April 27, 1954

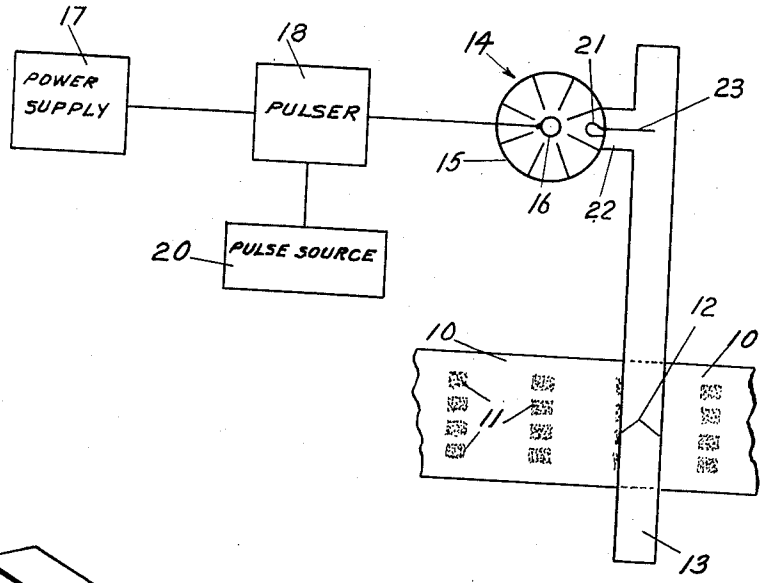
C. L. CALOSI ET AL

2,676,416

APPARATUS FOR SELECTIVE DRYING

Filed March 16, 1951

FIG. 1



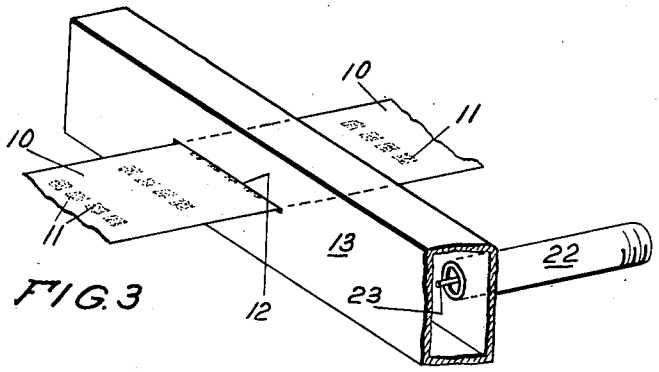
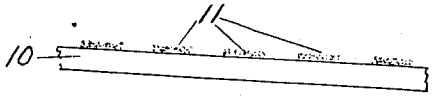


FIG. 3

FIG. 2



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APPARATUS FOR SELECTIVE DRYING

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2 Claims. (Cl. 34—1)

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This invention relates to methods and apparatus for the selective drying of wet deposits on a web of material.

It is frequently desirable, for example, in printing, to dry wet deposits on a web of material without removing too much of the original moisture of the web. In the case of printing, this means drying the ink without making the paper brittle.

It has been found that radio frequency energy may be used to dry various types of material by heating them. It is well known that various materials offer a characteristic amount of impedance to the passage of radio frequency energy, and, in overcoming this impedance, a portion of the radio frequency energy is dissipated as heat. It has been found that, if a material of certain electrical characteristics and thermal diffusivity deposited on a web of material of different electrical characteristics and thermal diffusivity is exposed to radio frequency energy for a time sufficient to heat the coating to a point where the solvents will be evaporated out of the deposits, but for a time insufficient to heat the web to a point where the solvents it contains are reduced below a desired minimum, the desired result of selective drying is obtained.

For this purpose, by the present invention a web of material having deposits to be dried is fed into a concentrated electromagnetic field and exposed to this field for a length of time sufficient to dry the deposits without excessive drying of the web.

The foregoing and other advantages, objects and features of the invention will be better understood from the following description taken in conjunction with the accompanying drawings, wherein:

Fig. 1 is a schematic diagram of one embodiment of the invention;

Fig. 2 is a section through the web of Figs. 1 and 3; and

Fig. 3 is a schematic diagram of another embodiment of the invention.

