Dec. 3, 1946. C. M. DOYLE 2,412,133

DRIER

Filed Nov. 5, 1942 2 Sheets-Sheet 1

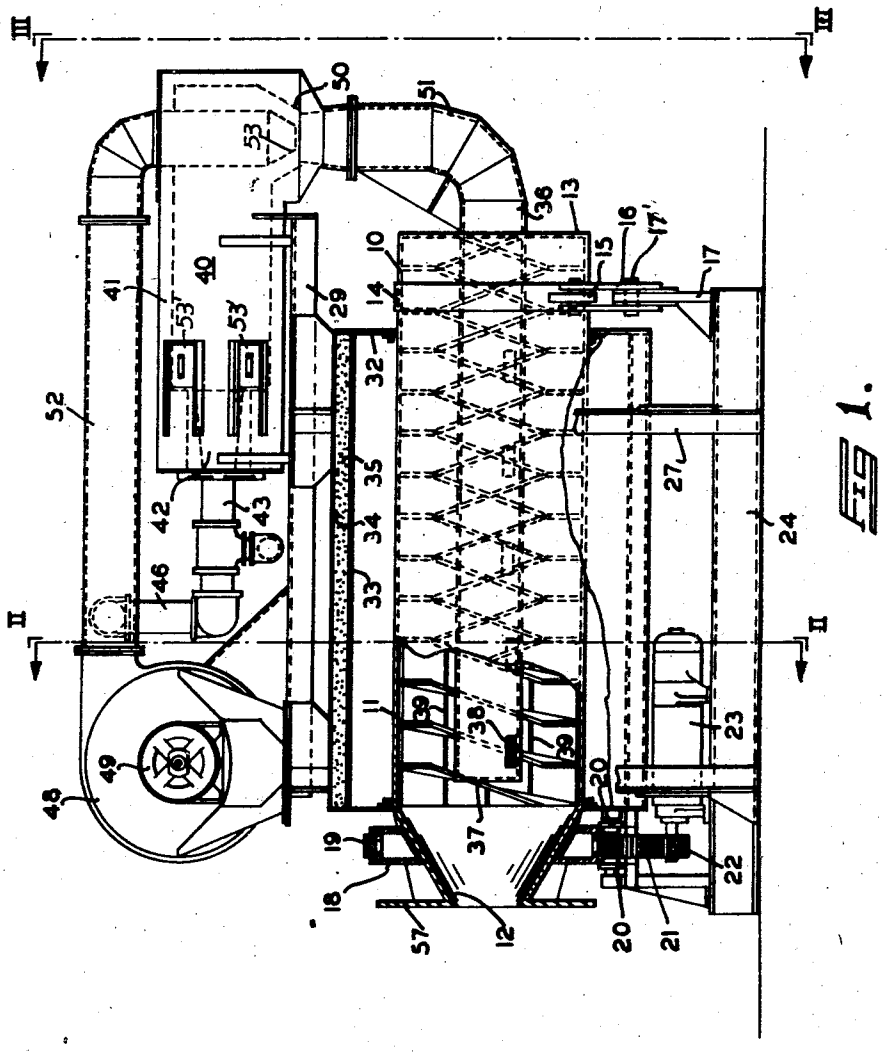


Fig 1.

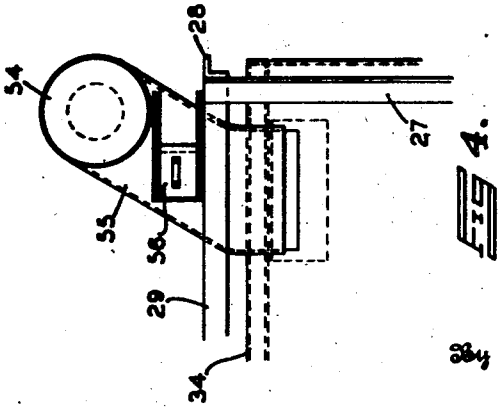


Fig 4.

