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MICROWAVE AND ULTRASONIC APPARATUS

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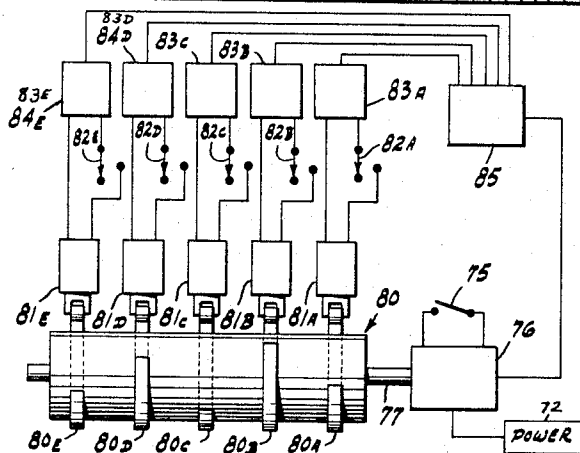
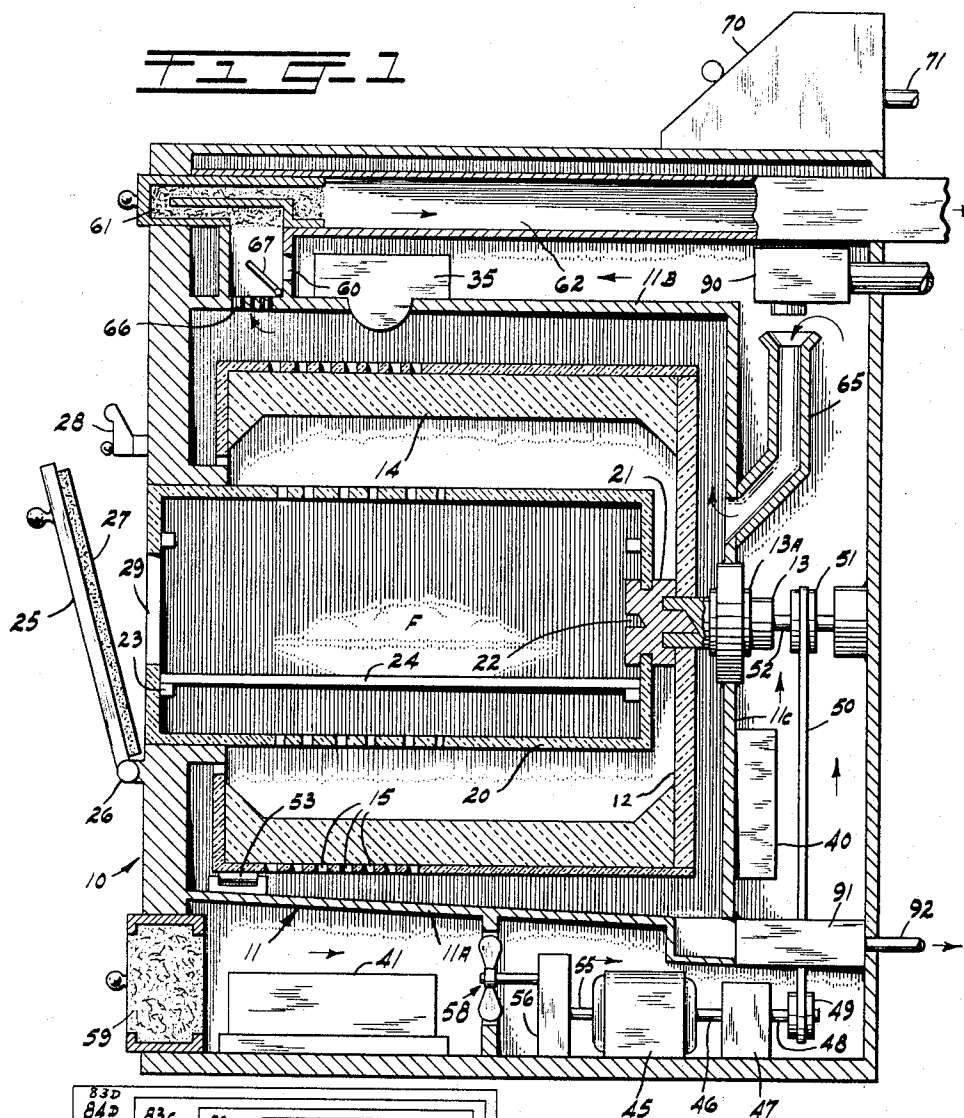


