

May 18, 1954

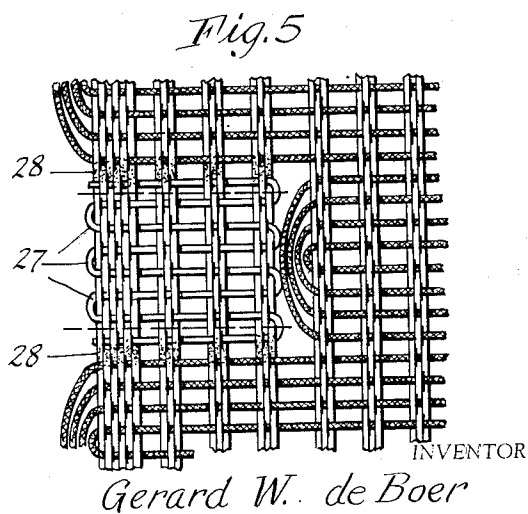
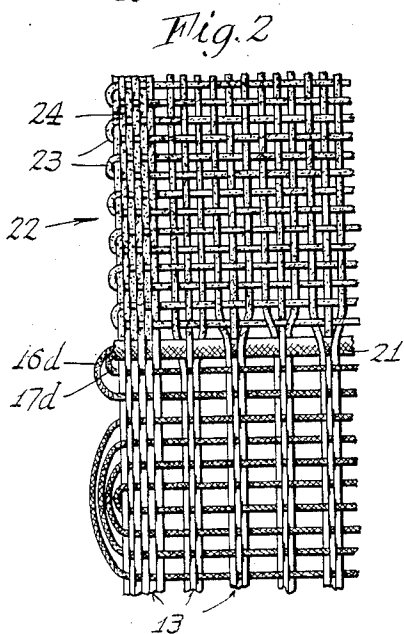
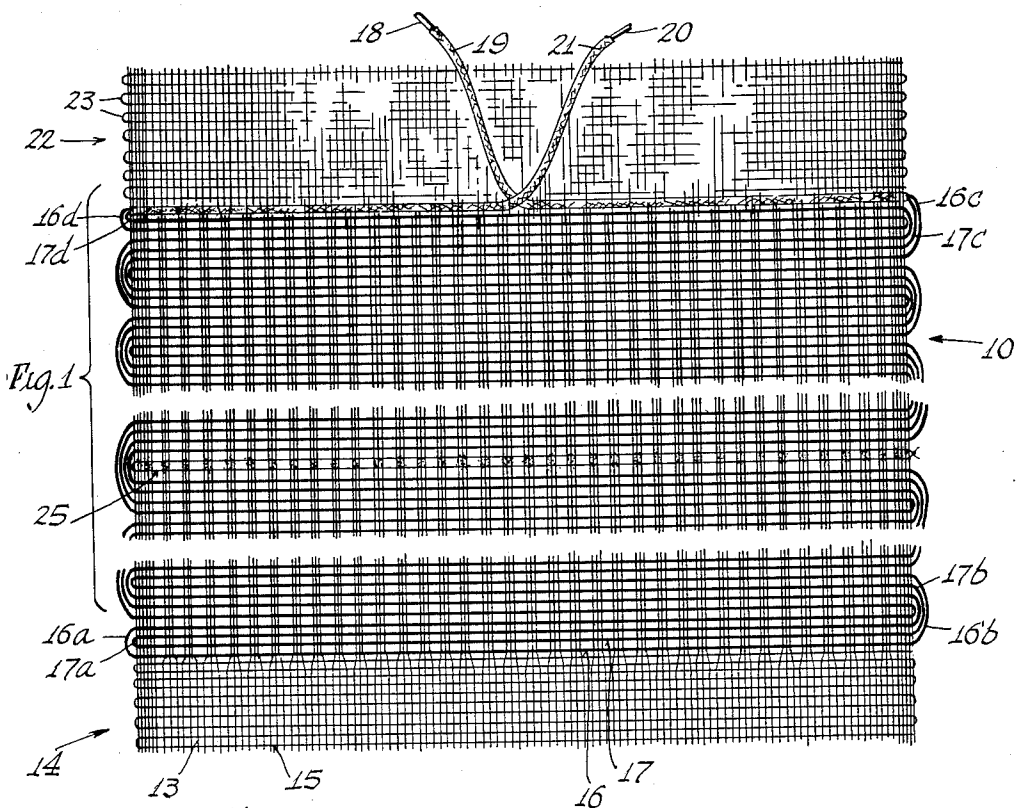
G. W. DE BOER