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DRIER

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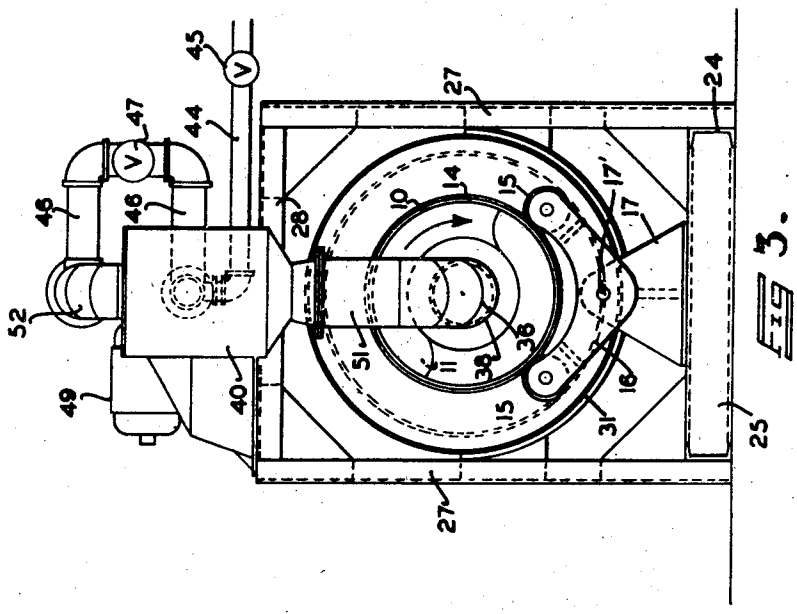


Fig 3.

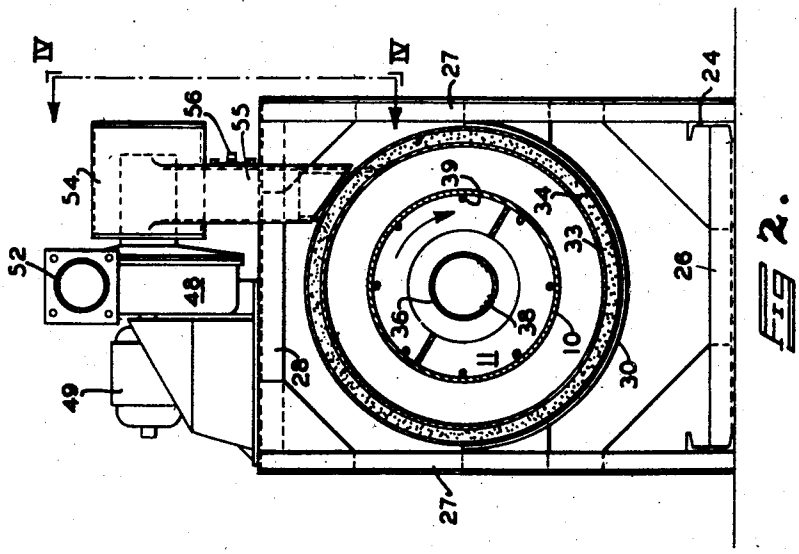


Fig 2.

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UNITED STATES PATENT OFFICE

2,412,133

DRIER

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Application November 5, 1942, Serial No. 464,558

3 Claims. (Cl. 263—32)

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This invention relates to drying apparatus and more particularly to a unitary, portable, self-contained assembly which is operative to dry small pieces such as small metal parts.

The primary object of the invention is the provision of a highly efficient apparatus of the character stated which is simple in design, compact and economical in construction, which may be completely assembled at the factory, and which may be readily moved about the parts manufacturing or processing plant as needs dictate. To this end all the operative parts of the apparatus are assembled on a unitary frame of minimum dimensions whereby the floor space required for the installation of the apparatus is materially less than in comparable devices heretofore proposed for performing the same functions. The frame is carried on skids and the major part of the necessary apparatus constituting the assembly is positioned in an out of the way location above the drying chamber.

A more specific object of the invention is the provision, in an apparatus of the character described, of an improved arrangement for generating the heat required to effect a rapid drying of the parts and for injecting the heat thus generated into the drying chamber. These improvements enable the complete apparatus to be materially simplified and compacted and reduces heat loss to a minimum whereby a greater efficiency of operation may be attained.

