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(54) Suction cleaning device

(57) A hand-held suction cleaning device has a suction pipe (7) leading to a cyclone separator (2) with an annular separator chamber (3)

into which pipe (7) feeds tangentially. The chamber (3) exhausts to atmosphere through a central exhaust pipe (15) and an upper exhaust chamber (19). Pistol-grip handle (1) has trigger control member (14) which operates air valve (13) controlling the air flow from inlet connection (12), which can be coupled to a compressed air supply, to nozzle (9) through pipe (10). Nozzle (9) is formed in the upper wall of pipe (7) adjacent the inlet end of the latter, and it produces an air jet which discharges into pipe (7) to produce an air flow therealong to separator chamber (3) and a resultant suction at the inlet end of pipe (7). Solids picked up by this suction are transported in the air stream along pipe (7) and separate out in chamber (3) from which they fall by gravity through funnel (4) into detachable container (5).

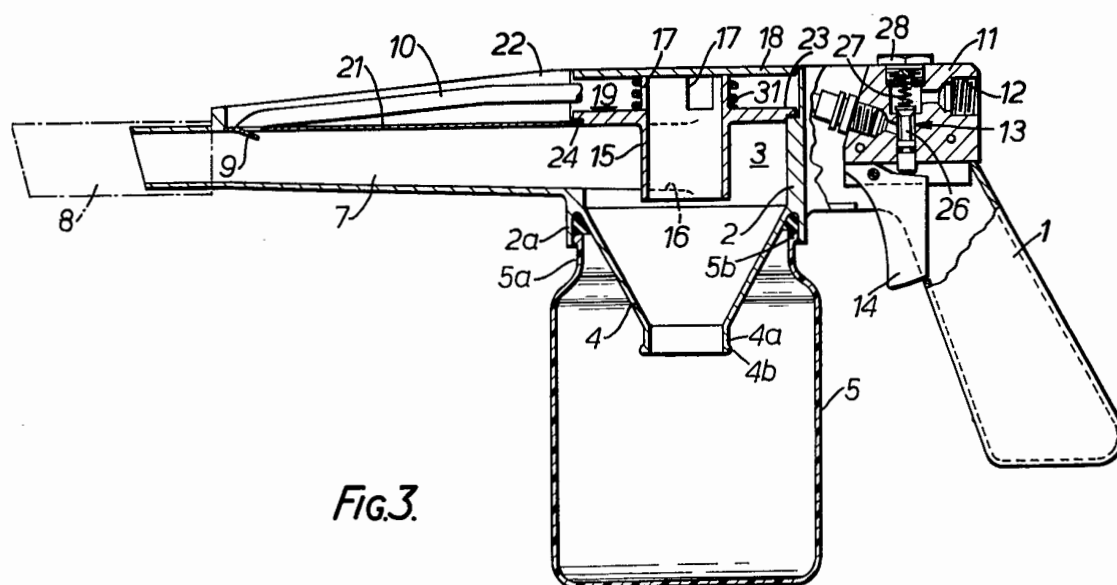


Fig. 3.

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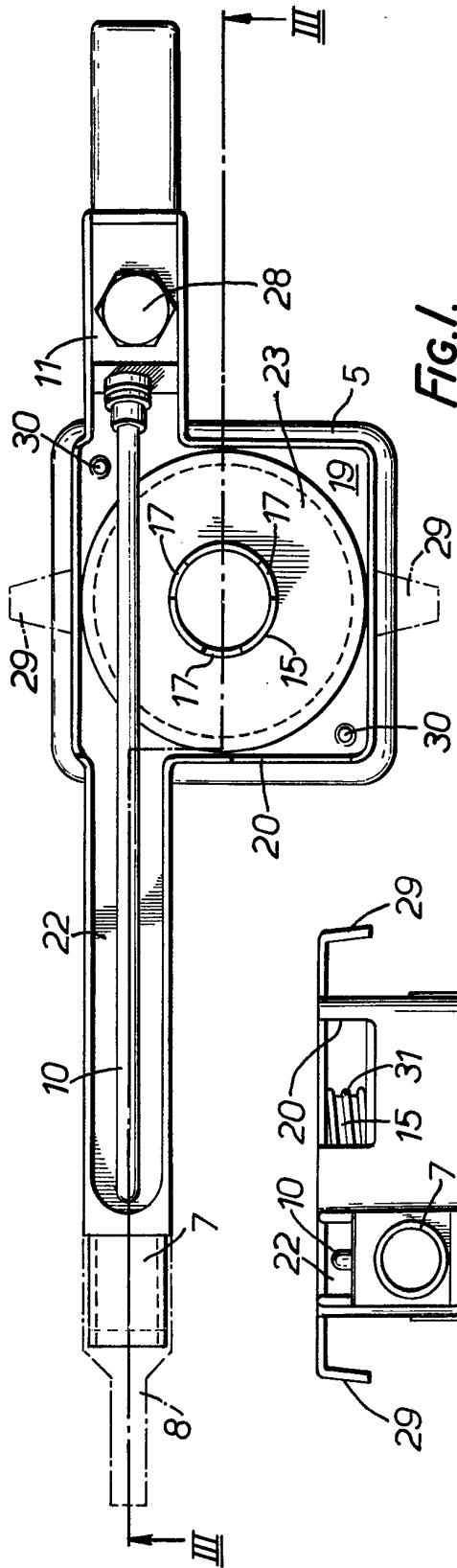


