

Sept. 18, 1956

G. M. MARKS
DRYING MACHINE

2,763,477

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2 Sheets-Sheet 1

Fig. 2

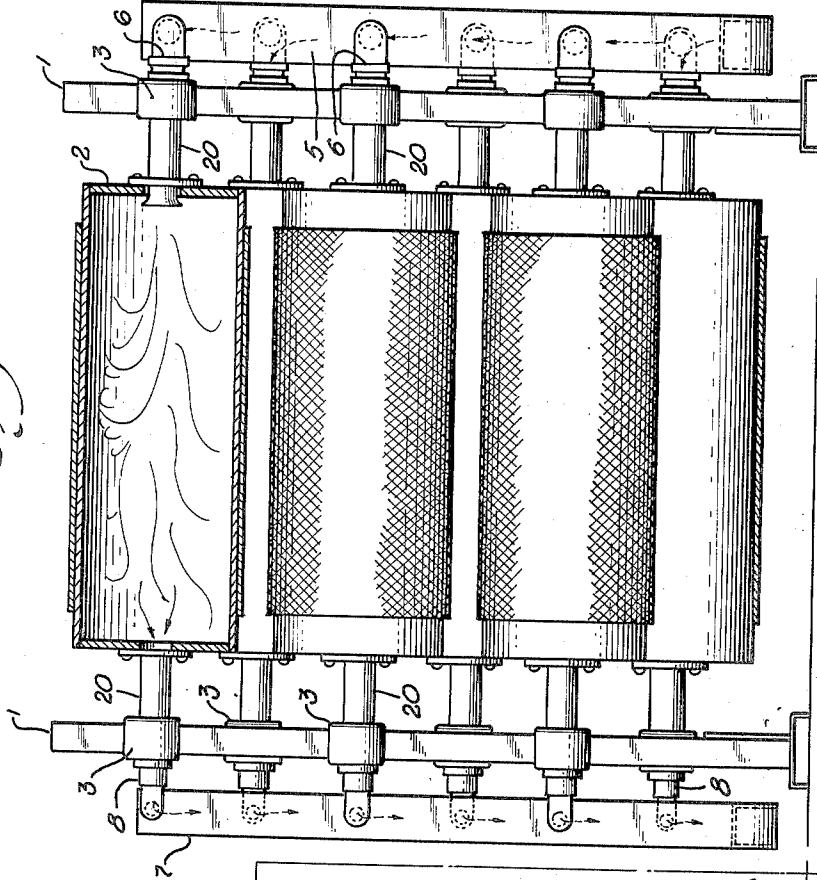
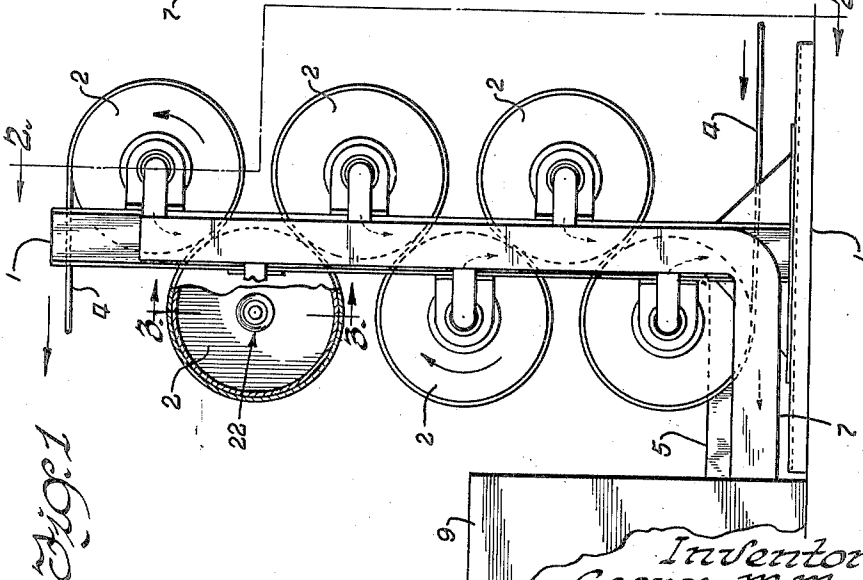