Another object of the invention is the provision, in apparatus of the character described, of a practical arrangement whereby a material recuperative effect is attained without sacrificing the efficiency or speed of drying.

A further object of the invention is the provision of a unitary and self-contained small parts drier which may be readily coupled directly with other equipment utilized in the particular process involved whereby the carrying out of the process or processes in a more continuous and economical manner may be effected. For this purpose the revolving drying and conveying chamber employed is so constructed and positioned in the assembly that it may be directly and mechanically coupled with the revolving drums of preceding equipment. This preceding equipment may, for example, consist of a combined pickling and washing unit utilizing one or more perforated drums at each stage. In this case the last washing or drying drum would be connected with the drying drum of the present apparatus and all the moving parts would rotate in unison to provide for the uniform and uninterrupted flow of

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the parts through the units of the complete processing line. Also the present apparatus is so devised that an additional drying drum may be readily attached to increase the length of the drying chamber which is desirable in certain situations.

The above and other objects and advantages of the invention will become apparent upon a consideration of the following detailed specification and the accompanying drawings wherein there is specifically disclosed a preferred practical embodiment of the invention.

In the drawings:

Figure 1 is a side view, partly in section, of an assembled drier constructed in accordance with the principles of the invention;

Figure 2 is a transverse section, with certain parts omitted, taken generally along the line II—II of Figure 1;

Figure 3 is an end view of the apparatus of Figure 1; and

Figure 4 is a fragmentary side view taken from the position IV—IV (Figure 2).

Referring to the drawings, reference numeral 10 designates a cylindrical drum having a helical material moving baffle or baffles 11 positioned against the inner surface of its side wall. One end of the drum 10 is funnelled at 12 to provide an inlet for the pieces or parts to be dried and it will be understood that upon rotation of the drum 10 the parts entering at 12 will be caused to move longitudinally along the drum and be discharged at the end 13. The parts, of course, will remain in the bottom of the drum and will be tumbled about to a certain extent as they progress through the drum. This turning movement is of material aid in hastening the drying process.

Adjacent the end 13 of the drum 10 is a wear band 14 which is arranged to be engaged by rollers 15 journaled in a cradle 16 which, in turn, is pivotally mounted on a support 17 by means of a pivot pin 17'. A ring 18 is fixed to the opposite end of the drum and pressed onto the ring 18 is a combined supporting and driving gear 19. As shown in Figure 1, the outer smooth races of the member 19 are engaged by the flanged rollers 20 while the teeth of the gear are engaged by a spur gear 21 which, in turn, is driven by a pinion 22 fixed to the shaft of a geared motor 23. It will be understood that at least two circumferentially spaced sets of rollers 20 will be employed to lend lateral stability to the drum. The rollers 20 as well as the gear 21, motor 23 and supports 17 are mounted on a base consisting of

the spaced longitudinally extending skids 24 and the transverse angle sections 25 and 26.

Extending upwardly from and rigidly secured to each of the skids 24 are two longitudinally spaced frame section members 27 which are interconnected at their upper ends with transverse and longitudinal members 28 and 29, respectively, to provide a box-like frame structure for the support of the parts to be described below. As shown in the drawing, suitable gusset plates are fastened into the corners of the frame to provide the proper strength and rigidity.

Supported on the semi-cylindrical hangers 30 and 31 which are welded or otherwise suitably secured to the stanchions 27 is a casing having end walls 32 apertured to receive the drum 10 and concentrically spaced side walls 33 and 34. The space between the walls 33 and 34 is filled with suitable insulating material 35 such as mineral wool, for example.

Projecting into the end 13 of the drum 10 and extending along the axis of rotation of the drum for substantially the entire length of the drum is a pipe 36 which, as shown in Figure 1, is closed off at its inner end 37. In the particular apparatus chosen for illustration the lower portion of the pipe 36 is provided with five air discharge openings 38 which are positioned to one side of the vertical plane passing through the central axis of the pipe. This is the side on which the parts being dried tend to accumulate upon rotation of the drum in the direction indicated. The openings 38 which are closer to the inlet 12 of the drum 10 are closer to this plane than are the discharge openings which are further removed.

