July 1, 1952 R. B. NELSON 2,602,134

HIGH-FREQUENCY DIELECTRIC HEATER

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Fig. 1.

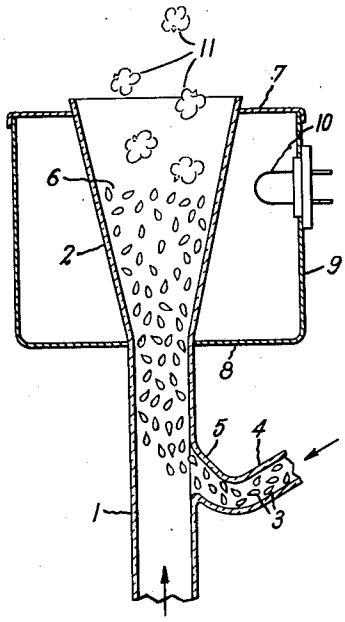
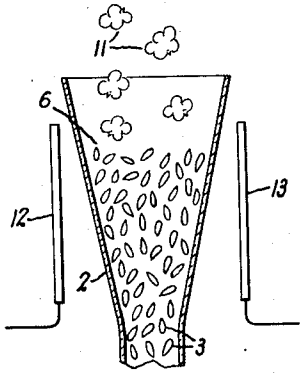


Fig. 2.



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HIGH-FREQUENCY DIELECTRIC HEATER

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2 Claims. (Cl. 219—47)

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My invention relates to high frequency dielectric heaters utilizing electromagnetic fields, and has for its object a simple and reliable heater of this type for continuously heating granular dielectric materials, more particularly for popping corn.

In carrying out my invention in one form, I utilize a funnel-shaped member made of low loss dielectric material into which the popcorn is fed and forced upward by a blast of air, together with high frequency dielectric heating means for heating the kernels of corn while suspended in the air blast which carries the lighter popped corn out of the upper end of the funnel-shaped member.

For a more complete understanding of my invention, reference should be had to the accompanying drawing, Fig. 1 of which is a view in section of a high frequency heater for popping corn embodying my invention, while Fig. 2 is a fragmentary view in section of a modified form of my invention.

Referring to the drawing, in one form of my invention I provide a quartz tube 1 which is mounted in a substantially vertical position and the upper end of which is enlarged to form a funnel-shaped portion 2. The popcorn 3 is fed into the tube 1 through a feed tube 4 adjacent its lower end and is carried upward through the tube into the funnel portion by a compressed fluid, preferably a gas such as air, supplied to the lower end of the tube 1 from a suitable source, such as a pressure tank or air compressor. The portion 5 of the feed tube is bent upward at its junction with the tube 1 so that a slight vacuum is formed in the portion 5 by the stream of air moving upward, whereby the kernels of corn are drawn into the tube 1.

The air pressure, and therefore the velocity of the stream of air moving upward, is adjusted so that the air stream carries the grains of corn upward through the tube 1 into the funnel-shaped portion 2 where the air stream expands and its velocity decreases. The kernels of corn continue to move upward into the funnel 2 to a location where the reduced air velocity is just sufficient to support or suspend the grains, as indicated by the reference numeral 6, and the grains remain in that position while they are being heated.

For the purpose of heating the grains of corn in the funnel 2, I provide suitable high frequency dielectric heating means, shown as a heating chamber, formed by top, bottom, and side walls 7, 8, and 9, made of electrically conducting material, such as copper. As shown, the side wall 9 may

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be cylindrical. The top and bottom walls are provided with central apertures for the funnel 2 which extends through the chamber. By means of suitable coupling means, shown as a loop 10, connected to a suitable source of high frequency current supply, not shown, electromagnetic fields having a desired mode are produced in the chamber whereby standing electromagnetic waves are produced in the chamber. These fields freely penetrate the quartz wall of the funnel 2 and, likewise, the grains of corn in the heating zone, whereby the corn is heated. But little, if any, heat is generated in the quartz wall of the funnel because of the comparatively low power factor of the quartz material. Moreover, current is supplied to the loop 10 from the supply source at a high frequency suitable for the effective heating of the corn, or other dielectric material having a relatively high loss characteristic without substantial heating of the funnel, such as 2000 megacycles.

