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(54) **Convective drying apparatus.**

(57) A hot gas convective drying apparatus is provided with a plurality of nozzles for directing hot gas onto material to be dried and with radio frequency heating means adapted to create a radio frequency field in the region through which the material to be dried travels. The electrode means of the radio frequency heating means comprises a pair of spaced perforated plates between which the material to be dried passes and with which are associated the hot gas directing nozzles. Alternatively the electrode means is a single perforated plate with an opposed array of individual hot gas directing nozzles.

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CONVECTIVE DRYING APPARATUS

This invention relates to convective drying apparatus or ovens (hereinafter and, in the claims for convenience simply referred to as "apparatus") in which heated air or other gas is directed onto material to be dried, processed, cooked or baked (hereinafter and in the claims for convenience simply referred to as "dried").

In Patent Specification GB 2123537B (The Electricity Council) there is disclosed a hot gas convective dryer having a plurality of jets or nozzles for directing a heated gas onto material passed between the jets or nozzles wherein the jets or nozzles are formed of electrically conductive material and are arranged to constitute the electrodes or at least some of the electrodes of radio frequency heating means providing a radio frequency field in the region through which the material to be dried is passed.

In the aforesaid Patent Specification the electrodes of the radio frequency heating means are discrete separate nozzle boxes incorporating the nozzles or jets for directing heated air or other gas onto the material to be dried, for example a fabric web.

According to the present invention there is provided a hot gas convective drying apparatus comprising a plurality of nozzles or a delivery chamber for directing hot gas onto the material to be dried and radio frequency heating means adapted to create a radio frequency field in the region through which the material to be dried travels, the drying apparatus being characterised in that the electrode means of the radio frequency heating means comprise a pair of spaced perforated plates between which the material to be dried passes and with which are associated the hot gas directing nozzles or chambers, or in that the electrode means of the radio frequency heating means comprises a single perforated plate with an opposed array of individual nozzle boxes incorporating hot gas directing nozzles.

Preferably, each perforated electrode plate includes a plurality of boxes or housings each with rows of nozzle perforations.

Preferably, the nozzle perforations in each perforated electrode plate are smaller in area than the perforations in the perforated electrode plate in the regions of the latter between the nozzle boxes or housings.

The nozzle boxes or housings in each respective perforated electrode plate may be staggered relative to the nozzle boxes or housings in the other perforated electrode plate, or may be in line depending upon the nature of the material to be dried.

The advantages of employing continuous perforated plate electrodes as opposed to discrete electrodes are threefold. Firstly, with certain material to be dried, there is a better distribution into the material of the radio frequency energy. Secondly, a perforated plate electrode is easier to clean and keep free from contaminants, especially in a food environment. Thirdly, a perforated plate electrode is less likely to form an impediment to passage of material to be dried if the latter has a tendency to make contact with the electrode means.

Embodiments of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:-

Fig. 1 is a diagrammatic illustration of hot gas convective drying apparatus according to the invention;

Fig. 2 is a detail view of a perforated plate electrode;

Fig. 3 is a diagrammatic illustration of an alternative embodiment of drying apparatus; and

Fig. 4 is a diagrammatic illustration of yet another embodiment of drying apparatus.

Referring to Figs. 1 and 2, the apparatus is used to dry moist material susceptible to dielectric heating by means of radio waves, such, for example, as fabric or paper webs or discrete items of material or foodstuff carried on a suitable conveyor system.

The conveyed material to be dried indicated at 10 in Fig. 1 passes between two perforated plates 11, 12 which constitute the electrodes of a radio frequency heating means, the perforated plates 11, 12 being connected to a radio frequency generator 13. The radio frequency may be either a balanced feed or a coaxial feed arrangement as is well known to those skilled in the art.

The plates 11, 12 have respectively connected thereto housings or boxes 14, 15, the housings or boxes 14 being in staggered relationship to the housings or boxes 15, the perforated plates 11, 12 and nozzle housings or boxes 14, 15 being disposed with a drying enclosure 16.