Secured to or formed in the inner surface of the cylindrical wall of the drum 10 are a plurality of circumferentially spaced tumbler ribs 39, the function of which is to increase the extent of turning movement of the parts passing through the drier as will be understood. To assist the drum in discharging the parts the ribs are preferably omitted in the last space convolution adjacent the discharge end 13 of the drum.

Supported on top of the frame provided by the members 27—29 is a combustion chamber or retort 40 preferably having a sheet metal shell and a refractory lining 41. A burner 42 is positioned in the retort 40 at one end thereof and connecting with the burner is a gas-air aspirator mixer 43, the details of which are unimportant in the present invention. Gaseous fuel is supplied to the mixer and burner through the conduit 44 by a valve 45 therein which may be either manually or automatically controlled and primary air for combustion is furnished by conduit 46 having a valve 47 therein which may likewise be either manually or automatically controlled.

Drying air as well as primary air for combustion is furnished by a blower 48 driven by the motor 49 which are also mounted on top of the frame provided by the members 27—29 at the burner end of the combustion chamber 40. It will be observed that at the end of the chamber 40 opposite the burner 42 there is provided a Venturi outlet 50 which is connected with the pipe 36 through the conduit 51. Connected with the outlet of the blower 48, and extending into the combustion chamber 40 is a conduit 52 which is provided with an end nozzle 53 positioned substantially in the throat of the outlet 50. It should also be observed that the conduit 46 supplying primary air for combustion is supplied from the conduit 52. Secondary air for combustion and

an auxiliary source of drying air is provided by one or more slide valves 53' located in the wall of the chamber 40 adjacent the flame end of the burner 42. The air inlet to the blower 48 is provided by a chamber 54 from which extends a large conduit 55 leading from the space about the drum 10 and within the chamber formed by the walls 32 and 33 as indicated in Figures 2 and 4. To insure that an adequate supply of air is always delivered by the blower 48 a slide valve 56 may be provided in the conduit 55 to take in as much outside air as may be required.

In operation, with the blower 48 furnishing a supply of air under pressure to the conduits 52 and 46, if the burner 42 is now lit combustion will take place in the chamber 40 and the volume of the hot gaseous products of combustion will be augmented by the air taken in through the valve or valves 53'. The hot gases and air thus provided will be withdrawn from the chamber 40 by the decrease in pressure created in the chamber by the flow of the air stream from the nozzle 53 through the restricted passage 50 as will be well understood. The gas and air from chamber 40 will be mixed with the air issuing from the nozzle 53 and this mixture will be forced into the pipe 36 through the conduit 51. Assuming the motor 23 to be in rotation, as the parts or other objects to be dried are charged through the end 12 the same will fall into the space convolutions between the baffles 11 and be moved longitudinally through the drum directly opposite the air discharge openings 38. At the same time the ribs 39 will operate to rotate or tumble the objects or parts thus further increasing the speed of the drying process.

It will be understood that the drying gas and air after having been blown over the wet parts will become heavily laden with moisture and, this being the case, this fluid is then allowed to escape out both ends of the drying drum. However, it is obvious that a substantial amount of heat will be imparted to the drum, particularly by reason of the character of construction of the drum, and in accordance with the present invention this heat is reclaimed by exhausting the air from the space immediately surrounding the drum into the blower 48. This is the function of the conduit 55 and the recuperation is further enhanced by the insulation provided at 35. It will be noted that the side wall of the drum 10 is impervious to the flow of gas or air so that none of the moisture laden fluid is drawn into the blower 48. Air is taken into the space between the drum 10 and wall 33 through the necessary clearances between the drum and the end walls 32. Thus the air is caused to move in wiping contact with the outer surface of the drum 10 thereby insuring maximum heat transfer.

