June 9, 1964 L. P. HYNES 3,136,885

HEATER

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Fig. 1.

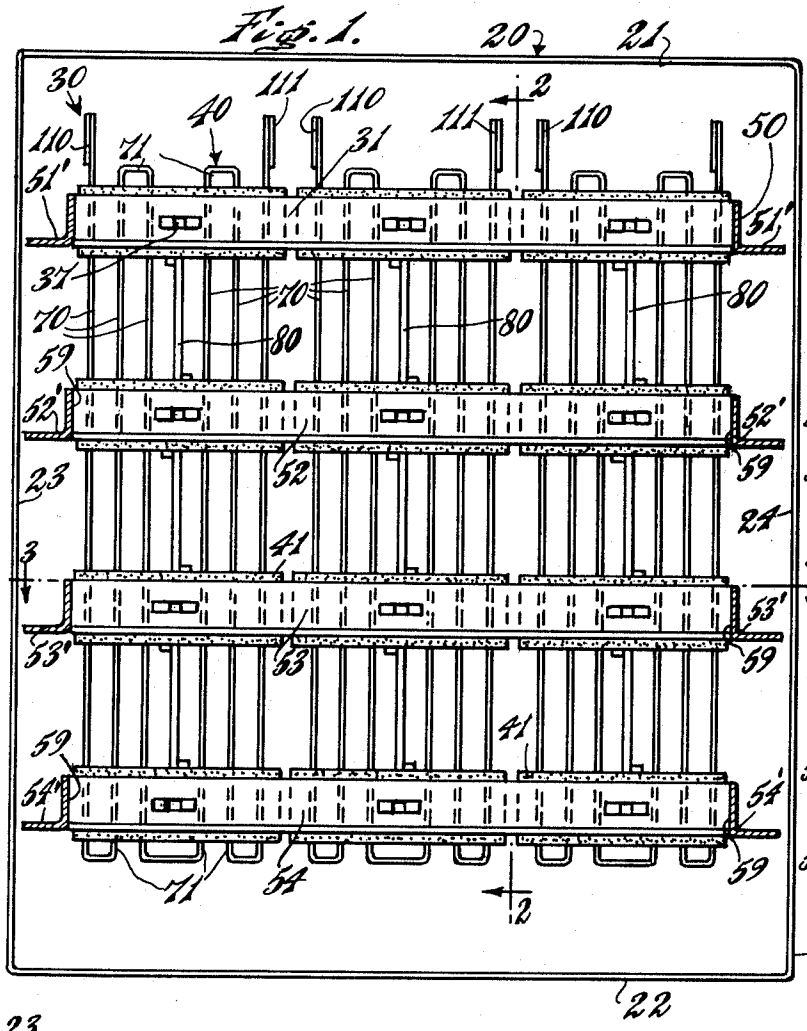


Fig. 2.

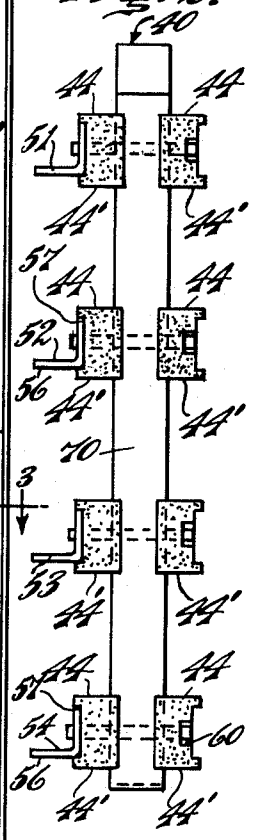
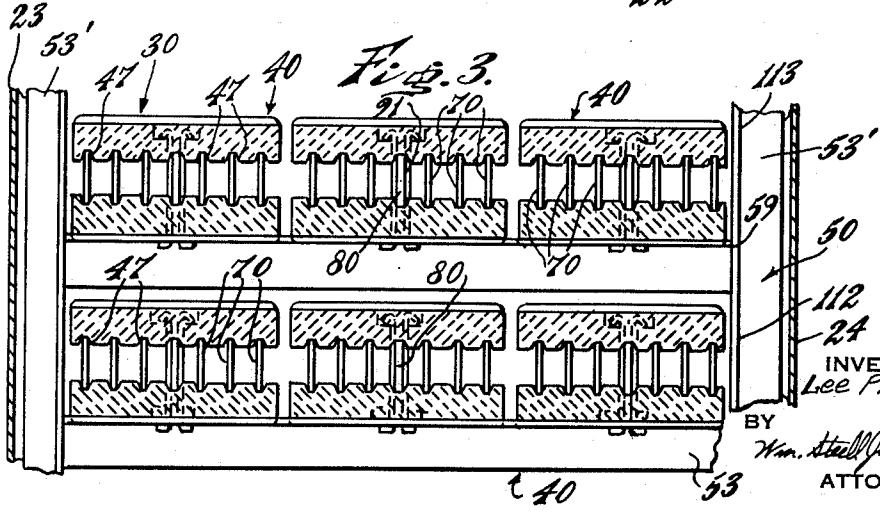


