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MAGNETIC CLEANER FOR COOLANT

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FIG. 1.

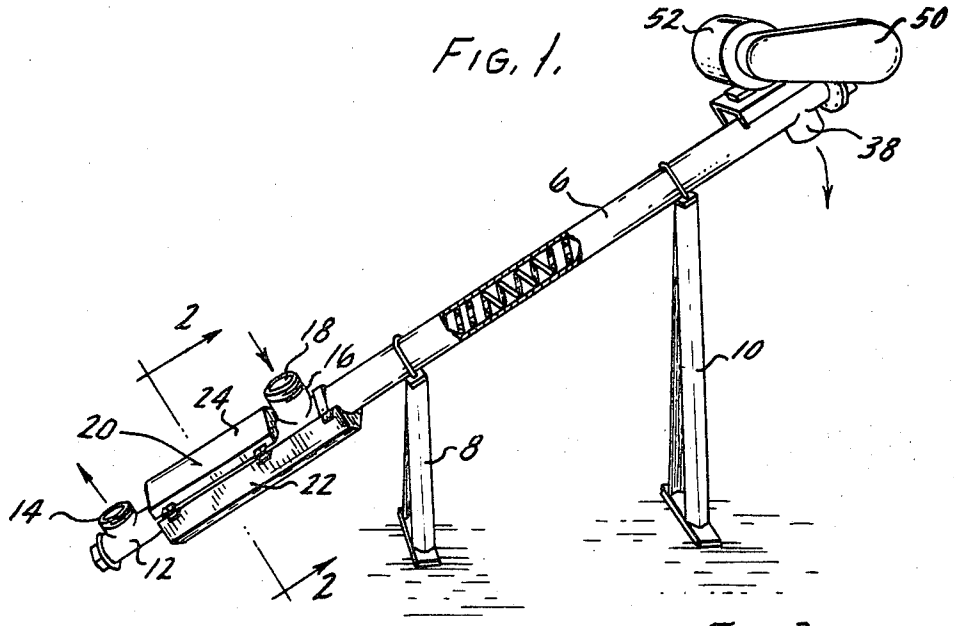
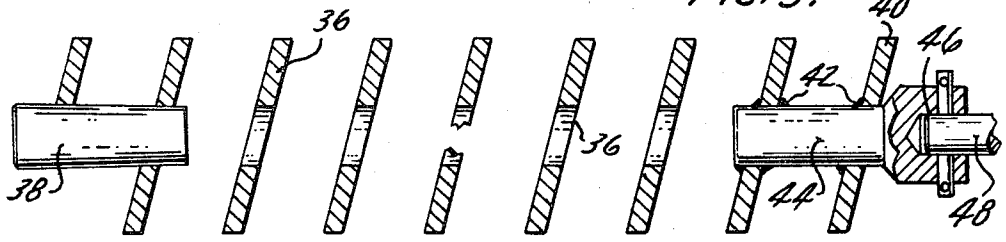


FIG. 3.



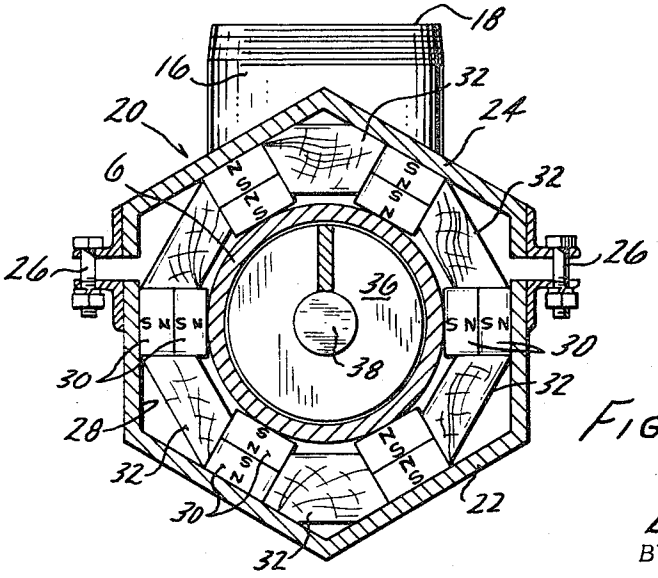


FIG. 2.

