it flows throughout the coil and creates a magnetic field.

Each of the electromagnetic devices 50 also includes a magnetizable metal plate 62 secured in place thereon on the inside arm 57 of the coil retainer and having a width substantially wider than the coil retainer 55. The precise configuration of these plates is important since they must be as large as possible without having contact with the adjacent plates to avoid short circuiting of the magnetic field. Thus the configuration of these plates is such that a space 64 is provided between the adjacent plates while allowing the plates to cover a maximum area. An end barrier 65 is created within the housing by the fingers 66 on each of the plates which are of different size and arranged so as to provide a space 67 between adjacent fingers while permitting a maximum area to be filled in by the plates. A precise configuration is shown in FIG. 4, but it is within the scope of the invention to use other configurations without departing from the scope of the invention so long as there is a clearance between all areas of the adjacent plates.

An inner liner 68 of non-magnetic material, for example brass, is supported within the housing 20 and includes the side walls 70, the bottom and top walls 71 and 72, and the integral back wall 73. Each of these walls is in intimate contact with the magnetic plates 62 although there is no shorting of the electromagnetic field because of the use of a substantially non-magnetic material in this liner. The outer edges 75 of this liner are deformed to provide a flange which encloses the space 76 between the liner 68 and the outside walls 22, 23 and 24 of the housing with the flange snugly engaging the outermost edges 26 of the otuside walls.

The inner liner 68 and the plates 62 are rigidly secured to the bars 52 of the magnetic devices 55 by the short posts 77 (FIGS. 5 and 6) having the threaded studs 78 on the inner ends thereof which extend through suitable openings in the liner 68 and plates 62, and into threaded bores 79 in the metal bars 52. Four such posts may be mounted on each of the walls 70, 71 and 72.

As shown in FIG. 3, the forward posts 77 on the upper and lower walls 71 and 72 have the rectangular magnetic bars 80 thereon extending generally rearwardly in the housing 20 and secured in place by the machine screws 82. These bars are utilized to distribute the magnetic field and provide additional surfaces on which the metallic particles may collect. It is therefore important that there be no contact between the bars which would cause shorting of the magnetic field. Moreover, these bars create a baffle effect which causes the metallic particles to swirl around in the housing 20 until they adhere to the magnetized surfaces, thus eliminating the possibility that the high speed particles may be deflected outwardly of the housing from the inner rear wall 73.

The operation of the magnetic dirt collector is best described in connection with the electrical schematic shown in FIG. 7. The housing 20 is first adjusted so that the center of the stream 19 of dirt particles is received in the center thereof. Because the grinding wheel 17 remains stationary, this pattern does not change materially as the workpiece 14 passes the grinding wheel, although further adjustment may be necessary if a large amount of metal is being removed from the workpiece. The housing 20 is mounted as close as convenient to the grinding wheel 17 with the necessary clearance for reciprocation of the chuck 12. As disclosed above, the housing 20 can easily be adjusted up and down, back and forth, or in an angular direction as the grinder is adjusted for workpieces of different sizes and configurations.

A source 85 of alternating current is supplied to the device 20 from a conventional source through the lines 86 and 87 having the on-off switch 88 therein. This switch is physically located within the rear portion 90 of the housing 20 (FIG. 6) and the glow light 92 is provided therein to indicate when the switch is in its on position. The alternating current flows to the full wave rectifier bridge 94 of conventional design which converts the alternating current to direct current flowing through the lines 96 and 97. From these lines the direct current flows through the double throw-double pole switch 100 which is normally in the position wherein the contact 101 connects the lines 96 and 102 and the contact 103 connects the lines 97 and 104. In normal use, each of the electromagnetic coils 60 is thus connected in the lines 102 and 104 and supplied with direct current.

The current flowing through the coils 60 creates a magnetic field which magnetizes the plates 62, the posts 77, and the elongated bars 80. Since the plates 62 are magnetized, substantially the entire area of the inside surface of the liner 68 is subjected to magnetic field so that, as the stream 19 of dirt is thrown into the housing at high speed, it strikes the bars 80 and is thrown against the walls 70, 71 and 72 where the metal particles adhere. The edges of the posts 77 and the bars 80, as well as the spaces 64 between the plates 62 create an increased magnetic field and thus the metal particles adhere in the area of these areas first. However, as a substantial amount of metal particles are thrown into the housing 20, the entire area of the posts, bars, and liner are covered, with little or no particles escaping from the housing 20.

When the housing 20 becomes filled with particles it can be easily emptied in a convenient container by merely pivoting the housing 20 about the vertical rod 37 to point downwardly into such container. The main switch 88 is turned off which releases a portion of the particles which fall into the container. The switch 100 which is in the form of a push button switch on the housing 20 (FIG. 2) is momentarily closed causing the contacts 101 and 103 to interconnect the lines 96 and 104, and 97 and 102, respectively, so that the direct current flows through the coils 60 in the direction opposite to that during normal operation. Since the metal particles will have a certain amount of residual magnetism, the polarity reversal will repel the particles away from the surfaces to which they are adhered thereby quickly releasing them to fall from the housing. This polarity reversal must be performed while the On-Off switch 88 has been moved to its Off position, otherwise some of the particles will re-adhere to portions of the housing.