Fig. 3.



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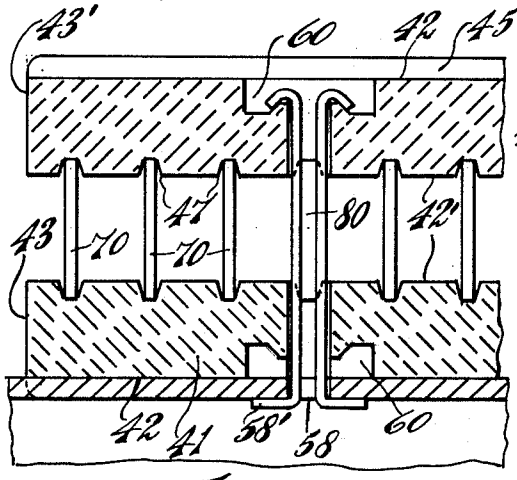


Fig. 4.

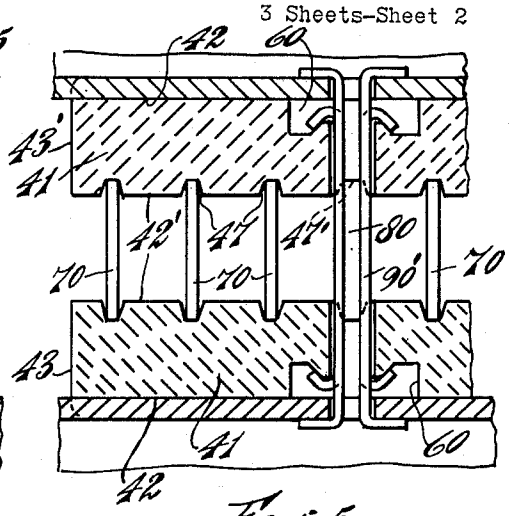


Fig. 5.

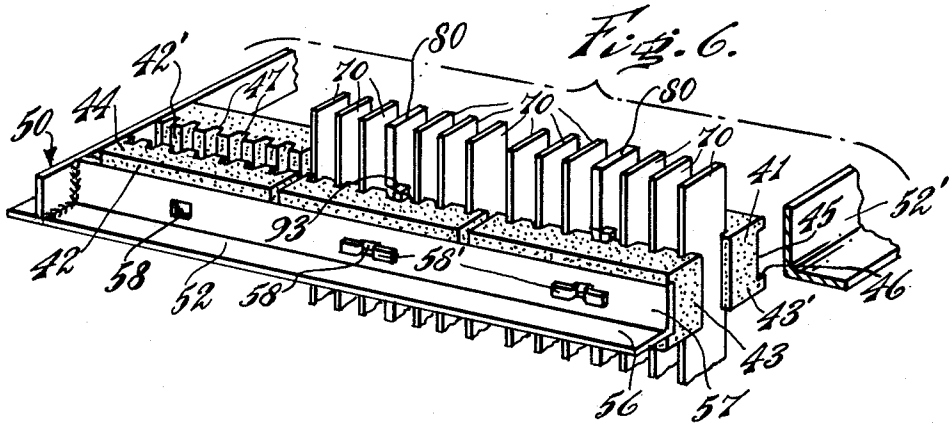
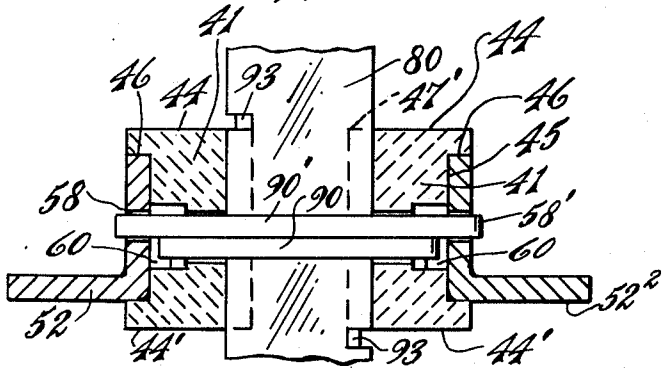


Fig. 6.