Fig. 1

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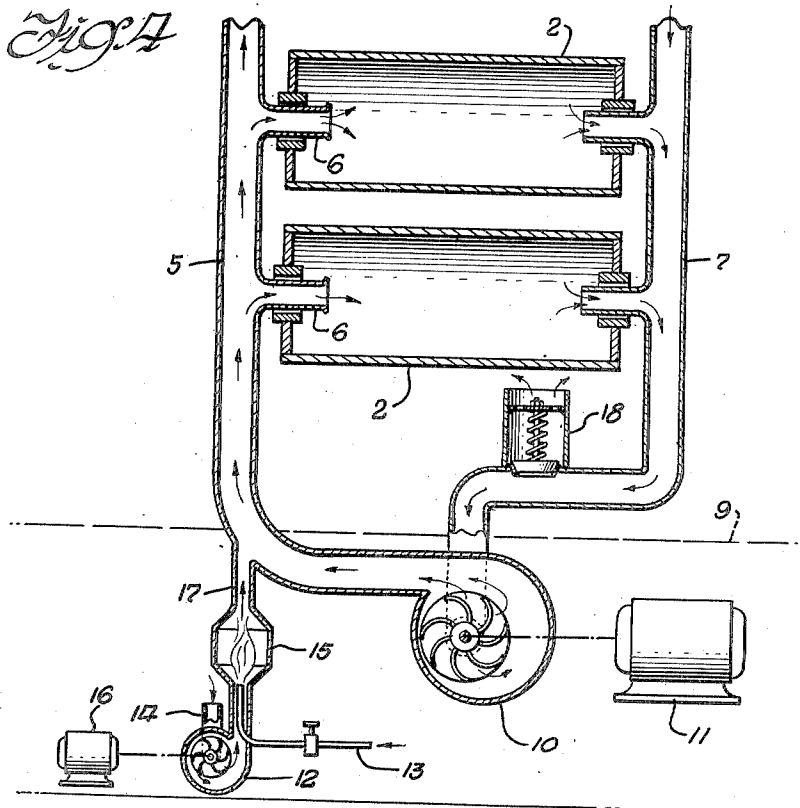
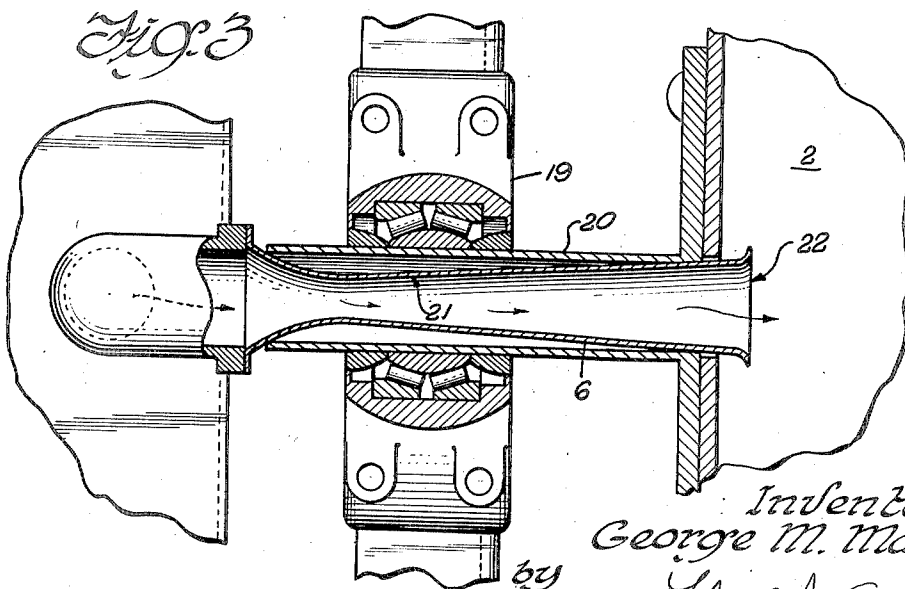
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DRYING MACHINE

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4 Claims. (Cl. 263—3)

This invention relates in general to machines for the continuous drying of textiles, paper and like film and is more particularly directed to a new construction whereby the direct use of the products of fuel combustion is used as the heating agent.

Drying machines prior to this invention, commonly used in industry, consist of a plurality of hollow cylindrical drums called "heat cans" which are rotated and over which fabrics or film are dried while carried thereby. These drums are heated by steam carried therein through packing glands through the journals of the drum. Thus, the outer surfaces of the drums are heated by conduction. This method of heating is relatively inefficient for several reasons which include the latent heat loss in creating the steam and the relatively high pressure and attendant danger that must be used to obtain desired temperatures. The drums must be constructed to withstand high pressures and the rotary glands connecting the drums are often troublesome from a leakage standpoint. Furthermore, since it is necessary to have uniform heat distribution on the surface of the drum, the condensate inside of the drums is a serious difficulty not only in causing non-uniform heating but in the provisions that must be made for its removal.