INVENTOR.
EDWARD P. LOHMANN
BY
Wheeler, Wheeler & Wheeler
ATTORNEYS.

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MAGNETIC CLEANER FOR COOLANT

Edward Pratt Lohmann, 2377 N. 73rd St.,
Wauwatosa, Wis. 53213

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ABSTRACT OF THE DISCLOSURE

A nonmagnetic tube continuously inclined in one direction has an intermediate inlet for coolant and chips to be removed therefrom, there being a lower outlet for coolant discharge and an elevated outlet for chip discharge. Surrounding the tube are radially magnetized ceramic magnets arranged in stacks with several stacks disposed in rows axially of the tubes to attract magnetic chips to the inner periphery of the tube so that a floating helix operated by power within the tube will lift the chips to the point of chip discharge while allowing the coolant to flow by gravity from the lower outlet.

This invention relates to a magnetic cleaner for coolant.

The coolant used in various machining operations and the like becomes contaminated with metallic chips and particles of various sizes and shapes. According to the present invention, the chip-laden coolant is passed through a substantially nonmagnetic tube surrounded by permanent magnets creating a field that draws the chips to the inner surface of the tube. A motor-driven nonmagnetic open coil helical screw advances the magnetic foreign matter up the interior surface of the tube to a level above the level of the coolant, and thereupon discharges the chips free of coolant. The coolant may be pumped through the tube but preferably flows by gravity through the inclined tube from top to bottom and issues free of chips from the lower end of the tube. At the lower end of the helix, the coolant is preferably constrained to pass through the space between successive turns of the coil, the otherwise open center of the helix having a nonmagnetic plug at its lower end.

The magnets used are preferably ceramic magnets which are flat and polarized across the flat dimension and may be stacked, if desired. The stacks are preferably in abutment axially but are arranged in rows of alternating polarity and spaced from each other circumferentially in series about the outside of the nonmagnetic tube. The magnets are magnetically engaged with a soft iron housing comprising segments clamped about them to complete magnetic circuits between the magnets and to hold them to the tube. Spacers of wood or other nonmagnetic material may be employed to keep the rows of magnets properly spaced circumferentially between the housing and the tube.

In the drawings:

FIG. 1 is a view in perspective showing apparatus embodying the invention.

FIG. 2 is a view taken in cross section on the line 2—2 of FIG. 1.

FIG. 3 is a fragmentary detail view in axial section through portions of the open helix screw.

It will be understood that all details given with regard to dimensions and positions and specific materials are by way of examplification and not by way of limitation.

An elongated substantially nonmagnetic tube **6** is mounted on adjustable supports **8** and **10** by which its angle may be fixed as desired. In a particular embodiment, this tube is made of 14 gauge 304 stainless steel. It is six feet in length and has an internal diameter of approximately three inches and is inclined thirty degrees to the horizontal.

At its lower end, it has connected with it a T **12** which provides outlet **14** for the cleaned coolant. A pipe coupling **16** welded to the tube **6** opens laterally into the tube at a point spaced from its lower end to provide an inlet **18** for the chip-laden coolant which is to be cleaned.

Between the coolant inlet **18** and the coolant outlet **14** is a housing **20** which, as shown in FIG. 2, comprises parts or segments **22** and **24** held together and clamped to the magnets by bolts **26**. This housing is made of highly magnetic soft iron or the like to complete the magnetic circuits between stacks. It is preferably polygonal rather than circular and has inner faces such as those shown at **28** to which adhere permanent magnets **30** preferably arranged in stacks of two, the stacks being in circumferentially spaced rows. In practice, I use sixty-four ceramic magnets, one-half inch by one inch by three inches, all polarized across the flat dimension. As indicated diagrammatically in FIG. 2, the magnets in successive rows alternate in polarity. While the magnets tend to retain their positions magnetically on the flat surfaces **28** of the housing **20**, it is preferred that the rows of stacks of magnets be positioned between the housing components and tube **6** by elongated nonmagnetic spacers **32** of trapezoidal form in cross section which are placed between rows of magnets in the manner clearly illustrated in FIG. 2. These may be made of wood. The magnets are also positioned by pressure of the clamping bolts **26**.