Fig. 7.



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Fig. 8.

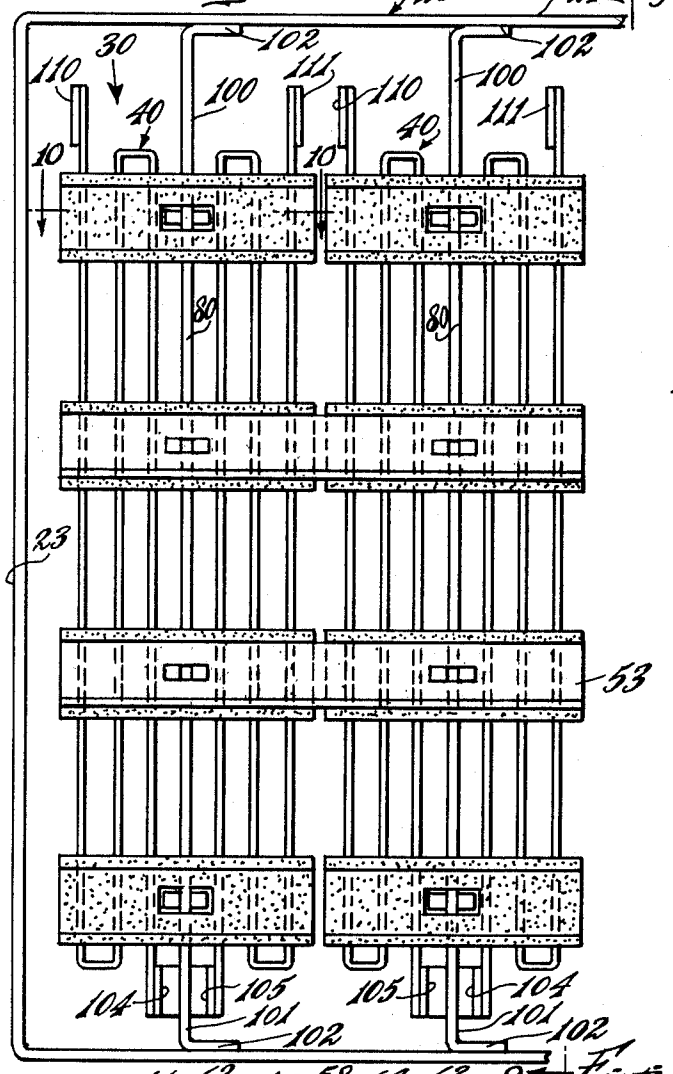


Fig. 9.

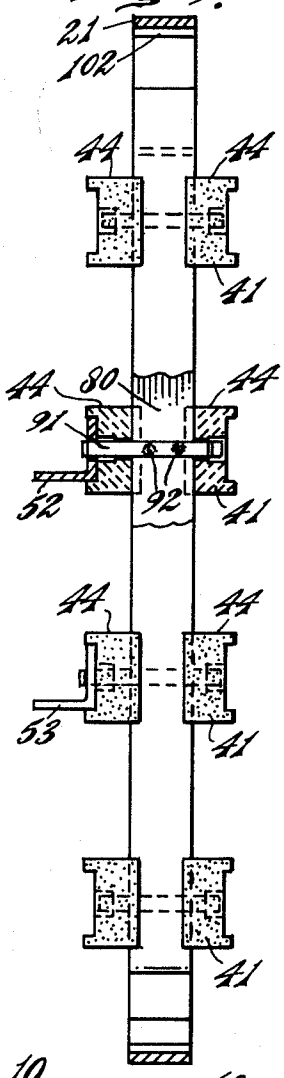
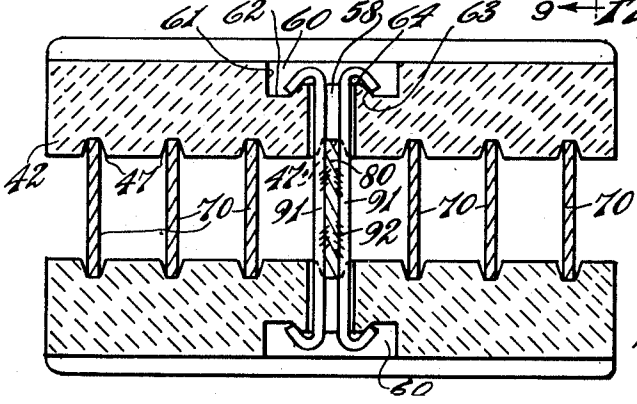


Fig. 10.