2,678,993

WOVEN RESISTANCE OR HEATER DEVICE

Filed March 13, 1952

2 Sheets-Sheet 1



BY
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Fig. 4

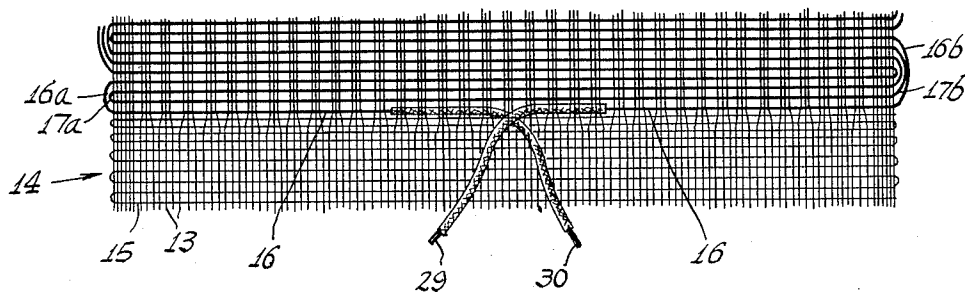
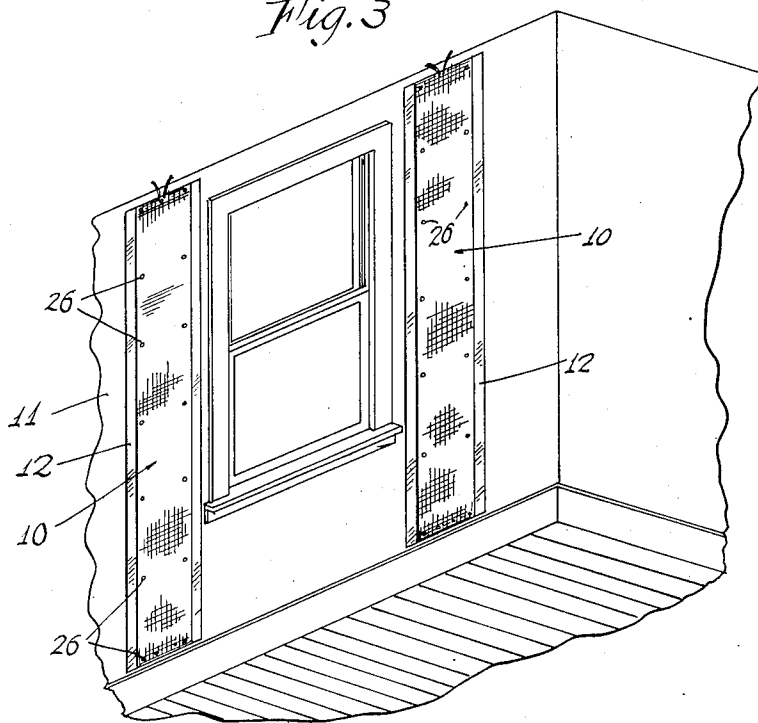


Fig. 3



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WOVEN RESISTANCE OR HEATER DEVICE

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9 Claims. (Cl. 219—46)

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The present invention relates to a novel woven resistance unit or a heater unit and particularly to a panel heater adaptable to radiant panel heating and to the method of making the same.

It is an object of the present invention to provide a woven resistance or heater unit in which a plurality of wires are distributed in predetermined spaced parallel relation throughout the unit and which can be connected as desired to produce a plurality of circuits extending there-through, thus providing for great versatility in the application and operation of the device.