In close proximity to the inner surface of the stainless steel tube **6** are the coils of a nonmagnetic open-centered helix **36** which serves as a feed screw for elevating the chips in the tube from a discharge port **38** provided in the upper end thereof. The tube is of such length and inclination that the port **38** will be well above the level reached by the coolant passing through the tube. Consequently, the chips are discharged with no substantial amount of adherent coolant. They are dry or nearly dry as discharged.

The helical screw **36** may conveniently be made of one by one-quarter inch bar stock wound on edge into a helix having a seven-eighth inch open center. In practice, I have made the helix six feet long for use in a six foot tube. It has an O.D. of two and one-quarter inches. The pitch is one and one-half inches. The material used has been the T304 stainless steel.

At the lower end of the screw **36**, it is preferred to close the otherwise open center of the screw by means of a nonmagnetic plug **38** which may be made of wood or synthetic resin. At its upper end **40**, the helix has a weld **42** connecting it with the stub shaft **44**. The shaft is provided with a socket **46** which receives, and is in pinned connection with, the output shaft **48** of gear reducer **50** driven from a motor **52**.

One of the merits of the device lies in the fact that it requires no circulating pump. Machine tools, lathes and the like which use coolant have coolant collecting troughs with return pipes for returning the coolant by gravity to a sump from which the coolant is returned to the point of use by a pump with which the machine tool itself is equipped. The device as disclosed is adapted to receive the coolant by gravity from the point at which it is collected and to pass the cleaned coolant by gravity back to the machine tool sump. Consequently, so far as the movement of coolant is concerned, no moving parts are required in the cleaner.

So far as the chips are concerned, the only moving part in the cleaner is the nonmagnetic helix which, by means of the gear reducer, is operated, in practice at about 10–12 r.p.m. The three inch device selected to exemplify the invention is capable of handling twenty-five gallons per minute of coolant, either water soluble or oil, and is capable of discharging chips at the rate of 3.75 cubic feet per hour, maximum. The adjustable supports **8** and **10**

may be used to regulate the height of the entire apparatus or to change the angle of inclination as required.

I claim:

1. A magnetic cleaner for coolant comprising an elongated substantially straight length of stainless steel tube having a discharge port for coolant adjacent one end and a discharge port for solids adjacent its opposite end, means for supporting the tube at an inclination with respect to the horizontal with the coolant discharge port at a low level and the discharge port for solids at a high level, a stainless steel helix within the tube extending from a point near the coolant outlet to a point near the solid outlet, the tube having a coolant inlet at an intermediate level, means including a motor having a driving connection to the helix adjacent said opposite end for rotating the helix within the tube in a direction to advance solids axially of the tube toward the solids outlet, the helix is provided with a nonmagnetic plug adjacent the coolant outlet, and means for establishing a magnetic field about that portion of the tube between the coolant inlet and the coolant outlet, comprising a plurality of stacks of flat ceramic permanent magnets, each stack containing at least one such magnet, the stacks being arranged in rows longitudinally of the tube, polarized ends of a magnet of each stack being substantially in external contact with the tube, the several rows being spaced circumferentially of the tube, nonmagnetic spacers interposed between rows, and a housing of soft magnetic material and comprising a plurality of segments bolted to each other in pressure engagement with the outermost magnets of the respective circuit between the magnets of the several stacks.

2. A magnetic cleaner for coolant according to claim **6** in which the driving means including a stub shaft welded into the helix adjacent the solids outlet.

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SAMIH N. ZAHARNA, *Primary Examiner.*