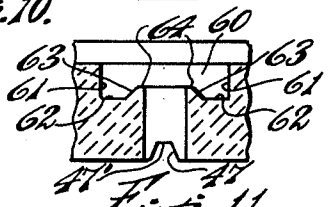


Fig. 11.

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United States Patent Office 3,136,885 Patented June 9, 1964

3,136,885
HEATER

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Filed Sept. 28, 1962, Ser. No. 226,933
5 Claims. (Cl. 219—382)

This invention pertains to a heater for gases and more particularly for the heating of low pressure air.

A purpose of the present invention is to utilize flat resistor ribbons in spaced heaters.

A further purpose is to support resistor ribbons from support elements held by insulators suspended from a frame.

A further purpose is to provide a flexible arrangement for a space heater wherein units can be added to form stages.

A further purpose is to simplify and reduce the cost of electric heaters suited for space heating in, for instance, a large dryer or dehumidifier or a large gas heater for process work or a large oven.

A further purpose is to provide a large grid work or structure for heating gas under low pressure.

A further purpose is to place a heater within an enclosure duct which in a high temperature installation could be of heat resisting material such as Inconel or stainless steel if required.

A further purpose is to provide buses whereby numerous different units can be connected in series or in parallel.

A further purpose is to provide a heater structure which can be used horizontally, vertically or inclined.

A further purpose is to set up a series of heaters in any conceivable number and in any conceivable length.

A further purpose is to utilize a support element of the same width as the resistor ribbon to provide structural support in the heater.

Further purposes appear in the specification and in the claims.

In the drawings I have chosen to illustrate a few only of the numerous embodiments in which my invention may appear, selecting the forms shown from the standpoints of convenience in illustration, satisfactory operation and clear demonstration of the principles involved.

FIGURE 1 is a transverse elevation of the heater of the invention installed in a duct.

FIGURE 2 is a vertical section taken on the line 2—2 of FIGURE 1.

FIGURE 3 is a plan section taken on the line 3—3 of FIGURE 1.

FIGURE 4 is a fragmentary section showing the fastener of the invention.

FIGURE 5 is a fragmentary section similar to FIGURE 4 showing the insulator blocks supported by the cross bracing.

FIGURE 6 is a fragmentary perspective showing the ribbons and structural element in contact with the insulator blocks.

FIGURE 7 is a fragmentary elevation showing the use of two fasteners in a single opening.

FIGURE 8 is a partial elevational view taken transversely of the duct showing a modified embodiment of the invention.

FIGURE 9 is an enlarged fragmentary section taken on the line 9—9 of FIGURE 8.

FIGURE 10 is a sectional view of the resistor ribbons, support element and insulator blocks of the invention.

FIGURE 11 is an enlarged fragmentary section showing the fastener receiving recess of the insulator block of the invention.

In the prior art, large area heating in industrial and research applications has been done with small finned tubes carrying steam. In many instances it has been necessary to duplicate electrically these steam units. Electrical heater bars of sufficient cross section to possess the necessary inherent structural strength have been used, but these have been limited in most instances to approximately 24 inches in length, and in order to cover a large area it was necessary to use many leads and terminals to arrange the bars in series. These prior art resistor grids have used the same element to provide the electrical and structural characteristics.

The present invention utilizes large ribbon resistors which do not support themselves but rather are supported by separate support elements. This support can be a straight bar of approximately the same width as the resistor ribbon which is required for the particular application. The invention makes use of resistor ribbons having very little structural strength for electrical requirements and utilizes separate support elements for the strength requirements. These resistor ribbons and support elements are suspended from a frame through insulator blocks.

The thickness of one of the heater units in the direction of air flow is, for instance, 3 inches and a very compact assembly can be arranged by putting several rows of these units in close alignment so that each row can act as a heater stage.

