Feb. 21, 1967 J. GESMAR ETAL 3,304,625

PORTABLE HAIR DRYER WITH HEATERS ON BOTH ENDS OF FLEXIBLE HOSE

Filed May 25, 1964 3 Sheets-Sheet 1

Fig. 1.

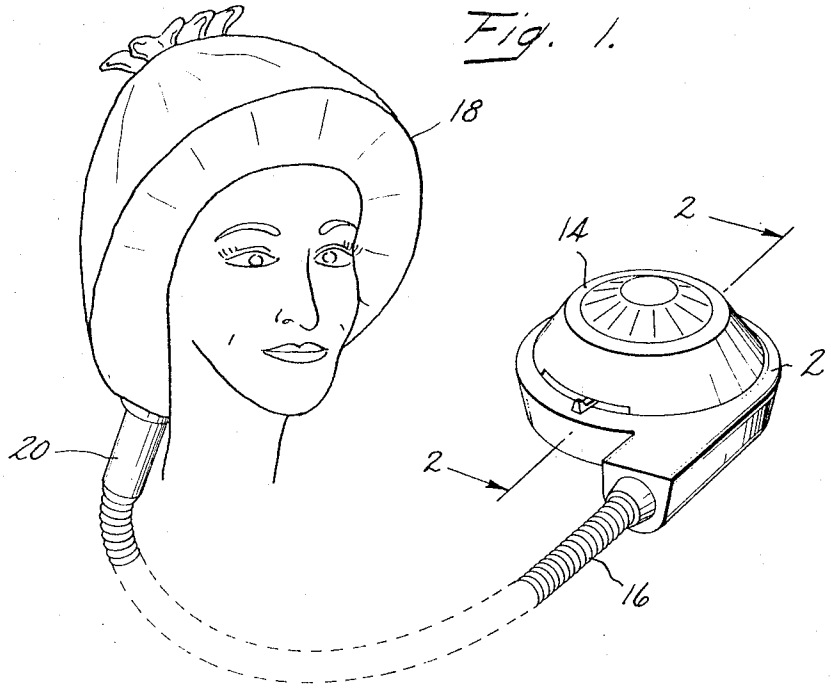


Fig. 2.

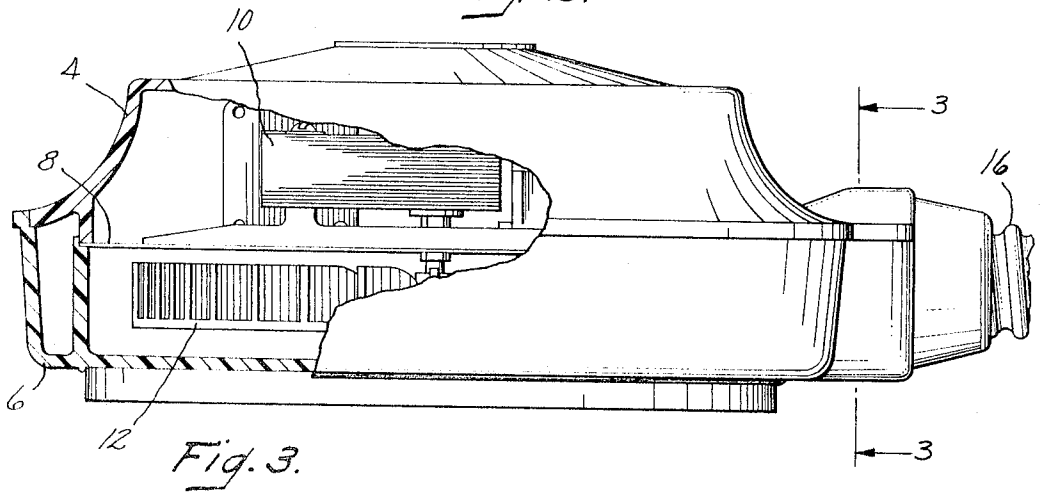
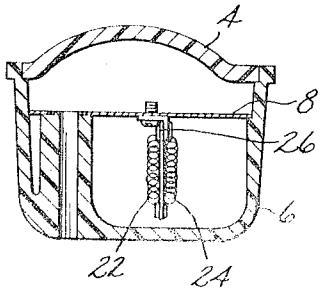


Fig. 3.



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PORTABLE HAIR DRYER WITH HEATERS ON BOTH ENDS OF FLEXIBLE HOSE

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Fig. 4.