FIG. 1.

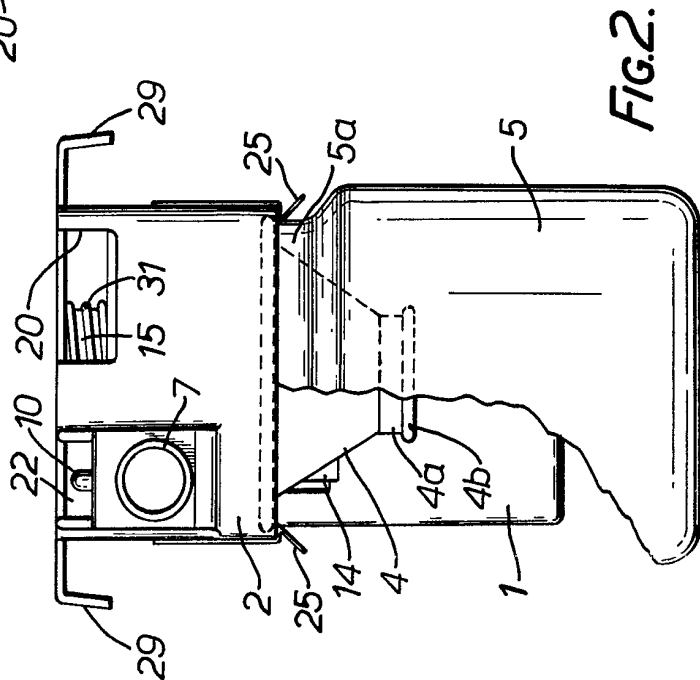
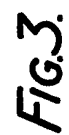


FIG. 2.



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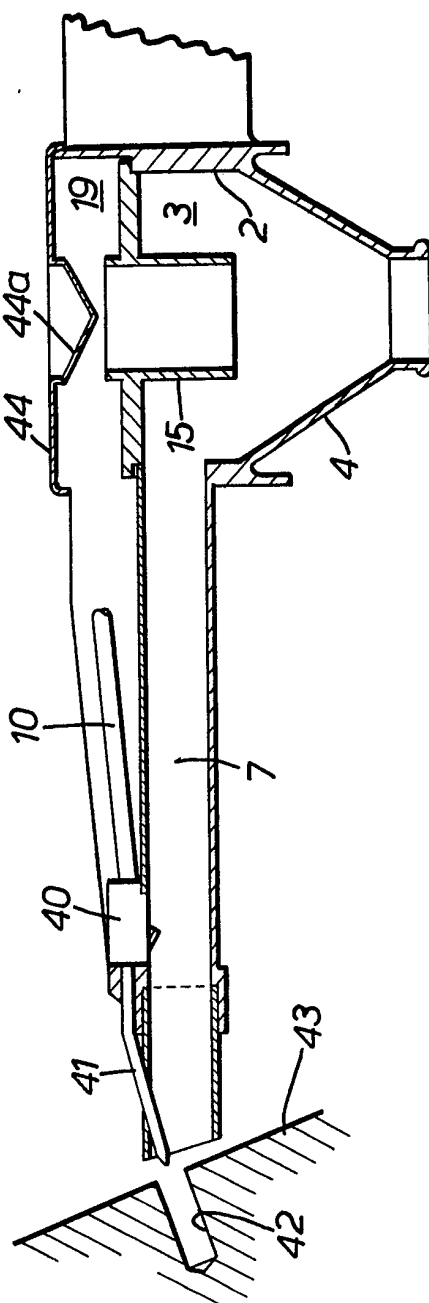


FIG. 4.