Another object of the invention is to provide a radiant heating panel having a plurality of spaced wires providing the same effective ohmage as heretofore used but which are thinner and spread over a large area to provide low watt densities therein so as to have safer and better heat distribution throughout without dangerous hot spots.

Another object of the invention is the provision of a resistance or heater unit which includes thin wires which will produce a unit which can be mounted in thin spaces and which will enable it to be readily bent for mounting purposes if desired.

These and other objects of the invention are accomplished by weaving into the warp a plurality of parallel resistance wires and maintaining them in spaced relation throughout the warp. More specifically this is achieved by weaving an intermediate portion of the wires transversely across the unit in spaced parallel relation and then weaving the ends of the wires at either side of said intermediate portion alternately back and forth throughout the warp in a predetermined pattern. This provides a plurality of spaced continuous conductors which extend from one end of the unit back and forth across the unit to the other end thereof and similarly returned to the first end and terminating in adjacent terminals at one end of the unit.

If desired, one or more of the wires may be tapped intermediate the ends to provide additional terminals so that said wires may be divided into a plurality of separate circuits.

The terminals of the resistance or hot wires may be connected to cold leads and the cold leads woven into the fabric which will anchor the leads and provide a strain relief for said leads. By proper selection of the wire and by a predetermined connection of the terminals of the parallel wires various heating relations in the heating unit can be achieved.

A feature of the invention resides in the fact

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that the heating unit may be woven in any desired pattern to provide a heating arrangement of a required shape. Any space in which the heating wires do not extend may be filled with a dead filling which may be utilized to support the unit or which may be cut out to permit the unit to be fitted over projecting members.

When the woven heating unit of the present invention is used in radiant panel heating, it can be mounted on the wall, ceiling or other support by having fastening devices pass through the portions thereof having dead filling therein and the panel can be covered with any suitable heat transmitting material.

In producing the unit of the present invention a novel method of weaving is employed in which a pair of shuttles for each wire in the unit is employed. These shuttles have the ends of the wire wound thereon and are moved alternately from side to side as the weaving progresses to lay in the strands in parallel relationship throughout the unit without any of the strands crossing one another, thus producing a plurality of wires in parallel spaced relationship extending from one end to the other and back. During the weaving of the unit dead filling may be woven in to form attaching selvages at either end of the unit and at spaced intervals throughout the unit to provide attaching spaces throughout so that the device may be readily mounted by a suitable fastening means.

Other features and advantages of the invention will be apparent from the specification and claims when considered in connection with the drawings in which:

Figure 1 shows a plan view of a radiant panel heater with sections broken away.

Fig. 2 is a detailed fragmentary view of the upper left-hand corner of Fig. 1.

Fig. 3 is a view showing the radiant panel heaters of the present invention applied to a wall.

Fig. 4 is a detail of the bottom of the panel unit showing one of the wires provided with tapped means therein.

Fig. 5 is a fragmentary view showing a pattern formed by the resistance wires.

The resistance or heater unit of the present invention may be used purely as a resistance unit in a circuit or may be used as a heater unit to provide a uniform predetermined watt density throughout. For the purpose of illustrating the invention, it is shown as applied to radiant panel heaters 10. These heaters may be mounted on the ceiling, walls or other surfaces. In Fig. 3

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they are shown mounted on walls 11 of a room to overlie metallic foil reflectors 12 so as to be covered by any suitable heat transmitting finishing material, not shown, as may be desired.

In carrying out the invention, a plurality of warp strands 13 are arranged in a predetermined pattern. An attaching selvage 14, if desired, is formed at the bottom by having a dead filling 15 woven therein for a predetermined distance. A plurality of parallel, spaced resistance wires are then woven into the warp. While any required number of spaced parallel wires may be used, for the purpose of simplicity only two are illustrated herein. These wires are woven by first laying midportions 16, 17 thereof through the warp transversely across the unit in spaced parallel relation adjacent the selvage 14. The portions of the wire 16a, 16b and 17a, 17b at each end of the said intermediate portion are then alternately woven back and forth across the unit in spaced parallel relation for the desired length of the resistance unit and produces adjacent terminals 16c, 16d and 17c, 17d at the one end of the unit. This results in two continuous wires extending in spaced parallel relation from terminals 16c, 17c back and forth across the unit to said intermediate portions 16, 17 at the other end of the unit and similarly back and forth to the first end to terminals 16d, 17d.