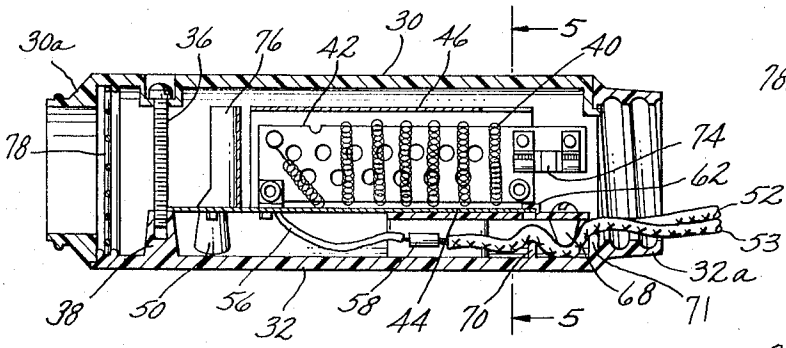
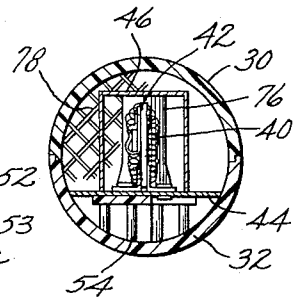


Fig. 5.



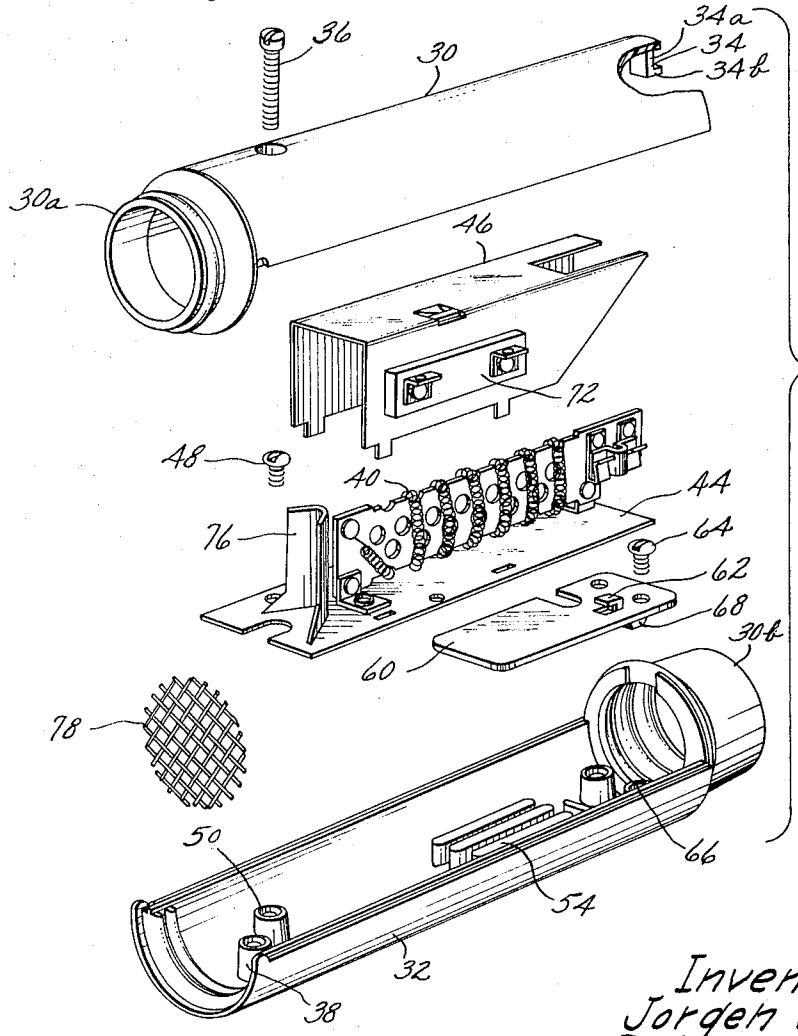


Fig. 6

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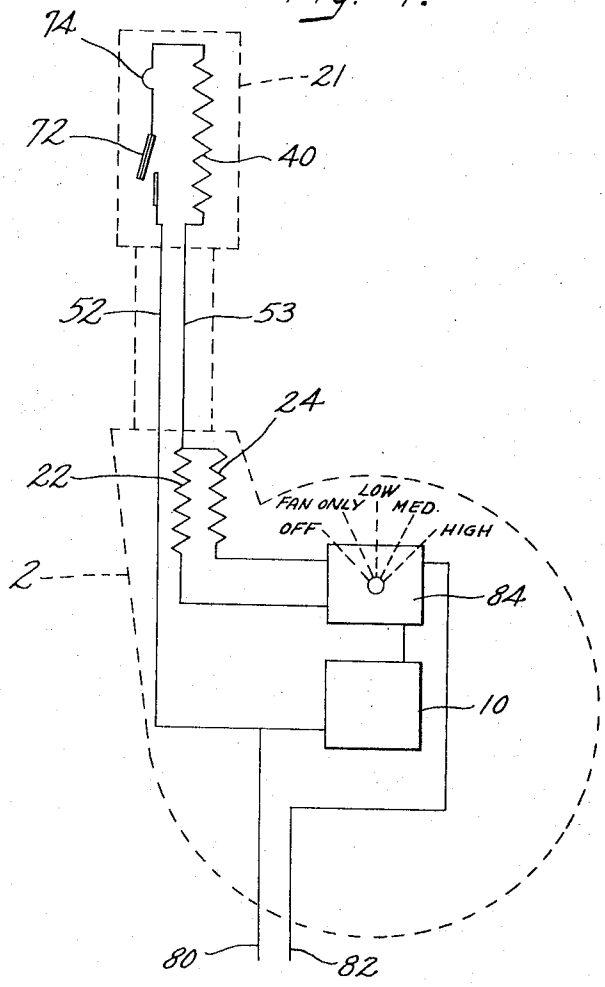
Fig. 7.



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3,304,625

PORTABLE HAIR DRYER WITH HEATERS ON BOTH ENDS OF FLEXIBLE HOSE

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12 Claims. (Cl. 34—99)

This invention relates to electric hair dryers, and more particularly to an improved heating arrangement for a hair dryer of the type including a compact, portable source of heated pressurized air and a lightweight, flexible, plastic hose connected to a flexible hair drying bonnet.

While hair dryers of this type have proven to be extremely popular and handy appliances for "home" hair drying operations, one shortcoming is that they typically do not dry the hair as rapidly as most of the larger, professional type dryers. One of their limiting factors in this regard is that the air passing through the flexible hose must not be so hot that the exterior of the hose becomes uncomfortable to the touch in that frequently portions of the hose contact the user's skin during the drying operation. Also, since it is necessary that such dryers be lightweight, easily portable, and inexpensive, the size of the fan and motor, and hence, the air output is limited.

The heat output of a dryer is most critical at the initial stages of a drying operation in that due to the large amount of moisture then present in the hair, there is a substantial cooling effect as the air passes through the hair. Consequently, most users can withstand a large amount of heat during the initial stages and it is therefore desirable to make such heat available to hasten a drying operation. Also since the appliance is usually cold when a drying operation is started, there is a further need for extra heat at the beginning stages to compensate for the loss. As the moisture evaporation rate, and hence the cooling effect, decreases, the amount of heat needed drops rather quickly; thus, it is naturally desirable that a dryer be provided with suitable adjustment means to furnish the proper amount of heat throughout a drying cycle.