SPECIFICATION

Suction cleaning device

5 This invention relates to cleaning devices of the type which employ suction to pick up solid matter which is transported in an air flow to a bag or container in which it collects for disposal.

10 Devices of this type are not, generally speaking, suitable for workshop use as they do not satisfactorily handle oily metal such as the swarf produced by machine tools. The cleaning out of oily swarf from the T-slots of lathes, milling machines and the like is a common workshop problem. This swarf normally has to be dislodged and brushed out by hand.

20 The object of the invention is to provide a portable hand-held suction cleaning device which is particularly suitable for workshop use, for example to clear out the T-slots of machine tool slides and tables.

25 According to the invention a hand-held suction cleaning device has a suction pipe leading to a cyclone separator which exhausts to atmosphere and is disposed above a container for solids which are in use picked up at an inlet end of the pipe and separated out in the separator, and an air inlet connection for coupling to a compressed-air line and which supplies an air jet which discharges into the suction pipe to produce an air flow therealong to the separator with resultant suction at the inlet of the pipe.

35 Preferably a detachable nozzle at the end of the suction pipe provides the suction inlet, and this nozzle may be one of a range of interchangeable nozzles which are differently shaped to suit a variety of applications. A device in accordance with the invention has in practice proved extremely useful for clearing out machine tool T-slots, and for this purpose an elongated rectangular cross-section nozzle is most suitable.

40 The device preferably has a piston-grip handle with ON/OFF air valve controlling the air jet and operated by a conveniently situated trigger control member. A pre-settable needle valve may also be provided for adjustable throttling of the air flow to the jet, whereby to provide optimum performance for picking up different solid materials. The separator may exhaust at the top and to the side away from the operator, and the container is preferably readily detachable from the separator for emptying when full.

50 A discharge funnel may be provided below the separator to discharge into the container, and this funnel may have an end section with a lip for attachment of a polythene bag by means of an elastic band in place of the container. This provides ready and safe disposal of contaminated material collected by the device.

An air blast nozzle may be provided which is operable to dislodge solid matter which is subsequently picked up by the suction of the device, for example to dislodge swarf from a blind hole or recess in a component. This air blast nozzle may be concentric with, or otherwise positioned with respect to, a detachable suction nozzle of the device and said ON/OFF air valve may simultaneously supply the air blast nozzle and the suction air jet. Alternatively, the air blast nozzle may have its own air supply controlled along with the suction air jet by a two-position trigger control valve operable to supply the air jet, and thus apply suction, first, and then to apply both an air blast and suction should this be necessary.

80 A general-purpose suction cleaning device designed with the problem of clearing out the T-slots of machine tools particularly in mind is illustrated, by way of example, together with a modification, in the accompanying drawings and will now be described with reference thereto. In the drawings:

Figure 1 is a plan view of the device;

90 *Figure 2* is a suction-inlet end view, with a container of the device partly cut away;

Figure 3 is a sectional view on the line III-III in Fig. 1; and

95 *Figure 4* is a fragmentary sectional view, on the same section line, showing the modification.

The hand-held device illustrated in Figs. 1 to 3 has a stock 1 (shown partly cut away in Fig. 3) which provides a pistol grip and to which is attached a cyclone separator chamber 3 disposed coaxially above a frusto-conical discharge funnel 4. A detachable circular blow-moulded polythene container 5 has a neck 5a which fits into a bottom skirt 2a of the separator 2, the funnel 4 projecting a short distance down into the container 5.

100 A suction pipe 7 enters the cyclone chamber 3 tangentially at one side of the device, and an interchangeable inlet nozzle 8 (shown in broken lines) is a push fit on the end of the pipe 7. The inlet nozzle shown is of elongated rectangular cross-section, which is particularly suitable for clearing swarf out of T-slots. An air jet nozzle 9, formed by semi-piercing the upper wall of the tube 7 adjacent the inlet end thereof, discharges into the separator 2 with the resultant production of a vacuum at the inlet nozzle 8.