The terminals can be connected by suitable means to provide separate circuits or series or parallel circuits in the panel. In the illustrated form of the invention the terminals 16c, 17c are connected together and to the cold lead 18 having an insulating sleeve 19 thereon and terminals 16d, 17d are connected together and to the cold lead 20 having an insulating sleeve 21 thus providing parallel circuits throughout the panel between the two cold leads. As shown in Fig. 1 the cold leads 18, 20 are located adjacent one another at the same end for easy connection and have portions woven into the fabric which anchor them therein thus providing a strain relief for the cold leads which prevents strains from being transmitted to the connections of the resistance wires to said cold leads.

If desired, an upper attaching selvage 22 formed by dead filling 23 may be woven into the warp adjacent the wire to hold it in place. Preferably, the upper and lower selvage are given a coating of an adhesive of any suitable type to adhere the warp and filling and prevent shifting thereof and unravelling of the unit. This is indicated at 24 in the detailed view of Fig. 2 by the stippling applied to the selvage. For example, the adhesive may be a low temperature curing varnish which is brushed over the same and set.

In order to provide for greater ease and more secure mounting of the elongate panel, dead filling 25 is woven into the unit at predetermined intervals therealong to produce, in addition to the selvages 14, 22, substantial attaching areas spaced throughout the panel and adapted to receive the fastening devices such as nails, staples or the like 26 without danger of contact with the wire or receive suitable adhesive to secure it in place on the wall. The dead fillings 25 are secured to the warps by adhesive in the same manner as in the attaching selvages.

The warp and dead filler may be of any suitable material, natural or synthetic, which will withstand heat. In the preferred form of the invention they are made of fiber glass which is

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strong and a good insulator. The wires may be of any suitable conducting material and may be bare or covered. In the preferred form of the invention they are formed of a resistance alloy and provided with a braided jacket of nylon which has good insulating properties and is stable through the heating ranges required in a heating panel.

Because of the use of parallel wires throughout, I have been able, by means of parallel circuits, to use wire which is of smaller diameter than heretofore required and which is spread over a large area and provides for low watt densities in the panel so that dangerous hot spots are avoided. These smaller wires result in a thinner structure which may be fitted into very narrow passages and which is highly advantageous when used as a radiant panel heater since it does not project any substantial amount from the wall and lends itself well to receiving a covering material.

Under some circumstances it may be desired to provide a panel with a heating surface which does not extend for the full area of the panel but which has a predetermined pattern. This is accomplished by extending the resistance wire filling in parallel relation only over the desired surface and by completing the surface of the panel by weaving in dead filling 27, as shown in Fig. 5, which may be adhered to the warp by suitable adhesive as indicated at 28 to fix the same against unravelling. If desired the section indicated by the dash lines may be cut out to provide a void to permit the same to be applied over a projection on the wall, such as a light switch, or form a passage for a pipe or the like.

In producing the woven resistance or heater unit of the present invention a novel method is employed wherein double shuttles are used for each of the parallel wires. The portions 16a, 17a and 16b and 17b of the wire on either side of the intermediate portion 16, 17 thereof which is laid in the warp adjacent the bottom selvage or starting point are wound on separate shuttles and the shuttles at each side are then moved alternately back and forth across the unit to lay in the filler of resistance wire in spaced parallel relation as shown in Fig. 1. It will be noted that at no point in the entire length of the unit do the wires cross one another but rather are always maintained in spaced parallel relation. Suitable dead filling may be woven in the unit as required and by selecting wires having proper ohmage, and by utilizing the required number of picks to the inch, the woven unit can be made with the wires distributed throughout the panel in any desired manner to produce the required heating surface. Furthermore, the lengths of the units can be varied at will since the two ends of the wires advance along the unit from the starting end in a uniform manner and will always produce adjacent terminals at the same end of the unit.