FIG. 2

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1

3,410,116

MICROWAVE AND ULTRASONIC APPARATUS

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Continuation-in-part of application Ser. No. 430,624,
Feb. 5, 1965. This application Oct. 24, 1966, Ser.
No. 594,964

10 Claims. (Cl. 68—3)

ABSTRACT OF THE DISCLOSURE

Apparatus capable of performing numerous functions on various workloads, which include means for emitting microwave energy for heating a workload, means for emitting ultrasonic energy to said workload, and means for selectively controlling the operation of said microwave and ultrasonic means. The apparatus is capable of functioning as a washer, dryer, dishwasher, microwave oven, and the like.

This application is a continuation-in-part of my copending application Ser. No. 430,624, filed Feb. 5, 1965, now abandoned.

This invention relates to microwave and ultrasonic apparatus, and particularly to a microwave-ultrasonic apparatus capable of performing numerous household and industrial functions.

In living areas where space is at a premium, such as a mobile home, camping trailer, small apartment dwelling or the like, it is apparent that the numerous items required for maintaining a household are space consuming and expensive. For example, it is most common to find a washer, dryer, dishwasher, oven, exhaust fan and the like in one's kitchen area. Also, even with many commercial enterprises, such as hotels and restaurants, the aggregate cost of these items are high and the space occupied thereby is great.

It is an object of this invention to obviate the use of individual apparatus for individual functions and to provide a single apparatus which is capable of performing numerous functions.

It is a further object of this invention to provide an inexpensive, space saving apparatus which is capable of functioning as a washer, dryer, dishwasher, oven, and the like.

It is a further object of this invention to provide a multi-purpose apparatus which utilizes microwave and ultrasonic energy.

In general, the invention, according to the objects, is an apparatus which includes means for emitting microwave energy for heating a workload, means for emitting ultrasonic energy to said workload, and means for selectively controlling the operation of said microwave and ultrasonic energy means.

In one embodiment, the apparatus is capable of functioning as an oven and includes an outer drum, an inner drum located within the outer drum for receiving a workload, means for rotating the outer drum, and means for emitting microwave energy into the drums to cook the workload.

In another embodiment, the apparatus is capable of functioning as a washer-dryer unit and includes a drum for receiving fabrics to be cleaned, means for rotating the drum, means for permitting a washing medium to flow within the drum, microwave means for emitting energy to heat the washing medium, and means for ultrasonically cleaning the fabrics, said previously mentioned microwave means emitting heat for drying said fabrics after the ultrasonic cleaning thereof.

2

FIGURE 1 is a cross sectional view of the apparatus excluding insulation and the like for the sake of simplicity, and FIGURE 2 is a control circuit for the apparatus.

Other objects, embodiments and a fuller understanding of the invention may be had by referring to the following description and appended claims.

Since the apparatus is capable of being utilized for many various operations, the apparatus will first be described generally and then in detail with respect to particular embodiments and utility thereof. The apparatus includes a frame 10 having a housing, generally referred to as 11 and formed by walls 11a, 11b and 11c. Located within the housing 11 is an outer rotatable drum 12 which is connected to a hub 13 provided within bearings 13a that extends through wall 11c of the housing. The outer drum 12 preferably is made of a material which is unaffected by microwave energy but permits said energy to pass therethrough. The material, for example, may be of a glass-ceramic composition, such as Pyroceram, or of a plastic, such as polypropylene.

The inner surface of drum 12 is provided with vanes 14 and a plurality of openings 15—15. The vanes 14 may be a microwave reflective material and are of a suitable size not only to add strength to the drum, but as will be seen, function to serve as a field stirrer for microwave energy and an agitator for fluids in a processing operation.

Capable of being located within the outer drum 12 is a removable inner drum 20 comprised of a material similar to the outer drum. The inner drum 20 is provided with a connecting bearing element 21 which is capable of being snapped into locking engagement with hub 13. The element 21 has a receptacle 22 therein for receiving a skewer (not shown) if desired, when the apparatus functions as an oven, to be described hereinafter. Adjustable shelf rests 23—23 are connected to the inner surface of drum 20 for receiving easily insertable shelves 24 for supporting various types of foodstuffs F.