Another embodiment of the plates 62 is shown in FIG. 8 wherein each of these plates is composed of alternating adjacent strips 110 and 111 of a metal capable of being magnetized and of a non-magnetic material so that the lines 112 of flux extend around (FIG. 8) the non-magnetic material rather than being shorted through the metal. This provides for a more even build-up of metal particles throughout the entire surface area of the adjacent liner 60.

Another embodiment of the invention is shown in FIG. 9 wherein the housing 20*a* and its components are identi-

cal to those described above. However, a rectangular duct **120** coextensive with the top wall **23***a* of the housing is mounted on this top wall with the inlet **121** disposed immediately above the front edge **26***a* of the housing. A screen or other grill work **122** may be provided on the inlet, and the outlet **123** is connected through a cartridge type filter **125** to a vacuum pump **126**. Thus when the apparatus is in use, the pump **126** draws air laden with non-metallic dust particles from the space surrounding the grinding operation, through the duct **120** and into the filter **125** wherein the dust particles are collected. This filter can be removed and cleaned or replaced from time to time. Because the non-metallic particles produced during the grinding operation are relatively light they float in the area surrounding the grinding operation, and a large portion thereof are drawn into the duct **120** by the air flow created by the vacuum pump.

Accordingly, the invention has provided a magnetic dirt collector for collecting the particles created during the grinding operation. A major portion of these particles is caused to adhere on the inside surfaces of the housing by the fields of magnetic flux which are created by the electromagnets therein. The instantaneous polarity reversing facilitates quick emptying of the particles from the housing which can be adjusted in substantially a universal manner to accommodate workpieces of different sizes and dimension.

The invention thus provides a noiseless, inexpensive, compact, and efficient apparatus for collecting the dirt particles produced during grinding, without interference with the air conditioning system. While a specific structural arrangement has been shown, it is within the scope of the invention to create the magnetic field by other types and arrangements of electromagnets, permanent magnets, or combinations thereof, and the shape of the housing is in no way a limitation on the invention. Likewise, the posts and bars may be eliminated without departing from the scope of the invention, and other types of baffles and magnetic flux distributing members may be utilized. It is also possible to mount the housing **20** for movement with a grinding wheel in a machine wherein the workpiece reciprocates rather than vice versa, as shown.

While the forms of apparatus herein described constitute preferred embodiments of the invention, it is to be understood that the invention is not limited to these precise forms of apparatus, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. A magnetic dirt collector for accumulating the metal particles from a stream of particles produced as a grinding wheel grinds a metal workpiece, said collector comprising a housing adapted to be positioned for cooperation with a grinding machine, means defining an opening to said housing for receiving the stream of dirt from the grinding machine, and magnetic means associated with said housing for creating a magnetic field to attract and deposit metallic particles on the inside surfaces of said housing.

2. A magnetic dirt collector as defined in claim **1** comprising mounting means for said housing adapted to permit adjustment in the position of said housing to substantially any direction to enable the stream of particles to pass into said opening.

3. A magnetic dirt collector as defined in claim **1** wherein said magnetic means includes a plurality of electromagnets adapted to create a magnetic field on the inside surfaces of said housing.

4. A magnetic dirt collector as defined in claim **3** wherein said housing includes an outer wall adapted to support a plurality of spaced electromagnetic devices, each of said devices including a flat plate on the inside thereof closely spaced from said plates on the adjacent electromagnetic devices, and an inner liner of non-magnetic material supported adjacent said plates to define a chamber adapted to receive the stream of particles through said opening.

5. A magnetic dirt collector as defned in claim **4** wherein each of said plates has a finger on the inner portion thereof which extends inwardly, said fingers being spaced from one another and defining a rear wall adapted to have a magnetic field created therein.

6. A magnetic dirt collector as defined in claim **4** wherein a plurality of projections are provided on the inside surface of said liner to alter the magnetic field.

7. A magnetic dirt collector as defined in claim **4** wherein a plurality of baffle means are provided on the inside surface of said housing for deflecting the stream of particles against the surfaces of said housing.

8. A magnetic dirt collector as defined in claim **7** wherein said baffle means are metal bars connected to said electromagnetic device to magnetize said bars and permit accumulation of metal particles thereon.

9. A magnetic dirt collector as defined in claim **3** comprising means adapted to connect a source of direct current to said electromagnetic devices, and switch means for momentarily reversing the direction of flow of the direct current to repel the metal particles from said housing to facilitate removal of the particles from said housing.

10. A magnetic dirt collector as defined in claim **1** wherein a vacuum device is associated with said housing for drawing the air surrounding said opening of said housing thereinto thus removing the non-magnetic particles.

11. A magnetic dirt collector as defined in claim **10** wherein said vacuum device includes filter means for removing the solid particles in the air drawn into said vacuum device.

12. A magnetic dirt collector as defined in claim **4** wherein said plates are composed of adjacent strips of magnetizable and non-magnetizable materials so that the magnetic field created by said coils extends between the magnetizable strips.

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JAMES L. JONES, JR., Primary Examiner

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