For some purposes it may be necessary to provide additional circuits in the panel. This can be accomplished by including tap means in one or more of the resistance wires whereby they can be divided into a plurality of circuits. In Fig. 4 is shown one such tap means in wire 16 which is cut and the ends connected to cold leads 29, 30 which have short portions woven into the warp to anchor them in place. By connecting these leads in the power supply either half of wire 16 may be utilized as a separate circuit.

The present invention lends itself well to panel heater units because of the great versatility of the circuits which may be obtained by the structure. Not only may different circuits be secured merely by connecting the terminals of the parallel wires in various circuit combinations, but the unit may be provided with wires of different ohmic resistance which may be selectively connected by suitable switch means, not shown, to a power source to produce a quick heat and a slow heat if required. Inasmuch as the wires extend throughout the whole area of the panel it will be effective in either circumstance to satisfactorily provide the heating condition demanded.

While the foregoing description has been limited to panel heaters, it is to be understood that the structure of the present invention is equally applicable to heaters of other types, for example, elongate heaters which are adapted to be wrapped around pipes or other structures for heating the same. Since fine wires are used in the unit they may be readily bent around pipes or the like to assist in the mounting thereof. Also the structure of the present invention is applicable for the purpose of a resistance unit since it provides a highly desirable structure in which a plurality of separate substantially identical circuits are provided having terminals which are located at one end and which unit will readily dissipate objectional heat therefrom and may be made very thin to fit in confined spaces such as may be encountered in meters or the like instruments.

Variations and modifications may be made within the scope of the claims and portions of the improvements may be used without others.

I claim:

1. A woven resistance unit comprising warp strands of insulating material and a continuous filling of resistance wire, said filling comprising a plurality of continuous spaced wires having intermediate portions laid in the warp across one end of the unit in parallel relation and the remaining portions of the resistance wires which are connected to each end of the intermediate portions being woven alternately back and forth across the unit in nested parallel relation to one another and to said intermediate portions throughout the unit to the other end of the unit to provide a plurality of resistance wires extending in parallel relation from said other end of the unit to the first end and back to said other end to produce terminals for the unit at said other end of the unit free of any return leads.

2. A woven resistance unit comprising warp strands of insulating material and a continuous filling of resistance wire, said filling comprising a plurality of continuous spaced wires having intermediate portions laid in the warp across one end of the unit in parallel relation and the remaining portions of the resistance wires which are connected to each end of the intermediate portions being woven alternately back and forth across the unit in nested parallel relation to one another and to said intermediate portions throughout the unit to the other end of the unit to provide a plurality of resistance wires extending in parallel relation from said other end of the unit to the first end and back to said other end to produce terminals for the unit at said other end of the unit free of any return leads; and means joining said terminals in a predetermined manner to connect said parallel resist-

ance wires together into required circuits in the unit.

3. A woven heater unit comprising warp strands of insulating material and a continuous filling of resistance wire, said filling comprising a plurality of continuous spaced wires having intermediate portions laid in the warp across one end of the unit in parallel relation and the remaining portions of the resistance wires which are connected to each end of the intermediate portions being woven alternately back and forth across the unit in nested parallel relation to one another and to said intermediate portions throughout the unit to the other end of the unit to provide a plurality of resistance wires extending in parallel relation from said other end of the unit to the first end and back to said other end to produce terminal portions at said other end of the unit free of any return leads; and insulated cold leads connecting the adjacent terminal portions of the parallel wires together to form parallel circuits thereby and provide a pair of terminals for the unit at said other end, said cold leads having portions interwoven with said warp strands to fix the leads therein and hold the insulation thereon against unintentional movement.

4. A woven heater unit comprising warp strands of insulating material and a continuous filling of resistance wire, said filling comprising a plurality of continuous spaced wires having intermediate portions laid in the warp across one end of the unit in parallel relation and the remaining portions of the resistance wires which are connected to each end of the intermediate portions being woven alternately back and forth across the unit in nested parallel relation to one another and to said intermediate portions throughout the unit to the other end of the unit to provide a plurality of resistance wires extending in parallel relation from said other end of the unit to the first end and back to said other end to produce terminals for the unit at said other end of the unit free of any return leads, portions of said wire filling extending for part of the width of the unit to provide a heating surface of predetermined shape, said unit having dead filling woven in the warp strands to complete the surface thereof.