Accordingly, it is a primary object of this invention to provide a portable hair dryer of the type discussed above with an improved heating arrangement to obtain more rapid drying.

It is another object of this invention to provide such a dryer with a heating system by which a large amount of heat is available almost instantly after the unit is energized.

It is a further object of this invention to provide a hair dryer of the type including a lightweight, flexible, plastic hose conducting air from a source to a hair drying bonnet with a heating system which provides a quick, high heat output, but yet does not cause the flexible hose to become uncomfortably hot to a user's skin.

Yet another object of the invention is to provide such an improved heating system incorporated into a lightweight, compact, rugged construction.

Briefly stated, the invention includes a hair dryer of the type having a housing containing an electric motor-driven fan, and having a lightweight, flexible, plastic hose with one end connected to the housing and the fan air output. A flexible hair drying bonnet adapted to fit over a person's hair is to receive the fan air output. So that the air is heated immediately prior to entering the hair drying bonnet, an electric heating means is attached to the downstream of the hose. This heating means is mounted within a lightweight, tubular, plastic casing which has one end connected to the hose and its other end connected to the bonnet air inlet. The electricity to energize the heating means may be provided by conductors

extending through the hose into the circuitry within the dryer housing. To supplement the heat introduced at the end of the hose, a heating element is also positioned in the conventional location within the fan output of the main housing. It has been found that with this unique arrangement, a large amount of heated air may be quickly provided to the user's hair, but yet the air hose does not become uncomfortably warm.