In Fig. 1, the reference numeral 10 represents the web of material, such as printing paper, having deposits 11 of material having different characteristics from the web, such as ink. The web 10 is arranged to be fed through a slot 12 into a wave guide section or cavity 13. This cavity is supplied with radio frequency energy from a generator, such as a magnetron 14. This magnetron 14 has an anode 15 and a cathode 16. The anode-cathode circuit is supplied with a potential from a source 17 that is pulsed at 18 by a source of keying pulses 20. The magnetron 14 is coupled to the wave guide 13 through a loop 21 and a coaxial cable 22 with a central conductor 23 which protrudes into the wave guide 13 to create the radio frequency field therein.

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By the use of the above apparatus, the web 10 of material having deposits 11 to be dried, as shown more in detail in Fig. 2, is inserted into the slot 12 in the cavity 13 either manually or in a continuous strip from one reel to another. The radio frequency energy w necessary to heat the deposits 11 is applied from the magnetron 14 at a peak level p and a time t sufficient to heat and dry the deposits 11, but for a time less than t_0, the time necessary for the heat generated to diffuse into the full thickness x of the web 10 having a thermal diffusivity d. The time

$$t_0=\frac{x}{4d}$$

and as

$$p=\frac{w}{t}$$

$$t<t_0$$

$$p>w\frac{4d}{x^2}$$

For example, with a pulse duration of ten times the thermal diffusion time of the sheet, the whole sheet is heated almost uniformly and a certain power may be needed to achieve a given surface deposit temperature. With a pulse duration equal to the diffusion time, only two-thirds of that power is needed to achieve the same surface temperature. At

$$t=\frac{t_0}{10}$$

only one-quarter of the original power is needed and at

$$t=\frac{t_0}{100}$$

only one-eleventh of the original power is required to obtain the same surface temperature. This shows that with pulsed power much less average power need be applied to obtain the same surface temperature. Thus the method and apparatus of the invention is economical of power as well as achieving the desired result of selective drying of the coating. In most cases where selective drying of deposits is desirable, the thickness and area of the deposits will be relatively small compared to that of the web exposed simultaneously to the electromagnetic

field. As the coating heats to the drying temperature much more rapidly than the web, only the exposed portion of the web will be heated sufficiently to dry it. Thus the power otherwise lost by heating the uncoated portions of the web is saved and the moisture loss of the uncoated portions of the web is prevented.

The same effect of a limited exposure to the electromagnetic field may be obtained where the characteristics of the materials used permit of a longer exposure by dimensioning the wave guide in the plane along which the web passes so that at the speed of travel of the web any particular portion of the web will only be in the electromagnetic field for the desired length of time. For example, if the web travels across the width w of the wave guide 13 at a speed v, it will be exposed to the field for a time

$$t=\frac{w}{v}$$

This accomplishes the same purpose as pulsing the source of radio frequency energy by limiting the total energy a given area is permitted to absorb. However, it is obvious that pulses may be made of shorter duration, in the order of microseconds, as compared to the transit time of the web in the wave guide, at best in the order of milliseconds. Thus for most purposes the use of a pulsed source of radio frequency energy as shown in Fig. 1 will result in greater flexibility.

Fig. 3 shows an embodiment of the invention dependent upon transit time for determining the amount of radio frequency energy to which an individual area of the web and deposits is exposed. As before, the web 10 enters the slot 12 in the wave guide or cavity 13 where it is exposed to an electromagnetic field introduced into the cavity 13 by a coaxial cable 22, the center conductor 23 of which protrudes into the cavity 13 to introduce the radio frequency energy and create the electromagnetic field. A similar wave guide and coupling means could be used for the embodiment shown in Fig. 1. Certain details of the radio frequency and electrical circuits have been omitted in the interest of clarity as these details form no part of the present invention and may take any one of several well-known forms.

This invention is not limited to the particular details of construction, materials and processes described, as many equivalents will suggest themselves to those skilled in the art. It is accordingly desired that the appended claims be given a broad interpretation commensurate with the scope of the invention within the art.

What is claimed is:

1. Apparatus for drying a wet deposit on a web of material, comprising a metallic enclosure defining a cavity, means for inserting the web to be dried into the said cavity and means for applying to the cavity pulses of radio frequency energy of a duration in the order of microseconds sufficient with reference to the thermal diffusivity of the web to dry the deposits while leaving a substantial portion of the original moisture in the web.

2. Apparatus for heating a wet deposit on a web of material comprising a conductive enclosure defining a cavity, means for inserting the web to be heated into said cavity, and means for applying to the cavity pulses of radio frequency energy of a duration in the order of microseconds sufficient with reference to the thermal diffusivity of the web to raise the temperature of the deposit to the vaporizing point of their solvents while leaving the web at a temperature substantially below the vaporizing points of its solvents.

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