The present invention embraces construction which overcomes the above difficulties by supplying directly, each of the drums with the products of combustion of the fuel which is usually in the form of natural, butane or like gas. The products of combustion may be used at desirable higher temperatures as compared to steam and may be conducted through simple manifolds to a plurality of drums directly from the burner through a relatively low pressure closed circuit system to be hereinafter described. Thus, the drying drums themselves are less expensive and more efficient due to relatively light weight construction. Suitable high temperatures are readily obtained on the outside surface of the drums through the use of ordinary slip joints through the journals without elaborate packing glands. The system of direct circulating of the products of combustion comprises one of the principal objects of the invention.

A further object of the invention is the provision of means for circulating and re-circulating the products of combustion for heating a plurality of drying drums at predetermined temperatures.

A further object of the invention is the provision of a closed system for directing the products of combustion of gas and air throughout the system and augmenting the circulation of said products of combustion by a forced draft burner system.

These and other objects and advantages in one embodiment of the invention are described in the appended specification and drawings, in which:

Fig. 1 is a reduced scale side elevation of the drying elements of the machine;

Fig. 2 is a front elevation of the machine shown in Fig. 1;

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Fig. 3 is a fragmentary enlarged cross sectional view taken through section line 3—3 of Fig. 1;

Fig. 4 is a diagrammatic view showing the complete heating system.

Referring to Figs. 1 and 2 a frame means 1 is provided to support a plurality of hollow cylindrical drums 2 which are journaled on coaxial hollow axes 20 for rotation in bearings 3 supported by frame 1 as shown; the construction of each of the bearings will be hereinafter described in connection with Fig. 3.

Each of the drums is provided with a drive means, not shown, for simultaneously rotating the right and left hand drums shown in Fig. 1 in opposite directions in order that the sheet material 4 is passed over the outer surface of each drum in intimate contact therewith in the direction shown by arrows.

An intake manifold 5 shown in Fig. 2 is positioned adjacent the frame 1 and provided with a plurality of fixed inlet nozzles 6 projecting through the bore of each bearing 3 into the interior of each drum. Similarly an exhaust manifold 7 is positioned on the opposite side of the machine and provided with a plurality of fixed exhaust nozzles 8, each of which also project through said bearings 3 into each of said cylinders.

The intake and exhaust manifolds enter into a chamber 9 partially shown in Fig. 1. Thus it is seen that when heated products of combustion are forced into intake manifold 5, it will be equally distributed into each of the drums 2 for heating the surfaces thereof and after expending a portion of the heat, the products of combustion will be collected by exhaust manifold 7 and returned to the system to be hereinafter described.

The complete system for heating the drying machine is illustrated diagrammatically in Fig. 4 showing a pair of the rotatable cylinders 2 connected by inlet and outlet manifolds 5 and 7. These manifolds terminate in a suitable chamber 9 in which a centrifugal compressor 10 is positioned. The compressor is adapted to be driven by an electric motor 11 and its inlet is connected with exhaust manifold 7 and the compressor outlet is connected to inlet manifold 5. Thus when the motor 11 is operated, it is apparent that gases will circulate in the system as shown by arrows. A gas burner 12 is also operatively related to chamber 9 and adapted to mix predetermined quantities of combustible gas supplied through feed pipe 13 and air through inlet 14 for combustion in chamber 15. When the burner motor 16 is operated, gases are intended to be burned in chamber 15 under relatively high pressure and forced through conduit 17 entering the intake manifold 5. Since the volume of gases circulated by compressor 10 are at relatively low velocity as compared with the movement of gas in from conduit 17 of the burner 12, a constant mixture into intake manifold 5 is assured. Thus the heated products of combustion will travel through the intake manifold into the drums 2 for heating their surfaces.

In order to operate the compressor burner simultaneously and create a constant pressure of products of combustion in the system, an escape valve 18 is provided in the exhaust manifold to permit the escape of a predetermined volume of gases from the system. However, since the volume of the gases circulated by compressor 10 is relatively large as compared with the injection of new products of combustion by burner 12, the heated gases escaping into the exhaust manifold will to a large degree be recirculated into the intake manifold, thus extracting a large percentage of useful heat from said products of combustion for heating the drums and drying the film carried thereby.

Fig. 3 shows an enlarged view of one of the roller bearings 19 for supporting the rotating drum 2 and the hollow axle 20 of the drum through which the nozzle 6 projects.

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The nozzle 6 is provided with a stricture portion at 21 and a flared outlet 22 in order to impart turbulent action to the products of combustion passing therethrough, to maintain more uniform distribution of heating effect in the drum. The exhaust nozzle, not shown is merely a fixed straight tube entering the drum through the opposite hollow axle.