As stated above, the apparatus of the invention is particularly suited to be connected directly and mechanically with handling and/or conveying drums of other equipment whereby the processing of the small parts may proceed in a continuous manner and with a minimum of batch handling. For this purpose the drum 10 is located fairly close to the floor level and the charging end 12 is provided with a flange 57 which may be bolted to a similar flange of the end drum of a preceeding piece of equipment as will be understood. When the drum 10 is so connected by the flange 57 the supporting cradle 16 may rock one way or the other thus avoiding the necessity of

aligning the base 24, 25 accurately with respect to the base or frame of the preceding piece of equipment.

It should now be apparent that I have provided an improved unitary, portable, self-contained small parts drier which accomplishes the objects initially set out. The apparatus is compact, readily constructed, and highly efficient in operation. The complete apparatus is light in weight and may readily be moved about on the skids 24, the only installation required being the provision of a gas connection and an electric current connection. Skids 24 and structural members 25, 26, 27, 28 and 29 constitute a portable frame enabling the complete apparatus to be moved about as a unit.

By reason of the high temperature maintained in the retort or combustion chamber 40 the fuel consumed is much more efficiently utilized since complete combustion is effected. This is brought about by furnishing an excess of secondary air through the valves 53' and, of course, any unused portion of the air as well as the hot gaseous products of combustion is utilized as drying fluid in the drum 10. A substantial part of the heat generated is reclaimed by conduction through the wall of the drum and absorption in the air which is drawn into the casing 33—34, passed through the blower, and delivered to the drying chamber through the conduits 52 and 36. The helix 11 aids in the conduction of the heat to the cylindrical shell of the drum 10.

While the use of above described burner and combustion chamber is the preferred method of providing the necessary heat for the drying apparatus of the invention, it should be understood that other suitable methods may be resorted to. For example, electric resistance heating elements or steam coils enclosed in a suitable housing or chamber may be provided for this purpose.

The above specifically described embodiment of the invention should therefore be taken as illustrative only as obviously many changes may be made therein without departing from the spirit or scope of the invention. Reference should therefore be had to the appended claims in determining the scope and extent of the invention.

What I claim is:

1. Apparatus of the character described comprising a portable frame having a base and uprights on said base, a horizontally disposed drying drum rotatably mounted in said frame for rotation about an axis extending intermediate said uprights, said drum having a tapered end portion, a flange connected to and extending radially outward of the outer end of said tapered portion and adapted to be rigidly and mechanically connected to a rotating part of an adjoining apparatus whereby material to be dried may be charged directly into said drum from said last mentioned apparatus, means in said drum to move the material longitudinally through said drum, air heating means supported on said uprights, a blower supported on said uprights, and means comprising said blower to move heated air from said air heating means into said drum.

2. Apparatus of the character described comprising in combination a portable frame having a base and uprights on said base, a horizontally disposed drying drum rotatably mounted in said frame for rotation about an axis extending intermediate said uprights, means in said drum to move the material being dried longitudinally through said drum, said drum having a centrally open material charging end, air heating means supported on said uprights, a blower supported on said uprights, an air distributing duct extending centrally in said drum from the discharge end thereof, and means comprising said blower and duct to move heated air from said air heating means into said drum.

3. Portable drying apparatus having a box-like frame, a tubular insulating shell mounted in said frame, a rotary drying drum having a material moving helix therein and rotatably mounted on said frame for rotation about an axis substantially coincident with the longitudinal axis of said shell, said drum projecting outwardly from either end of said shell, a combustion chamber having a fluid fuel burner therein mounted on said frame above the discharge end of said drum and having a portion overhanging the discharge end of said drum, a motor driven blower mounted on said frame above the opposite end portion of said drum and having an inlet conduit communicating with the space intermediate said drum and shell, the bottom wall of the overhanging portion of said combustion chamber having a Venturi opening therein, a conduit connected with the outlet of said blower and projecting through a wall of said combustion chamber to a discharging position in said Venturi opening, a distributing tube projecting into the said discharge end of said drum, and a short curved tube interconnecting said Venturi opening and said distributing tube.

COLLIN M. DOYLE.