A door 25, pivotally connected at 26 to frame 10, is provided with an electrically conductive gasket 27 for securely sealing the door against the housing when engaged by a locking latch 28. The gasket 27 insures the prevention of leakage of microwave energy through the door opening 29 when the apparatus is used for one function and prevents the escape of any processing fluids through the door opening when the apparatus is used for other functions.

A suitable microwave generator 35, such as is employed in my copending application Ser. No. 492,183, filed Oct. 1, 1965, now abandoned, is connected to the housing at 11b and matched by suitable means for emitting microwave energy through the outer and inner drums 12 and 20, respectively. Likewise, a conventional type ultrasonic generator 40, connected to the housing wall 11c, is matched by suitable means for emitting ultrasonic energy through the apparatus. The microwave generator 35 and ultrasonic generator 40 are powered from a supply 41.

The outer drum 12 may be rotated by a motor 45 which drives a shaft 46 through a variable speed transmission 47 having a shaft 48 with a pulley 49 thereon. A driving belt 50 driven by pulley 49 drives a pulley 51 which is connected to hub shaft 52 for rotating the outer drum 12. A roller 53 is disposed between the outer drum 12 and housing wall 11a for supporting the drum during its rotational movement.

The motor 45 also drives a shaft 55 through a variable speed transmission 56 which, in turn, operates a fan 58. As indicated by the arrows, the fan draws cool air through a removable type air filter 59 for cooling the power supply 41, motor 45, ultrasonic generator 40 and microwave gen-

erator 35. Also, the forced air stream passes through a tube 65 leading through wall 11c, thereby permitting the air to pass through the working area of the outer rotatable drum 12, a channel 66, filter 61 and exhaust passage 62. A selectively operable baffle 67 may be utilized for either totally or partially blocking channel 66 for effectively controlling the flow of air through exit 60.

A programmer 70, having a line 71 connecting to a source of supply (not shown), can be selectively programmed to operate the apparatus for any one of its intended functions. The programmer 70 is associated with circuitry, as seen in FIGURE 2, and includes a switch 75 for energizing a motor 76, connected to source of supply 72, which drives a shaft 77 for rotating a drum switch 80. The drum switch 80 is provided with a plurality of contact rings 80a-80e of varying lengths for making contact with corresponding normally open microswitches 81a-81e, respectively.

A plurality of manually operable switches 82a-82e are provided for selectively operating control circuits 83a-83e each of which govern the performance of a different function of the apparatus. It should be noted that there are numerous known control circuits which may be employed for the hereinafter discussed functions of the apparatus and, accordingly, for the sake of simplicity the control circuits 83a-83e are shown in block form.

In general, the circuitry is operative by selectively closing one of the switches 82a-83e. Start switch 75 is depressed for energizing the motor 76 which rotates drum switch 80. As soon as the drum switch rotates, microswitches 81a-81e are closed by contacts 80a-80e, respectively, and a control circuit 83a-83e functions in response to the selected closed switch 82a-82e when contact ring breaks contact with the microswitch of the selected contact circuit, said control circuit opens thereby energizing a motor return mechanism 85 which quickly returns the drum switch 80 to its normal position ready for another cycle.

Microwave cooking of frozen foods

As seen in FIGURE 1, the inner drum has been inserted through door opening 29 and connecting element 21 is snapped into locking engagement with hub 13. Food-stuffs, such as frozen food, are placed on shelf 24, the door then being closed and secured by latch 28. The programmer 70 is set by closed switch 82a which is connected to the microwave cooking control circuit 83a. Switch 75 is depressed to start motor 76 to rotate drum switch 80 which, in turn, closes microswitch 81a thereby actuating the control circuit 83a. Power supply 41 is energized causing the microwave generator 35 to emit microwave energy to cook the frozen food, the outer drum 12 being rotated so that the vanes 14 stir the microwave energy thereby causing a uniform cooking of the food. The microwave cooking is described in more detail in my copending application Ser. No. 430,624, now abandoned. At the end of the cooking cycle, microswitch 81a opens causing the motor return mechanism 85 to return the drum switch to its normal start position.