Further features, objects and attendant advantages will become apparent with reference to the following drawings in which:

FIG. 1 is a perspective view of the hair dryer of the invention shown in operation on a model's head;

FIG. 2 is a side elevational, partially sectionalized view of the hair dryer housing along line 2—2 of FIG. 1;

FIG. 3 is a cross-sectional view of the housing air outlet along line 3—3 of FIG. 2;

FIG. 4 is a longitudinal cross-sectional view of the heating unit which is positioned on the downstream end of the hose;

FIG. 5 is a cross-sectional view of the heating unit on line 5—5 of FIG. 4;

FIG. 6 is an exploded perspective view of the heating unit; and

FIG. 7 is a schematic diagram showing the electrical circuitry of the hair dryer of the invention.

Referring now to FIGS. 1 and 2, there is shown a hair dryer housing 2 formed by an upper section 4 and a lower section 6, both preferably made of strong, lightweight plastic. An orifice plate 8 extends between these two sections and supports an electric motor 10 having its output shaft drivingly connected to a centrifugal type fan 12. Air intake openings are roughly shown in the top housing section 4. In operation, air is drawn in through these openings, flowing past the motor and through the opening in orifice plate 8 before being forced through an outlet section and into a lightweight, flexible re-enforced plastic hose 16. The air is then ducted through the hose into the large flexible bonnet 18 shown positioned on the head of the model.

In accordance with this invention, the hair dryer is provided with a unique heating system which includes electrical heating means positioned at the end of the hose 16 in a tubular, preferably cylindrical, plastic casing 20. As can be seen, one end of the casing is connected to the downstream end of the hose and the other end of the casing is adapted to be connected to the air intake of the bonnet 18. Electrical energy for the heating means within the casing 20 may be provided by means of the conductors extending through the hose 16 to the electrical circuitry within the housing 2. To supplement the heat provided by the heating elements within the casing 20, a pair of heating elements 22 and 24 are provided in the conventional location in the air output section of the housing 2 mounted on a suitable insulating member 26 which in turn is attached to the orifice plate 8, as may be seen in FIG. 3.

Refer now to FIGS. 4, 5 and 6 for a detailed description of the internal construction of the casing 20 and the heating means contained therein. First, it should be noted that the diameter of the casing is only slightly larger than the hose diameter, such that the casing gives the appearance of being a mere extension of the hose and is relatively unobtrusive. The fact that the casing 20 has a slightly larger diameter compensates for the decrease in cross-sectional space caused by the components mounted within the casing, as can be best seen in FIG. 5. However, note that the components are arranged to provide a minimum of obstruction to the airflow.

It is also important that the length of the heating unit be minimized so as not to become too bulky or cumbersome. In a production version of the unit herein de-

scribed, the casing 20 is only approximately six inches long.

As another feature of the invention, the casing 20 is uniquely formed of two complementary halves or portions 30 and 32, each having a semi-cylindrical cross-section and an integral annular section. Annular section 30*a* is adapted to be connected to the air inlet on the bonnet 18, and annular section 30*b* is formed with internal threads adapted to mate with the re-enforcement wire in flexible hose 16. Forming the casing 20 into two sections simplifies molding of the unit, and the operation of assembling the components into the casing is greatly facilitated. Forming an annular section with each of the casing halves provides stronger and more reliable connections with the hose and bonnet than would be obtained, for example, if the annular portions were also formed in split sections.

Another unique feature is the manner in which the casing sections 30 and 32 are assembled or clamped together. Casing section 30 is formed with an integral locking tongue 34 having a radially extending portion 34*a* and an axially extending portion 34*b*. When the casing is assembled, as shown in FIG. 4, the axially extending portion 34*a* of the tongue extends within the inner diameter of annular section 30*b* to prevent the casing sections from being separated by movement in a radial direction. With this locking tongue, only a single screw 36 extending through a recessed opening in casing section 30 and threading into a lug 38 formed integral with the inner wall of casing section 32 is required to hold the two sections together.