As shown, the walls of the heating chamber surround the funnel throughout substantially its entire length and, preferably, the electromagnetic fields in the chamber are positioned so as to start the heating of the corn immediately after it passes into the chamber. This heating continues as the corn moves upward into the funnel, and I contemplate that when the corn reaches the position 6 of substantially stable equilibrium in the air stream the corn will be heated substantially, or nearly, to the popping temperature. When the corn pops, the kernel, of course, enlarges with greatly decreased density, i. e., low specific gravity, and, consequently, the popped kernels 11 are immediately blown out of the top of the funnel by the air stream.

I contemplate, also, that a plate or electrode type of dielectric high frequency heater may be utilized instead of the chamber. Such an arrangement is shown in Fig. 2, in which two plate electrodes 12 and 13 are provided on opposite sides of the funnel 2. These electrodes are connected to a suitable source of high frequency supply having a much lower frequency than required with the form shown in Fig. 1, such as 60 megacycles.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A high frequency dielectric heater for heating a granular material which expands and whose specific gravity decreases with an increase in temperature, comprising a funnel-shaped member of relatively low power factor dielectric material mounted in an upright position with the

larger end upward, said upper end being open, means for supplying a gas under a predetermined pressure to the lower end of said member for producing an upwardly directed gas current in said member having a velocity sufficient to support the granular material to be heated in a predetermined position of equilibrium within said member, tube means communicating with the lower portion of said member for feeding the granular material to be heated into said member whereby said material is blown upward by said gas current to said predetermined position, and electrically conductive means positioned externally of said member for producing within said member including said predetermined position a high frequency field to heat said material whereby to increase its volume and decrease its specific gravity sufficiently to cause said material to be carried upward by the gas current and out of said upper end of said member.

2. A high frequency dielectric heater for heating pop corn and the like comprising a funnel-shaped member of relatively low power factor dielectric material mounted in an upright position with the larger end upward, said upper end being open, means for supplying air under a predetermined pressure to the lower end of said member for producing an upwardly directed air current in said member having a velocity sufficient to raise the pop corn kernels from the lower portion of said member to a predetermined location of equilibrium defining a heating zone within said member where the reduced air velocity due to increased cross-section of the funnel member is just sufficient to suspend said kernels in said air current, tube means communicating with the lower portion of said member for feeding said kernels into said member, said kernels being drawn into said member by the vacuum created

in said tube by the upward air current and being blown upward by said air current to said heating zone, a heating chamber of electrically conductive material surrounding a portion of said member including said heating zone, said chamber being provided with apertures in the top and bottom through which said member extends through said chamber, and means for producing within said chamber including the portion of said member surrounded thereby high frequency standing electromagnetic waves to heat said kernels and cause them to pop, said kernels being carried upward after popping by said air current and out of said upper end of said member.

RICHARD BURTON NELSON.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
Re. 21,653	Bigelow	Dec. 10, 1940
1,888,372	Bramwell	Nov. 22, 1932
1,972,050	Davis	Aug. 28, 1934
2,054,441	Peebles	Sept. 15, 1936
2,125,207	Suggs	July 26, 1938
2,132,961	Morgan	Oct. 11, 1938
2,364,526	Hansell	Dec. 5, 1944
2,413,420	Stephanoff	Dec. 31, 1946
2,473,539	Merriam	June 21, 1949
2,480,679	Spencer	Aug. 30, 1949
2,497,501	Himmel et al.	Feb. 14, 1950
2,500,752	Hanson et al.	Mar. 14, 1950

OTHER REFERENCES

"Engineering Abstracts," Product Engineering, January 1947, pages 137–140, particularly pages 138 and 139.