Dishwasher

In the event it is desired to clean the cooking utensils and the inner drum, the utensils are placed in the inner drum and programmer switch 82b is closed. Upon depression of switch 75, drum 80 again rotates thereby closing microswitch 81b which actuates the cleaning control circuit 83b. Operation of said circuit 83b causes a valve 90 to open thereby permitting water to flow through tube 65 and about the cavities of the inner and outer drums through the openings thereof into contact with the utensils. The microwave generator 35 is energized causing the emission of heat for boiling the water and the ultrasonic generator 40 is energized to emulsify and wash any fats and residue on the utensils and inner drum by way of cavitation. After the washing cycle, a pump 91 is ener-

gized to withdraw the water from the drums, the water passing through outer drum openings 15-15 and along the sloped wall 11a into the exit passage 92. During this cycle, the fan 58 operates and the baffle 60 is moved to a desired open position for directing the air stream in such a manner that the working cavity is kept from filling with steam.

Fabric dyer

The inner drum 20 is removed from the apparatus thereby enabling the apparatus to dye fabrics. The fabrics are placed into the outer drum 12 and the necessary dye is inserted therein. The programmer is set by closing switch 82c which is connected to dye control circuit 83c. Again, upon depression of switch 75, drum switch 80 rotates causing microswitch 81c to close thereby actuating the dyer circuit 83c. Water is permitted to flow through valve 90 and tube 65 into the working cavity of the outer drum 12. The outer drum is caused to rotate thereby tumbling the fabrics and mixing the dye evenly. The ultrasonic generator 40 is energized for ultrasonically forcing the dye into the fabrics. Simultaneously the microwave generator 35 heats and maintains the water at a desired temperature. When the dyeing operation is completed, the dye and water is drained by means of pump 91 and fresh water is introduced through the tube 65 to the working cavity for rinsing the fabrics. At the end of the rinsing operation, the outer drum 12 is rotated and the microwave generator 35 again is energized for emitting heat to dry the fabrics. During this operation, baffle 67 is moved to an open position for directing the heated air in such a manner so as to carry off moist, waste air.

Washer-dryer

The inner drum 20, when removed from the apparatus, may thereby enable the apparatus to function as a washer-dryer unit.

Fabrics are inserted into the outer drum 12 and the programmer is set by closing switch 82d which is connected to the washing and drying circuit 83d of the apparatus. Again, upon depression of switch 75, drum switch 80 rotates causing microswitch 81d to close thereby activating the washer circuit 83d. Operation of the washer circuit 83d causes water to flow through valve 90 and tube 65 into the working cavity. Subsequently, the microwave generator 35 is energized for emitting energy to heat the water, the ultrasonic generator 40 is energized for ultrasonically cleaning the fabrics, and the outer drum 12 is rotated to constantly stir the water and released microwave energy. It should be noted that as a result of the ultrasonic energy, the noise level of the apparatus is greatly lower than conventional type washers.

After the clothes are washed, the microwave generator 35, outer drum 12 and fan 58 are actuated for drying the fabrics. Upon completion of the drying operation, the dryer circuit opens and the fabrics are removed from the outer drum.

Exhaust fan

This apparatus may be employed as an exhaust system by venting it outside, particularly when the apparatus is located in a confined area, such as a small room or trailer. This system functions upon the closing of selective switch 82e which is connected to the exhaust fan circuit 83e. Operation of the fan circuit 83e occurs upon depression of switch 75 which causes drum switch 80 to rotate thereby resulting in the closing of microswitch 81e and the fan circuit. Operation of circuit 83e causes fan 58 to rotate at its maximum speed and the baffle 67 to be completely open so as to maximize the flow of air through the apparatus. When ring contact 80e breaks contact with microswitch 81e, the fan circuit opens and motor return unit 85 is activated to return the drum switch to its normal ready position for another cycle.

In this writing a general knowledge of known considerations in the making of an electronic oven and an ultra-

sonic cleaner are presumed (for example, the specifications of grid 66 and/or other grids or chokes (not shown) needed to make the frame secure against the loss of microwave energy through openings in the otherwise microwave impervious frame; the ability to use more than one ultrasonic transducer in parallel and, the ability to use more than one magnetron or other microwave generator in parallel, etc.).

It is fully expected that anyone skilled in these arts could easily make the programming drum switch 80 variable and interchangeable to provide different arrangements of contact rings 80a-80e.

It is fully expected that anyone skilled in these arts could easily make control circuits 83d and 83e control an individual circuit (for example 83d, now 84d, would control only the microwave generator 35, and 83e, now 84e, would control only the ultrasonic generator 40, etc.).