The heating assembly within the casing includes resistance heating coil or element 40 wound around a plate 42 formed of mica or other insulating material, and a metal enclosure shielding the surrounding casing walls from direct radiation from the heating element. The metal enclosure is formed by a plate 44 and a U-shaped member 46 which has its open ends secured to the plate 44. Insulating plate 42 is secured by suitable fastening means in perpendicular relation to metal plate 44. Plate 44 is, in turn, supported by the surrounding casing by means of a screw 48 extending through one end of the plate to be threadedly received in a lug 50 formed integral with casing section 32.

The plate 44 is further supported on its opposite end by structural elements which also uniquely form strain relief and insulating functions for the conductors 52 and 53 which are connected to the heating element 40. More specifically, casing 32 is formed with a plurality of spaced, longitudinally extending ribs 54 which extend beneath and support plate 44. Conductors 52 and 53 are connected to leads attached to the heating element circuitry, one of which is shown at 56 in FIG. 4. The connection 58 is insulated from the other lead connection (not shown) by being positioned between two of the ribs 54. These connections are electrically insulated from plate 44 by means of a high temperature insulation member 60 which is sandwiched between the upper surfaces of ribs 54 and the lower surface of plate 44. Member 60 also serves to thermally insulate the low temperature insulation used on conductors 52 from the heating element and the metal enclosure. A hook 62 formed on the upper surface of insulating member 60 cooperates with the upstream edge of plate 44 to hold the plate in the position shown in FIG. 4. Member 60 is further secured to the casing by means of a screw 64 extending through the member into a lug 66 formed integrally with lower casing half 32.

A lug 68 formed on the lower surface of insulating member 60 forces the conductors 52 and 53 against the bottom surface of casing 32 while transversely extending rib 70, formed integral with the bottom wall casing 32, forces the conductors 52 and 53 away from the bottom wall of casing 32. Also, the change in diameter of the casing in that area results in an annular rib or ridge 71 which further bends the conductors. Hence, as can be seen in FIG. 4, lug 68 and ribs 70 and 71 cooperate to clamp the conductors 52 and 53, thereby forming an effective strain relief arrangement.

Additional elements of the heating assembly are a bimetallic thermostat 72 mounted on a side wall or shield 46, and a fusible link 74 mounted on insulating plate 42. Both the thermostat and the fusible link are serially connected to heating element 40 to prevent the system from overheating. The thermostat 72 is designed to cycle at a maximum desirable temperature level whereas the fusible link 74 serves as a safety device which will melt to interrupt the circuit in the event the thermostat does not function properly.

A single insulating member, such as plate 42, with a resistance heating element wound thereon forms a very inexpensive heater; however, as the air flows through the casing 22 the heat is naturally concentrated at the center section in the area of the heating element. While this is desirable from a standpoint of minimizing the heat transfer to the casing wall, it is important that the air entering the bonnet be uniformly mixed so as to prevent hot spots to the user. Hence, as another element of the heating assembly, there is provided a V-shaped baffle 76 mounted on plate 44 and positioned at the downstream end of the heating element with the closed end of the V pointing upstream. With such an arrangement, the heated air emanating from the downstream end of the metal enclosure surrounding the heating element is caused to converge outwardly and mix with the cooler air flowing closer to the casing walls. By properly designing the shape of the baffle 76 with respect to the temperature and velocity characteristics of the air stream, substantially uniformly heated air can be provided entering the bonnet. As an incidental benefit, note that the screw 36 is shielded by baffle 76 so that it has little effect on the air stream as an obstruction.

To minimize the possibilities of objects being inserted in the end of the casing and reaching any of the internal components, there is provided a perforated protective member or screen 78 positioned by suitable annular ribs in the downstream end of the casing. The mesh of the screen is selected to minimize the resistance to airflow while yet providing a reasonable safety factor.