Each housing or box 14, 15 has nozzle perforations 17 for directing heated pressurised air onto the material 10 (see arrows 18). The nozzle housings or boxes 14, 15 are connected by suitable ducts 19 to an air circulating fan and heater 20, which may be located either within the drying enclosure 16 or external thereof.

The perforated electrode plates 11, 12 have, as aforesaid, nozzle perforations 17 from the housings or boxes 14, 15 and these are smaller in area than perforations 21 in the areas of the perforated elec-

trode plates 11, 12 between the nozzle housings or boxes 14, 15, the larger perforations 21 facilitating return of air (moisture-bearing air) from the vicinity of the material 10 back into the air circulating fan and heater 20, a proportion of this air being exhausted through an outlet duct 22 incorporating a suction fan (not shown).

In Fig. 1, parts similar to those of the embodiment of Figs. 1 and 2 are designated by the same references with the suffix "A".

The difference in this embodiment is that each perforated plate 11A, 12A with its associated housings or boxes 14A, 15A forms one wall of an air delivery chamber 23, the air flow, in this instance, being from the air supply fan and heater 20A into chambers 23, through the perforations in the plates 11A, 12A for impingement against the material 10A and return into the housing or boxes 14A, 15A and from open ends thereof into the drying enclosure 16A for return to the air supply fan and heater 20A with a proportion thereof exhausting through outlet duct 22A under the action of its associated suction fan (not shown).

In this embodiment, the perforations in the plates 11A, 12A may be larger than those in the plates between the housings or boxes 14A, 15A.

In Fig. 4, parts similar to those of the embodiment of Figs. 1 and 2 are designated by the same references with the suffix "B".

In this embodiment there is only one perforated electrode plate 11B with opposed individual and separate housings or boxes 14B incorporating nozzles.

In yet another arrangement (not shown), the air is externally ducted to exhaust after impingement with the material to be dried, i.e. it is not returned into the drying enclosure.