Prior art electric heaters have utilized electric resistors which generally have been of spirally wound round wire. The present invention utilizes resistor ribbons which are arranged in a parallel relationship about the center support element, the ribbons being held with respect to the support element by a series of ceramic insulators which in turn are supported by cross angles. The cross angles in turn are all joined together to form a longitudinally extending frame. In effect, a frame of transverse and longitudinally extending angles are erected which support the ceramic insulators which in turn support the resistor ribbons. In some instances, it may be conceivable under certain circumstances that the heaters may be directly supported from the enclosure duct by extending the support element.

Referring to the drawings, the heater of the invention is mounted in a duct **20**. This duct **20** is permissibly of any cross sectional shape but desirably of rectangular cross section. The duct is formed of any heat resisting material such as Inconel or stainless steel and is of any length. The duct may extend in any direction and, for instance, would be vertical or horizontal or inclined at any angle. The duct generally would be of the type which conducts a low pressure air flow.

The ducts have parallel sides **21** and **22** and parallel sides **23** and **24**. The cross sectional dimension of the duct may be, for example, 5 feet in one direction and 6 feet in the transverse direction, but any desirable dimensions could be used.

Within the duct **20** is a heater **30**. The heater **30** is comprised of heater units **40** and a frame **50**. Each of the heater units **40** comprises paired insulator blocks **41** of generally rectangular form spaced longitudinally along the heater unit. The insulator blocks **41** have first and second parallel extending faces **42** and **42'**, and faces **43** and **43'** and opposed parallel faces **44** and **44'**. The face **42** has a longitudinally extending groove **45**. The groove **45** extends to a depth **46** to receive a brace as later described. The face **42'** has slots **47** extending in parallel spaced relationship transversely of the block. The blocks are arranged in opposed pairs and receive resistor ribbons **70** and support element **80**. At the face adjacent the groove **45** a recess **60** is placed to receive a fastening element as will be explained.

The recess as best seen in FIGURE 10 has sides 61, a bottom 62, inclined faces 63 and a flat shoulder 64. On the opposite side of insulator 41, a slot 47' adapted to receive the support element 80 as later explained is placed. The electrical resistor ribbons 70 can be permissibly of one long ribbon bent in serpentine fashion as, for instance, at 71 or the ribbon 70 may be one of a plurality of ribbon segments joined together at the bends 71 by heliarc welding or the like. The resistor ribbons 70 are generally of rectangular cross-section and have a large dimension in one direction compared to the dimension in a transverse direction.

A support element 80 consisting of steel or other structurally strong metal extends between the paired insulator blocks into the groove 47. The element 80 is approximately the same width as the resistor ribbons 70 but is desirably of greater thickness to provide stiffness to the heater unit.

The serpentine extending resistor ribbon 70 and the support element 80 are held in a spaced parallel relationship by the insulator blocks 41. The paired insulator blocks 41 are spaced longitudinally along the resistor ribbon 70 and the support element 80 to provide a rigid assembly. The blocks 41, ribbons 70 and support element 80 are all held together by fasteners 90. The fasteners 90 comprise thin metal strips 91 which extend transversely along each side of the support element 80, as best seen in FIGURE 9. The strips 91 extend through the transverse opening in the insulator blocks and are bent back at their ends into the recess 60 along the sloping shoulder 63. In this manner, the blocks are held securely to the support element 80 and in turn support the resistor ribbons 70. The fasteners 90 may be held to the support bars 80 by welding as at 92 as seen in FIGURE 9 or in an alternative form as seen in FIGURE 7. In this form, the support elements 80 may be lanced at 93 to provide abutments for positioning the insulator blocks 41 longitudinally on the support element with the strips 91 extending only in abutting contact with the support element but not connected in any way. Where the strips 91 are welded to the element it will be seen that the insulators will have to be placed over the strips which have been initially welded to the element whereas if the element is lanced to position the insulator blocks, the fastener may be inserted into position after the blocks, support element and ribbons have been assembled. In the latter case, the bends at one end of the fastener may be prefabricated.

In the embodiment shown, there is one support element 80 only per pair of insulator blocks 41 but it should be understood that any number of support elements may be used.