For a description of the electrical circuitry of the hair dryer and a more detailed discussion of its operating characteristics, refer now to FIG. 7. It can be seen that heating elements 22 and 24 are electrically connected in parallel and are connected in series with element 40, and the heating elements are further serially connected with thermostat 22 and fusible link 74. One conductor 80 of the line input is connected directly to conductor 52 leading to the hose heating unit and is also connected to the motor 10. The other conductor 82 of the line input is connected to a five position switch 84, along with leads from the motor 10 and from heating elements 22 and 24. Any conventional switch may be employed which will provide the following operation. In an "off" position, neither the motor nor any of the heaters are energized. In a second position, only the fan is energized so that no heat other than motor heat is provided. In the "low," "medium," or "high" positions various combinations of the heating elements are connected in parallel with the motor which is in operation in all of the heating positions. In "low" position, one of the heating elements, such as element 22, is serially connected with hose heating element 40, while heating element 24 is not energized. In the "medium" position elements 24 and 40 are energized, and element 22 is not energized. Finally, in "high" position, elements 22 and 24 are energized in parallel relation to each other while both are serially connected to element 40. With the arrangement shown, a desirable temperature range can be simply provided. Also, it should be noted that thermostat 72 and fusible link 74 are connected in the circuit whenever any of the heating elements are energized; hence, a safety factor is provided during heating operations.

It has been found that the temperature range preferred by most women for the drying air is quite narrow. That is, the maximum temperature desired by a woman having a relatively high heat withstanding capacity is not a large amount higher than the minimum temperature normally desired by a women having a low heat withstanding capacity. More specifically, it has been found that an air temperature at the exit end of hose casing **20** need be no higher than approximately 160° F.; whereas, if any heat is desired, an exit air temperature of approximately 130° F. can be satisfactorily employed. Accordingly, the resistances and wattages of the heating elements and other parameters of the dryer shown have been selected to provide such temperatures at the "high" and "low" settings, and the "medium" heat setting is designed to provide exit air at a temperature of approximately halfway between the high and low or in the order of 145° F.

With normal line current and voltage, the resistances of the heating elements have been selected to provide the necessary wattages coupled with the motor wattage to attain the desired temperatures. At the "low" setting, element **22** provides approximately 140 watts and element **40** provides approximately 90 watts for a total of 230 watts plus the motor wattage. As the "medium" setting, element **24** provides approximately 140 watts and element **40** provides approximately 150 watts for a total of 290 watts. At the "high" setting, element **22** provides approximately 55 watts, element **24** provides approximately 80 watts and element **40** provides approximately 225 watts for a total of 360 watts.

As previously explained, the primary purpose for placing a heating element at the end of the hose is to quickly obtain a large amount of heat at the beginning stages of a hair drying operation. It is at this stage when the greatest amount of heat can be readily used in that the rapid evaporation rate cools the user's head and therefore the user can withstand the high temperature drying air. While various circuit arrangements having heating elements of different wattages can be employed, the most important criteria is that at the maximum heat setting the majority of heat should be provided by the heating element at the end of the hose to furnish the necessary quick drying action; and at the same time, the supplementary heat provided by the elements within the housing should not raise the temperature of the hose to an undesirable level. If heaters providing equivalent air temperatures at the hose exit were placed solely in the housing **10**, the heat would not be provided nearly so quickly, or as efficiently, in view of the necessary heating of the hose and housing. Further, at the high heat setting, the typical hose would become uncomfortably hot to the user's skin.

Following this line of reasoning, it would seem that the most desirable arrangement might be to position all of the heating elements at the downstream end of the hose. However, there are certain practical limitations to the size of the casing which can be satisfactorily positioned at the end of the hose, and hence there are space limitations within the casing. As mentioned, the casing described herein is only slightly larger in diameter than the hose and the length of the casing is only approximately six inches. It has been found that a casing of this size containing the heating assembly described does not add appreciably to the weight of the hose so that the effect on the positioning of a flexible bonnet and the handling of the hose is minimized.

With regard to the maximum size of the heating element which can be conveniently placed in the end of the hose, another limiting factor is that it is essential that the air leaving the end of the hose casing should be uniformly heated to prevent hot spots. If all of the heat provided at the "high" setting for the hair dryer described herein were provided at the end of the hose, a more elaborate and expensive baffling arrangement would be required and possibly more expensive insulating supports

than the simple plate shown might be required. Moreover, increasing the amount of heat positioned at the end of the hose would tend to complicate the temperature problems with respect to the surrounding casing and the design of the metal enclosure surrounding the heating element.

Another factor of the airflow system which naturally affects air temperature and drying time is the air output of the system. In the arrangement shown, a motor drawing 60 watts is used to drive a six inch fan to provide approximately 17 cu. ft. of air per minute. It has been found that an air flow of this type with the heating system described above provides excellent drying results when the heating ranges provided are used to their maximum extent. In a typical operation, the user starts the dryer on "high" heat position and moves to lower heat settings when and if necessary.