Claims

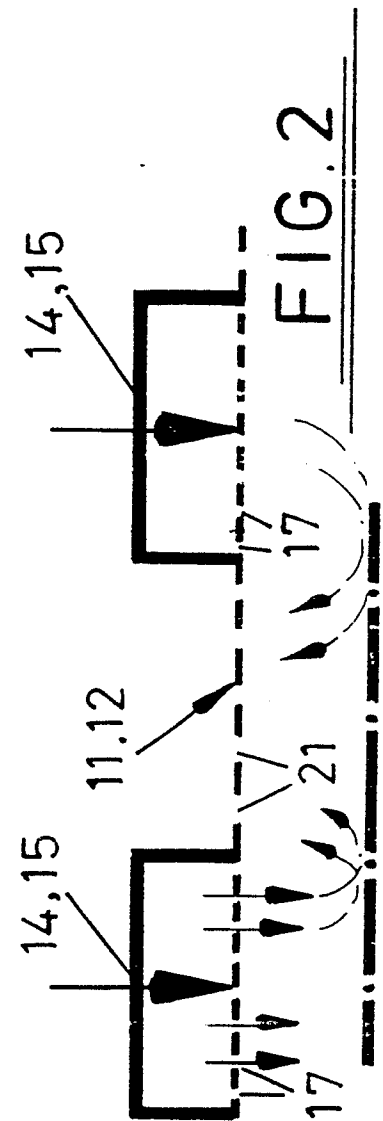
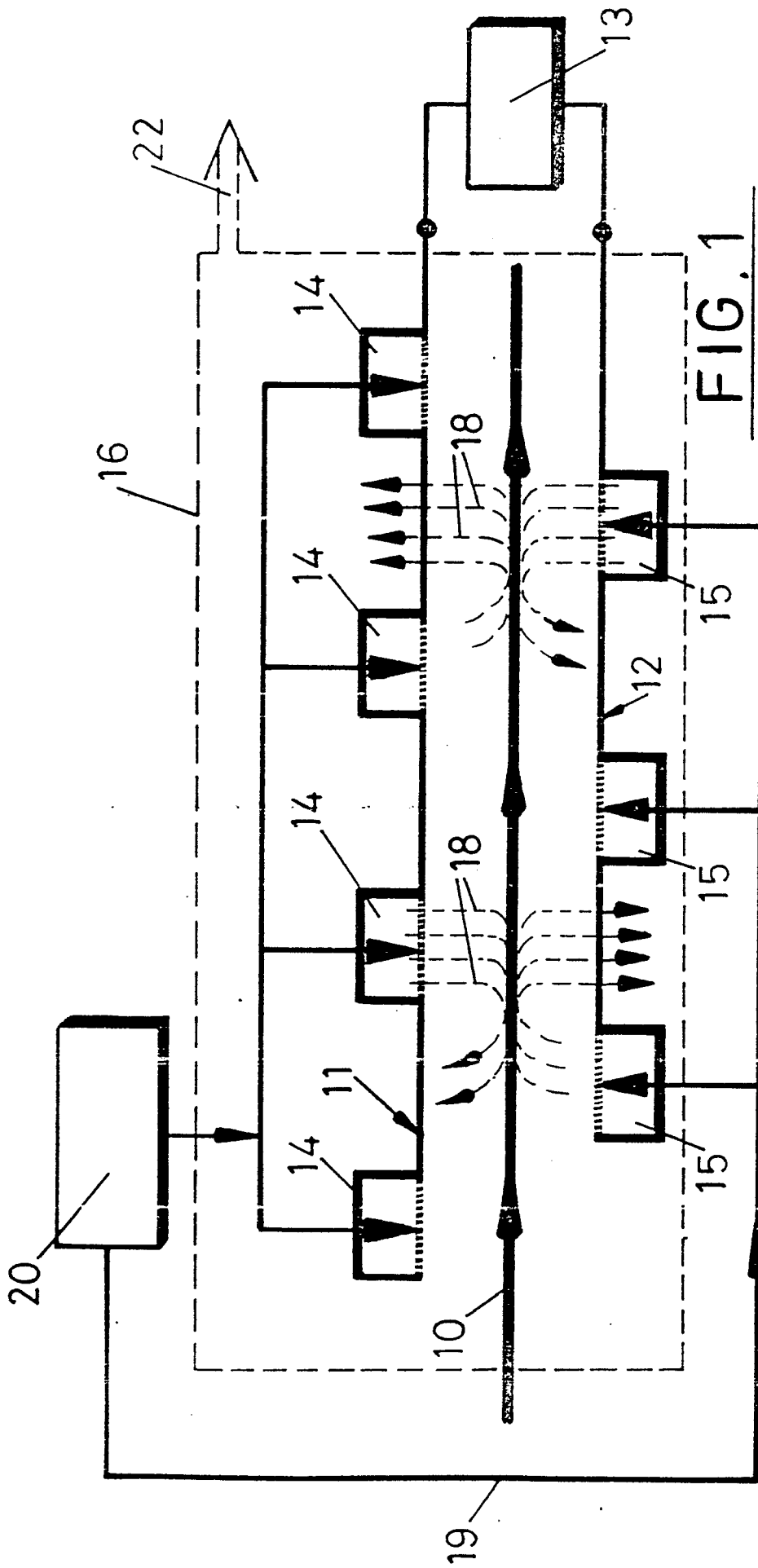
1. A hot gas convective drying apparatus comprising a plurality of nozzles or a delivery chamber for directing hot gas onto the material to be dried and radio frequency heating means adapted to create a radio frequency field in the region through which the material to be dried travels, the drying apparatus being characterised in that the electrode means of the radio frequency heating means comprise a pair of spaced perforated plates between which the material to be dried passes and with which are associated the hot gas directing nozzles or chambers, or in that the electrode means of the radio frequency heating means comprises a single perforated plate incorporating hot gas directing nozzles.

2. Apparatus as claimed in claim 1, in which each perforated electrode plate includes a plurality of boxes or housings each with rows of nozzle perforations.

3. Apparatus as claimed in claim 2, in which the nozzle perforations in each perforated electrode plate are smaller in area than the perforations in the perforated electrode plate in the regions of the latter between the nozzle boxes or housings.