5. An elongate woven radiant heater panel which comprises a series of warp strands of insulating material, a dead filling of insulating material at one end of the panel to form an attaching selvage; a continuous filling of heater wire, said filling comprising a plurality of continuous spaced strands of fine resistance wire having intermediate portions laid in the warp across the end of the panel adjacent said attaching selvage and in parallel relation and the remaining portions of the strands which are connected to each end of the intermediate portions being woven alternately back and forth across the panel in nested parallel relation to one another and to said intermediate portions throughout the panel to the other end of the panel to provide a plurality of resistance wires extending in parallel relation from said other end of the panel to the first end and back to said other end to produce terminals for the panel at said other end of the panel free of any return leads; and a dead filling of insulating material at the other end of the panel forming an attaching selvage at said other end.

6. An elongate woven radiant heater panel which comprises a series of warp strands of insulating material, a dead filling interwoven at one

end of the panel to form an attaching selvage; a heater surface comprising solely a filling formed of a plurality of spaced parallel fine strands of resistance wire having the midportions of the parallel wires extending across the panel adjacent the said selvage and having the remaining portions of the strands of resistance wire which are connected to each end of said midportions woven alternately back and forth across the panel in nested parallel relation to one another and to said midportions throughout the panel in a predetermined pattern to the other end of the panel to provide a plurality of circuits extending in parallel relation from said other end of the panel to the first end and back to said other end and having terminals at said other end of the panel free of any return leads; a dead filling woven in the warp to complete the pattern; a dead filling woven in the panel to extend thereacross at spaced intervals therealong to provide fastening zones free of wire; and a dead filling forming an attaching selvage at said other end.

7. An elongate woven radiant heater panel which comprises a series of warp strands of fiber glass, a dead filling woven at one end of the panel to form an attaching selvage; a filling comprising a plurality of spaced parallel strands of resistance wire covered with braided nylon and having the midportions of the parallel wires extending across the panel adjacent the said selvage and having the remaining portions of the strands of resistance wire which are connected to each end of said midportions woven alternately back and forth across the panel in nested parallel relation to one another and to said midportions throughout the panel in a predetermined pattern to the other end of the panel to provide a plurality of circuits extending in parallel relation from said other end of the panel to the first end and back to said other end to produce a plurality of circuits having terminals at said other end of the panel free of any return leads; a dead filling woven in the panel at spaced intervals therealong to provide fastening zones for the panel free of wire; and a dead filling woven at the other end and forming an attaching selvage for the panel at said other end.

8. The method of forming a woven resistance unit which comprises arranging a series of warp strands of insulating material, interweaving a plurality of spaced continuous parallel strands of resistance wire with said warp strands by weaving the midportions of the wires in spaced parallel

relation across the unit at one end and weaving the remaining portions of the strands of resistance wire which are connected to each end of the midportions alternately back and forth across the unit to lie in nested parallel relation to one another and to said midportions throughout the unit to the other end of the unit to provide a plurality of resistance wires extending in parallel relation from said other end of the unit to the first end and back to said other end to produce terminals for the unit at said other end of the unit free of any return leads.

9. The method of forming a woven heater unit which comprises arranging a series of warp strands of insulating material; weaving in the warp a dead filling of insulating material at one end of the unit to form a mounting selvage; interweaving into said warp a heater portion comprising solely a plurality of spaced continuous parallel strands of resistance wire by weaving the midportions of the wires in spaced parallel relation across the unit at one end and weaving the remaining portions of the strands of resistance wire which are connected to each end of the midportions alternately back and forth across the unit in a predetermined pattern to lie in nested parallel relation to one another and to said midportions throughout the unit to the other end of the unit to provide a plurality of resistance wires extending in parallel relation from said other end of the unit to the first end and back to said other end to produce terminals for the unit at said other end of the unit free of any return leads; and weaving in a dead filling of insulating material at said other end to form a second selvage.

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