110 The jet nozzle 9 is supplied by an air supply pipe 10 leading from a valve block 11 at the top of the stock 1. At the block 11 an inlet connection 12 enables the pipe 10 to be connected to a compressed-air line through an ON/OFF valve 13 housed in the block 11.

125 The valve 13 is normally OFF and is actuated, to operate the device, by a trigger control member 14 mounted in the stock 1.

A tubular exhaust outlet pipe 15 mounted centrally of the separator 2 projects upwardly from and downwardly into the chamber 3 to a

level below the port of entry 16 of the tube 7 into the chamber 3. The exhaust pipe 15 has side outlets 17 at an upper level and is capped by a closure plate 18 which closes the top of the pipe 15 and surrounding exhaust chamber 19 which in turn discharges to atmosphere forwardly, and thus away from the operator holding the stock 1, through an air discharge aperture 20.

The stock 1, separator 2, funnel 4 and tube 7 are all provided by an integral die-cast body of aluminium or zinc based alloy. The casting is open at the top above the tube 7 and the separator chamber 3, the casting being closed to form the tube by a closure plate 21 providing said upper wall in which the jet nozzle 9 is formed. The supply pipe 10 to the nozzle 9 passes through the space 22 within the die-cast body above the plate 21 as well as through the chamber 19, and it is encapsulated within the space 22, for example with an epoxy resin. The exhaust pipe 15 is provided by a further die-cast moulding which fits into the body and has an intermediate annular flange 23 which seals against the body through a gasket 24 to form the top of the cyclone separating chamber 3.

The neck 5a of the container 5 has a top lip 5b engaged by two spring clips, which are respectively fixed to the sides of the body and act to retain the container. This provides a quick-release attachment for the container 5, and the rim of the container neck 5a seals against a foam rubber sealing ring housed in a recess between the skirt 2a and the funnel 4. The frusto-conical funnel 4 has a short cylindrical extension at its lower end with a lip 4b to retain an elastic band which can be used to secure a disposable polythene bag to the funnel in lieu of the container 5. This simplifies the disposal of contaminated material which can be thrown away with the bag.

The valve 13 comprises a simple poppet valve member 26 which is directly displaceable off its seating in the block 11 (which is shown sectioned in Fig. 3) by the trigger member 14 which is pivoted to the block 11. The valve member 26 is urged to the closed position, as shown, by a valve spring 27 an abutment for which is provided by a closure plug 28 screwed into the block 11. This plug seals off an aperture through which the valve member 26 and the spring 27 are fitted.

To use the device the operator actuates the trigger member 14, thus starting the air flow along the tube 7 into the cyclone chamber 3. Swarf or other solid matter to be collected can then be picked up by the suction at the nozzle 8, and transported by the air stream along the tube 7 to the chamber 3. In that chamber a normal centrifugal cyclone separation occurs, the solid matter which is separated out falling down the funnel 4 into the container 5 which can be detached and emptied when full, or

into a disposable polythene bag fixed to the extension 4a when preferred. The air discharges to atmosphere from the chamber 3 through the pipe 15 and chamber 19.

As shown the pistol grip is offset to said one side of the central section line II-II and in line with the tube 7 to improve balance, and as a modification (not shown) the air jet 9 may be positioned on the vertical centre line of the tube 7. As a further modification (again not shown) the air jet may be provided by a drilling, which may be divergent, in a connecting piece mounted at the end of the tube 7 and on to which the interchangeable nozzles such as 8 fit.

At the sides of the device the closure plate 18 has projecting angled lugs 29 (see Fig. 2). These enable the device to be hung up out of the way when not in use. The closure plate 18 is shown in ghost broken outline in Fig. 1 to show how the pipe 10 passes through the chamber 19 to the valve block 11. The plate 18 is held in place by two screws at 30, and it retains a spring 31 which holds the flange 23 in sealing engagement with the gasket 24. The bottom end inlet of the exhaust pipe 15 is positioned at the bottom of the cyclone separator chamber 3, and the exhaust discharge path through the exhaust chamber 19 prevents any possibility of non-separated solids being exhausted to atmosphere. Any solids which may enter the pipe 15 will collect in the chamber 19. Removal of the plate 18 enables the chamber 19 to be cleaned out, and also the moulding 15, 23 to be removed for cleaning of the device as a whole and should the chamber 3 become clogged with swarf.