While a preferred arrangement of the various aspects of the invention has been described, it is intended that all variations and modifications which fall within the true spirit and scope of the invention are to be included within the appended claims.

What we claim is:

1. In a portable hair dryer including a housing containing an electric motor driven fan and first electric heating means in the air stream of the fan, a lightweight, flexible plastic hose having one end connected to the housing and the fan air output; a flexible hair drying bonnet adapted to fit over the user's hair and having an air inlet; a lightweight, tubular plastic casing having one end connected to said bonnet air inlet and having its other end connected to the downstream end of said hose; a heater enclosure supported within said casing and spaced from the inner walls of the casing; electric heating means mounted within said enclosure; conductor means extending through said hose and connecting the heating means in said housing to the heating means in said enclosure, and switch means to control the energization of said first and second heating means, said first and second heating means being connected through said switch means to a power line input for simultaneous energization of said first and second heating means.

2. An electric hair dryer comprising a housing; an electric motor driven fan positioned within said housing; first electric heating means including two electrical resistance heaters electrically connected in parallel with each other and positioned within said housing in the air output of said fan; a lightweight, flexible plastic hose having one end connected to the housing and the fan air output; a flexible hair dryer bonnet adapted to fit over a person's hair and having an air inlet; a lightweight, tubular plastic casing having one end connected to said bonnet air inlet and having its other end connected to the downstream end of said hose; second electric heating means mounted within said casing; conductor means for connecting said first electric heating means in electrical series with said second electric heating means; and switch means positioned within said housing connected to said heaters for selectively varying the heat output of the hair dryer; said switch means and said heating means being arranged such that at maximum heat setting the majority of heat is provided by said casing heating means and at each heat output position said flexible hose is not uncomfortable to the user's skin.

3. The device as set forth in claim **1** wherein said tubular plastic casing is formed of two complementary portions each having a semi-cylindrical cross section and an integral annular section with one annular section being connected to the downstream end of the hose and the other annular section being adapted to be connected to said bonnet inlet; and means for connecting said complementary portions together.

4. The device as set forth in claim **2** wherein a thermostat is positioned in said casing and connected in electrical series with said second heating element.

5. The device as set forth in claim 2 wherein said switch includes a "low heat" position wherein said second heating means and one of said heaters of said first heating means are energized, a "medium heat" position wherein said second heating means and the other of said heaters of said first heating means are energized, and a "high heat" position wherein all of said heaters are energized.

6. The device as set forth in claim 2 wherein said switch includes a "low heat" position, a "medium heat" position and a "high heat" position, and the total heat output from said first heating means remains substantially constant for each of said positions.

7. In a portable hair dryer including a housing containing an electric motor driven fan, a lightweight, flexible plastic hose having one end connected to the housing and the fan air output; a flexible hair drying bonnet adapted to fit over a person's hair and having an air inlet; a lightweight, tubular plastic casing having one end connected to said bonnet air inlet and having its other end connected to the downstream end of said hose; an electric heating assembly mounted within said casing including a tubular metal enclosure extending longitudinally within the casing and having both ends open, said enclosure being supported within the casing with a minimum of contact with the casing so that the enclosure is essentially spaced from the inner wall of the casing and air flowing through the casing can flow within and around the enclosure, an insulating member mounted within said enclosure, an electric resistance heating element supported on said insulating member, a baffle means positioned downstream from said heating element to promote proper dispersion of the heat to obtain a uniformly heated air stream entering the bonnet.

8. In a portable hair dryer including a housing containing an electric motor driven fan, a lightweight, flexible plastic hose having one end connected to the housing and the fan air output; a flexible hair drying bonnet adapted to fit over a person's hair and having an air inlet; a lightweight, tubular plastic casing having one end connected to said bonnet air inlet and having its other end connected to the downstream end of said hose; a tubular enclosure mounted within said casing; an insulating plate mounted within said enclosure; an electric resistance heating element wound around said insulating plate and spaced from the surrounding enclosure; and a V-shaped baffle positioned downstream from said heating element with the enclosure end of the baffle pointing upstream toward said plate to aid in proper mixing of the heated air.