Anyone skilled in these arts could easily make the motor 76 a variable speed motor so that the operator would have control over the time of each function (e.g. to provide long or short washing cycles; timed cooking cycles; etc.).

While the invention has been described above, and illustrated by several different embodiments, it should be understood that variations in the details and mode of operation can be made without departing from the scope of this invention which is to be limited only by the claims appended hereto.

I claim:

1. Apparatus for performing work on workloads, which comprises, means for emitting microwave energy for heating a workload, means for stirring the microwave energy for uniformly heating the workload, means for emitting ultrasonic energy to said workload, and means for selectively controlling the operation of said microwave and ultrasonic means.

2. Apparatus, according to claim 1, which includes a drum for receiving the workload.

3. Apparatus for performing work on workloads which comprises, a drum for receiving a workload, means for rotating said drum, means for emitting microwave energy for heating the workload, means for emitting ultrasonic energy to said workload, and means for selectively controlling the operation of said microwave and ultrasonic means.

4. Apparatus for performing work on workloads, which comprises, means for emitting microwave energy for heating a workload, a drum for receiving the workload and comprised of a type of material capable of permitting microwave energy to pass therethrough, said drum having a plurality of vanes therein for stirring the microwave energy emitted from the microwave means, means for emitting ultrasonic energy to said workload, and means for selectively controlling the operation of said microwave and ultrasonic means.

5. Apparatus for performing work on workloads, which comprises, a drum for receiving a workload, a plurality of adjustably removable shelves for holding the workload stationary, means for emitting microwave energy for heating the workload, means for emitting ultrasonic energy to said workload, and means for selectively controlling the operation of said microwave and ultrasonic means.

6. Apparatus for performing work on various type workloads, which comprises, a frame, means connected to the frame for receiving a workload, microwave means connected to the frame for imparting heat to the workload, means for stirring the microwave energy for uniformly heating the workload, ultrasonic means for imparting ultrasonic vibratory movement to the workload,

and means for selectively controlling the operation of said microwave and ultrasonic energy means.

7. Apparatus for performing work on various type workloads, which comprises, a frame, microwave emitting means connected to the frame for imparting heat to the workload, ultrasonic means for imparting ultrasonic vibratory movement to the workload, means for selectively controlling the operation of said microwave and ultrasonic means, a rotatable outer drum capable of receiving a first workload therein so that work may be performed thereon in response to a first selective setting of the controlling means, and an inner drum capable of being removably located within the outer drum for receiving a second workload therein so that work may be performed thereon in response to a second selective setting of the controlling means.

8. Apparatus, according to claim 7 wherein the inner and outer drums are comprised of a material for permitting the passage of microwave energy therethrough, said outer drum being further provided with a plurality of openings extending through the walls thereof and with a plurality of vanes in spaced relationship along its inner surface.

9. Apparatus, according to claim 8, which includes exhaust means for drawing and circulating relatively cool air through the apparatus, said exhaust means including a fan and at least one baffle connected to the frame for controlling the flow of air through the apparatus.

10. Apparatus capable of functioning as a fabric washer, fabric dryer, dishwasher and oven, which comprises, a frame; an outer drum of microwave permeable material connected to the frame and capable of receiving fabrics to be washed and dried therein; an inner drum capable of being removably located within the outer drum for receiving foodstuffs to be cooked or utensils to be washed; means for permitting the flow of a washing medium within the outer drum; microwave means for imparting heat to the washing medium, foodstuffs and utensils; ultrasonic means for emitting ultrasonic energy to the washing medium; first, second, third and fourth control circuits; and program means for selectively operating said first, second, third and fourth control circuits; said first circuit being energized, when the inner drum is removed from the apparatus, for controlling the operation of the outer drum, washing medium means, microwave and ultrasonic means for washing the fabrics; said second circuit being energized, when the inner drum is removed from the apparatus, for controlling the operation of the outer drum and microwave means for drying the fabrics; said third circuit being energized, when the inner drum is located within the outer drum and the fabrics are removed from the latter, for controlling the operation of the microwave means and the outer drum for cooking foodstuffs within the inner drum; and said forth circuit being energized, when the inner drum is located within the outer drum, for controlling the operation of the microwave means, ultrasonic means and outer drum for cleaning utensils within the inner drum.

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