In the modification of Fig. 4 the air supply pipe 10 supplies an air distribution block 40, which in turn supplies a forwardly directed air blast nozzle 41 as well as the suction air jet nozzle 9. The interchangeable inlet suction nozzle 8 is cut away to allow the nozzle 41 to project within the cross-sectional area of the suction nozzle 8. Fig. 4 illustrates how the modified device is used to remove swarf from a blind hole 42 in a component 43. The device is positioned so that when the trigger-operated ON/OFF valve is actuated the air blast from the nozzle 41 dislodges the swarf in the bore 42, the dislodged swarf then being picked up by the suction nozzle 8 and transported along the suction pipe 7 to the cyclone chamber 3.

The device as modified in Fig. 4 also has a top cover 44 which replaces the closure plate 18 of Figs. 1 to 3 and is in the form of a light pressing. This pressing has an indentation 44a to assist the air flow and for location of the spring 31. The exhaust pipe 15 projects only a short distance upwardly into the exhaust chamber 19, terminating well below the top cover 44 so that slotting of the pipe 15 is not now necessary.

CLAIMS

1. A hand-held suction cleaning device having a suction pipe leading to a cyclone separator which exhausts to atmosphere and is disposed above a container for solids which are in use picked up at an inlet end of the pipe and separated out in the separator, and an air inlet connection for coupling to a compressed air line and which supplies an air jet which discharges into the suction pipe to produce an air flow therealong to the separator with resultant suction at the inlet end of the pipe.
2. A device according to claim 1, wherein a detachable nozzle at the inlet end of the pipe provides the suction inlet.
3. A device according to claim 2, wherein said nozzle is one of a range of interchangeable nozzles differently shaped to suit a variety of applications.
4. A device according to claim 2 or 3, wherein said nozzle, or one of said range thereof, is of elongated rectangular cross-section as suited to clearing out the T-slots of a slide or table of a machine tool.
5. A device according to any one of the preceding claims, wherein a discharge funnel below the separator discharges into the container.
6. A device according to claim 5, wherein said funnel has an end section with a lip to retain an elastic band by means of which a disposable polythene bag can be secured to the funnel in place of the container.
7. A device according to any one of the preceding claims, wherein the device has a pistol-grip handle, an ON/OFF air valve to control the air jet and a trigger control member for operation of the air valve.
8. A device according to any one of the preceding claims, wherein a pre-settable needle valve is provided for adjustable throttling of the air flow to said air jet.
9. A device according to any one of the preceding claims, wherein said separator has an annular chamber into which the suction pipe feeds tangentially and which exhausts to atmosphere through an exhaust pipe positioned centrally of the chamber, said exhaust pipe having an inlet at the bottom of the separator chamber and an outlet above the chamber.
10. A device according to claim 9, wherein said exhaust pipe outlet discharges into an exhaust chamber disposed above the separator chamber and which in turn discharges to atmosphere away from an operator when holding the device.
11. A device according to claim 9 or 10, wherein the separator chamber is formed within a main body moulding to which the container is detachably secured, and the exhaust pipe is provided by a removable moulding which includes an intermediate flange

which forms the top wall of the separator chamber.

12. A device according to claim 11, wherein the removable moulding is held in position within the body moulding by a top closure plate which provides the top of said exhaust chamber and is detachable for cleaning the exhaust chamber and removal of the exhaust pipe moulding.
13. A device according to any one of the preceding claims, wherein said air jet issues from a nozzle in the wall of the suction pipe adjacent the inlet end thereof.
14. A device according to any one of the preceding claims, wherein an air blast nozzle of the device is positioned to produce an air blast operative to dislodge material to be picked up at the inlet end of the suction pipe.
15. A device according to claims 7 and 14, wherein said ON/OFF valve supplies both the suction air jet and the air blast nozzle.
16. A hand-held suction cleaning device constructed and arranged substantially as herein particularly described with reference to and as illustrated in Figs. 1 to 3 of the accompanying drawings, or modified as shown in Fig. 4 of the accompanying drawings.

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