9. In a portable hair dryer including a housing containing an electric motor driven fan, a lightweight, flexible plastic hose having one end connected to the housing and the fan air output; a tubular rigid plastic casing having one end connected to the downstream end of said hose and its other end adapted to be connected to a flexible hair drying bonnet; heating means positioned within said casing; a power cord extending from said housing through said hose and into said casing and connected to said heating means; and strain relief means for said power cord including a pair of spaced parallel ribs formed integral with an interior wall of said casing in transverse relation to said cord, and lug means positioned between said ribs and secured to said casing to clamp the cord between the ribs and the lug means.

10. In a portable hair dryer including a housing containing an electric motor driven fan, a lightweight, flexible plastic hose having one end connected to the housing and the fan air output; a tubular rigid plastic casing having one end connected to the downstream end of said hose and its other end adapted to be connected to a flexible hair drying bonnet; said casing having a plurality of screw receiving lugs formed integral with an interior wall of said casing; a plurality of longitudinally extending ribs formed integral with said interior wall between the lugs; a metal plate supported within said casing by said lugs and said ribs; an insulating support attached to and supported by said plate; an electric resistance heating element wound around said insulating support; a thermostat positioned adjacent said heating element; a multi-conductor electrical power cord extending from said housing through said hose and into said casing; electric leads connecting said heating element and said thermostat to the conductors of said power cord with the connections joining the leads and the conductors being positioned in insulated relation between said ribs; a high temperature insulating member positioned between said ribs and said metal plate to insulate said connections from the metal plate; a threaded fastening member extending through one end of said metal plate into one of said lugs; hook means formed integral with the top surface of said insulating member and extending over the opposite end of said metal plate to position the metal plate; and a threaded fastening member extending through said insulating member into one of said lugs to secure said insulating member to said casing.

11. In a portable hair dryer including a housing containing an electric motor driven fan, a lightweight, flexible plastic hose having one end connected to the housing and the fan air output; a tubular rigid plastic casing having one end connected to the downstream end of said hose and its other end adapted to be connected to a flexible hair drying bonnet; a plurality of longitudinally extending ribs formed integral with an interior wall of said casing; a metal plate supported within said casing and extending over said ribs; an insulating support attached to and supported by said plate; an electric resistance heating element wound around said insulating support; a thermostat positioned adjacent said heating element; a multi-conductor electrical power cord extending from said housing through said hose and into said casing; electric leads connecting said heating element on said thermostat to the conductors of said power cord with the connections joining the leads and the conductors being positioned in insulated relation between said ribs, a high temperature insulating member positioned between said ribs and said metal plate to insulate said connections from the metal plate; means securing one end of said plate to said casing; hook means formed integral with the top surface of said insulating member to position the opposite end of said metal plate; means securing said insulating member to said casing; and strain relief means for said power cord including a transversely extending lug formed integral with the bottom surface of said insulating member and a transversely extending rib means formed integral with an interior wall of said casing; said transverse lug and said transverse rib means being positioned in closely spaced parallel relation to clamp said power cord to protect said electrical connections from pulling forces on the cord.

12. In a portable hair dryer including a housing containing an electric motor driven fan, a lightweight, flexible plastic hose having one end connected to the housing and the fan air output; a tubular rigid plastic casing having one end connected to the downstream end of said hose and its other end adapted to be connected to a flexible hair dryer bonnet; a plurality of screw receiving lugs formed integral with an interior wall of said casing; a plurality of longitudinally extending ribs formed integral with said interior wall between said lugs; a metal plate supported within said casing by said lugs and said ribs; electrical resistance heating means supported in insulated relation by said metal plate; a thermostat connected to and positioned adjacent said heating means; a multi-conductor electrical power cord extending from said housing through said hose and into said casing; electric leads connecting said heating means and said thermostat to the conductors of said power cord with the connections joining the leads and the conductors being positioned in insulated relation between said ribs; a high temperature insulating member positioned be-

tween said ribs and said metal plate to insulate said connections from the metal plate; a threaded fastening member extending through one end of said metal plate into one of said lugs; a hook-shaped portion formed integral with the top surface of said insulating member and extending over the edge of the opposite end of said metal plate to position said metal plate; a threaded fastening member extending through said insulating member into one of said lugs to secure said insulating member and one end of said metal plate to said casing; and strain relief means for said power cord including a transversely extending lug formed integral with the bottom surface of said insulating member and transversely extending rib means formed integral with an interior wall of said casing; said transverse lug and said transverse rib means being positioned in closely spaced parallel relation to clamp said power cord to protect said electrical connections from pulling forces on the cord.

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