The heater units 40 are supported from a frame 50 having cross braces 51, 52, 53 and 54. These cross braces are suitably of angle cross section having a first flange 56 and a second flange 57 disposed at right angles to the first flange. The braces 51 to 54 extend in a parallel relationship with the flanges 57 extending in a common plane. The braces have openings 58 adapted to receive the fasteners 90. Extending at right angles to the cross braces 51 to 54 are longitudinal braces 51', 52', 53' and 54'. The longitudinal braces receive the ends of the cross braces and are attached thereto as by welding or the like at 59. The cross braces 51 to 54 engage the slots 45 in the faces 42 of the insulator blocks 41. The flange 57 of the bracing lies in the groove and the depth of the groove is desirably the same as the thickness of the flange 57. The heater units 40 are held to the braces 52 to 56 by the fasteners 90 which extend through the openings 58 and which are spread apart to lie against the flange at 58'.

Where desirable, a second cross brace 52^2 is used in a position opposed to the cross brace 52 as best seen in FIGURE 7. A similar cross brace is used along the other insulator blocks 41 opposed to the braces 51, 53 and 54. The cross brace 52^2 is joined to the longitudinal brace 52' in the same manner as the cross brace 52 as by welding or the like.

In some instances, a first fastener 90 may be used through the same opening to hold a pair of insulators together around the ribbons 70 and the support element 80 and another fastener 90' may be used to join the heater unit 40 to the cross bracing.

Where two cross braces are used opposed to one another as, for instance, in FIGURE 5, one fastener 90 may be used to secure the insulator blocks 41 in supporting relationship to the resistor ribbons and the supporting element while another fastener 90' passing through the same hole as the first fastener 90 may be used to hold the entire heater unit 40 to the cross braces.

In an alternative embodiment of the invention, as shown in FIGURES 8 and 9, the structural element 80 extends beyond the insulator blocks 41 at 100 and 101 at the ends of the heater units 40 and the element 80 is connected directly to the duct 20 by welding or the like at 102. In this embodiment no need for longitudinal braces 51', 52', 53' and 54' exists. Cross braces 52 and 53 may be desirably used to join the individual heater units 40 into a more rigid structure. In this embodiment, the insulator blocks 41 support the resistor ribbon 70 and the insulator blocks 41 are in turn supported from the support element 80 in the same manner as earlier described. However, instead of a continuous serpentine arrangement of the resistor ribbons 70 there is provided a jumper 104 for suitably connecting the resistor ribbons around the support element 80. The jumper 104 is of a U shape in cross section. The jumper is connected to the resistor ribbon by heliarc welding or the like at 105.

Suitable electrical connections are made to the heater units 40 at 110 and 111. These connections can take the form of bus bars heliarc welded to the heater units or they may be bolted or otherwise joined.

Any number of heater units can be connected in series or in parallel as desired. The heaters could be arranged in banks 112, 113 as shown in FIGURE 3. Any number of such banks of heaters can be spaced longitudinally in the duct 20. The cross bracing would be supported throughout the length of the heater unit 30 from the longitudinal braces. Any suitable means such as vertical posts may be used to support the longitudinally extending braces from the duct work or from any other foundation.

It should be understood that a cross bracing and longitudinal bracing shown is merely illustrative and any number of cross braces and longitudinal braces could be used in the heater of the invention.

In view of my invention and disclosure, variations and modifications to meet individual whim or particular need will doubtless become evident to others skilled in the art, to obtain all or part of the benefits of my invention without copying the structure shown, and I, therefore, claim all such insofar as they fall within the reasonable spirit and scope of my claims.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. In a heater for gases passing longitudinally through a duct, a frame including longitudinally extending members extending longitudinally of the duct and transversely extending members supported from the longitudinally extending members and extending transversely to the duct and parallel to each other and grouped in a series of parallel planes normal to the flow of gases through the duct, insulator blocks having grooves and grouped in pairs and forming resistor ribbon receiving grooves and support element receiving grooves, spaced, parallel, resistor ribbons in the insulator block resistor ribbon receiving grooves and extending between the transversely extending members in one of said parallel planes, each of said resistor ribbons having a rectangular cross section of which the major dimension is parallel to the flow of gases through the duct, support elements extending parallel to

and spaced from the resistor ribbons in the insulator block support element receiving grooves and supporting the pairs of insulator blocks in spaced relationship to the resistor ribbons, and fasteners securing the insulator blocks and the support elements to the transversely extending members whereby the resistor ribbons are supported from the insulator blocks.

2. A heater of claim 1, wherein the insulator blocks have fastener receiving recesses.

3. A heater of claim 1, wherein the fasteners are strip fasteners and are welded to the support element.

4. A heater of claim 1, wherein the support element has lanced portions to longitudinally position the insulator blocks.

5. A heater of claim 1, wherein opposed walls of the heater form the longitudinally extending members.

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