In one embodiment of the invention, and in operation, using a Butane gas as fuel, the products of combustion are largely a mixture of CO_2 , H_2O , N_2 and CO and using a system as described the flame temperature is in the range of 3920°F . providing the heated products of combustion to maintain temperatures between 70 and 800°F . on the surface of each drum. This wide range of temperature is made possible by adjusting the burning of the fuel burner. It is now apparent that high range temperatures possible with this system are not practical to obtain with conventional steam.

It is also to be noted that certain portions of unburned combustible gases such as CO , that pass through combustion chamber 15, are subjected to re-ignition by means of their re-circulation when they pass the high temperature zone at the outlet of conduit 17.

It is also to be noted that it is not necessary to maintain gastight connections between the inlet and outlet nozzles and hollow axles 20 as it is even desirable to permit a small escape of the products of combustion since this has an equalizing effect on the distribution of heat in the system and also it is not a serious loss since a predetermined portion of the products of combustion must be permitted to escape through valve 18.

Having described my invention, I claim:

1. A drying machine for the continuous evaporation of moisture from sheet materials comprising a means forming a frame, a plurality of hollow cylindrical drums journaled for rotation in said frame, said drums positioned adjacent each other with their axes in parallel relation and adapted to transport said materials in contact with their outer surfaces, drive means for rotating said drums simultaneously, each of said drums having a coaxial inlet and outlet orifice through its journals in opposite ends thereof, an inlet manifold connecting to a fixed nozzle projecting into each said inlet orifice in close proximity therewith, an exhaust manifold connecting with a fixed nozzle projecting into each said outlet orifice in close proximity therewith, a centrifugal rotary compressor having its inlet connected to said exhaust manifold and its outlet connected to said intake manifold for circulating hot gases through said drums at predetermined volume displacement and velocity when operated, a gas burner including a combustion chamber and an independent means for supplying a mixture of air and gaseous fuel into said combustion chamber for combustion therein at a predetermined volume displacement less and a velocity higher than the said displacement and velocity of said compressor, said combustion chamber connected in said inlet manifold, whereby the heated products of combustion in said combustion chamber will be circulated and recirculated through said manifolds and said plurality of drums when said rotary compressor and said burner is operated for supplying heat to the outer surfaces of said drums.

2. In a drying machine of the character described a plurality of rotatable hollow drums, an intake manifold for conducting products of combustion into each of said drums, an exhaust manifold for conducting said products

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of combustion from each of said drums, a relief valve in said exhaust manifold for permitting the escape of a predetermined quantity of said products of combustion, a circulation chamber connected to said intake and exhaust manifolds, a centrifugal compressor in said chamber for circulating said products of combustion through said manifolds said chamber and said drums at predetermined volume displacement and velocity when operated, a burner positioned in said chamber, independent pressure means for supplying said burner with a mixture of air and gas fuel at a predetermined displacement less and velocity greater than the said displacement and velocity of said compressor, whereby said burner will supply heated said products of combustion in said chamber when operated and the simultaneous operation of said compressor will circulate and recirculate said products of combustion from said chamber through said inlet manifold, said drums, said exhaust manifold and return to said chamber to heat said drums to a predetermined temperature.

3. In a drying machine of the character described, a cylindrical hollow drum journaled for rotation on its axis by hollow bearings at each end thereof and adapted to transport and dry film material in contact with its outer surface, a fixed inlet nozzle projecting through one of said bearings into said drum in coaxial relation therewith, a fixed outlet nozzle projecting through the remaining of said bearings into said drum in coaxial relation therewith, a centrifugal compressor having its outlet connected to said inlet nozzle by means of an inlet manifold, the inlet of said compressor connected to said outlet nozzle by an exhaust manifold, a combustion chamber having an inlet and outlet with its outlet connected into said inlet manifold, a fuel injection means positioned in the inlet of said chamber for supplying fuel when operated, a second compressor connected to said chamber inlet for supplying air to said chamber at predetermined volume and velocity when operated whereby said second compressor and said fuel means will supply mixture of air and fuel in said chamber for combustion therein and whereby said products of combustion will be circulated through said inlet manifold, said drum and said exhaust manifold by said first mentioned compressor.

4. In a drying machine with closed circuit means for operating rotatable radiators with heat comprising a plurality of rotatable drums, a mixing chamber having inlet and outlet manifolds connecting said drums including means for connecting said manifolds to said drums for circulating products of combustion through said drums, a cylindrical compressor in said chamber for circulating said products of combustion at relatively high volume and low pressure when operated, a burner in said chamber for providing the combustion of a mixture of gas and air when operated, independent pressure means associated with said burner for supplying said mixture of gas and air at relatively low volume and high pressure whereby the products of said combustion are moved through the said closed circuit means to heat said drums when operated.

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