4. Apparatus as claimed in any one of claims 1 to 3, in which the nozzle housings or boxes in each respective perforated electrode plate are staggered relative to the nozzle boxes or housings in the other perforated electrode plate, or may be in line depending upon the nature of the material to be dried.

5. Apparatus as claimed in claim 1, in which each hot gas delivery chambers has, as one wall, one of the perforated electrode plate with associated housings or boxes serving to receive gas after its impingement against the material to be dried.



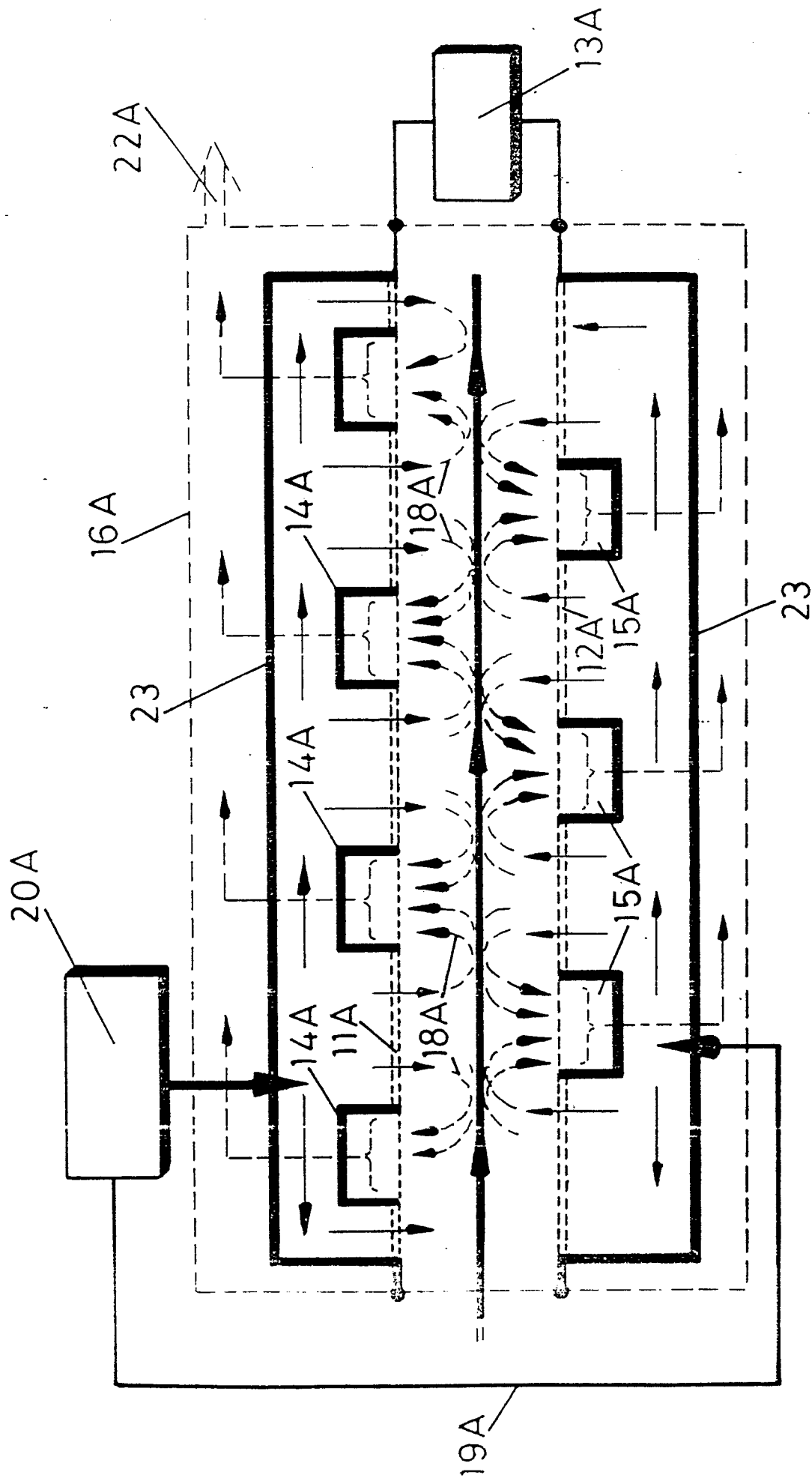


FIG. 3

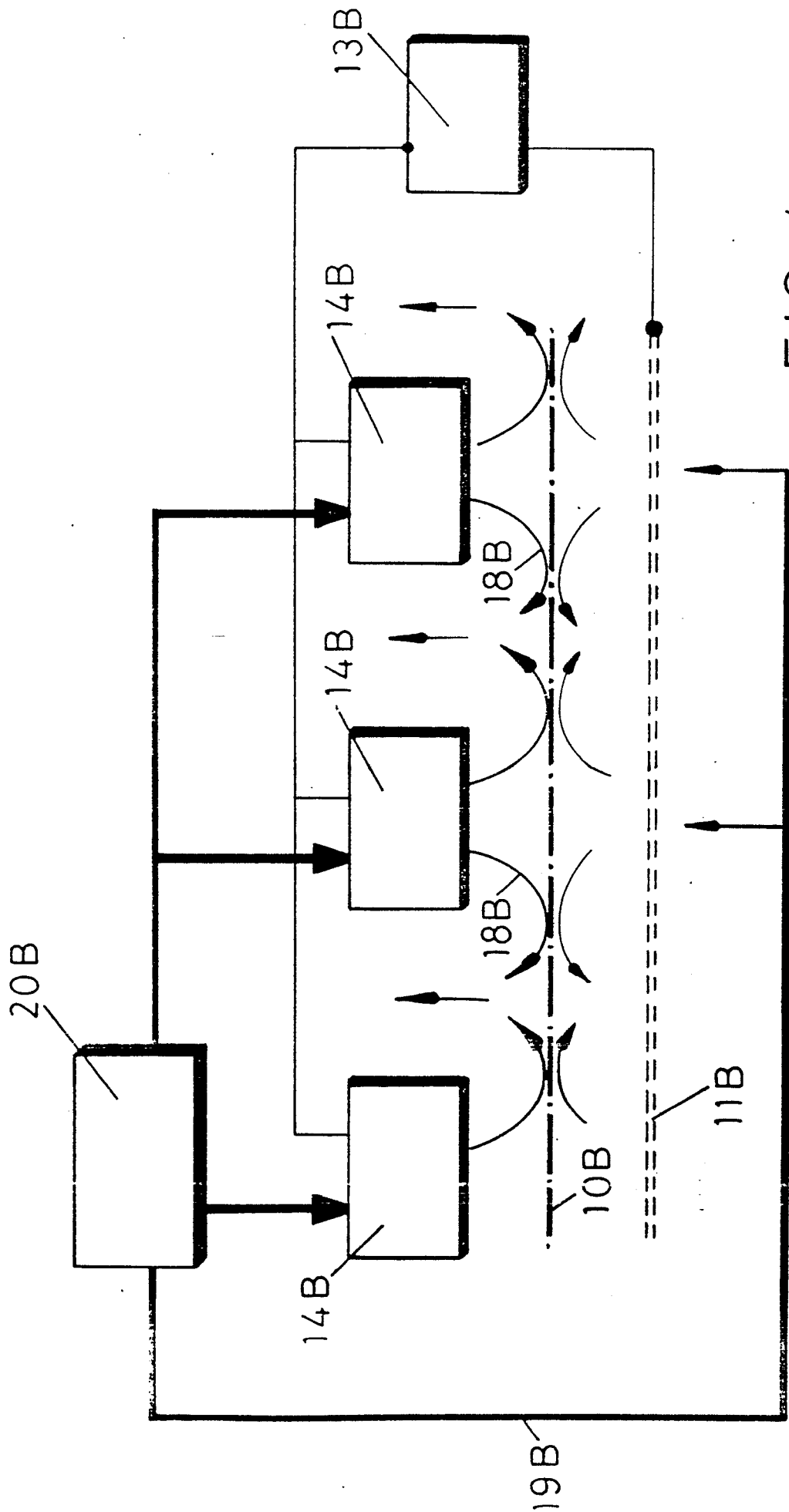


FIG. 4