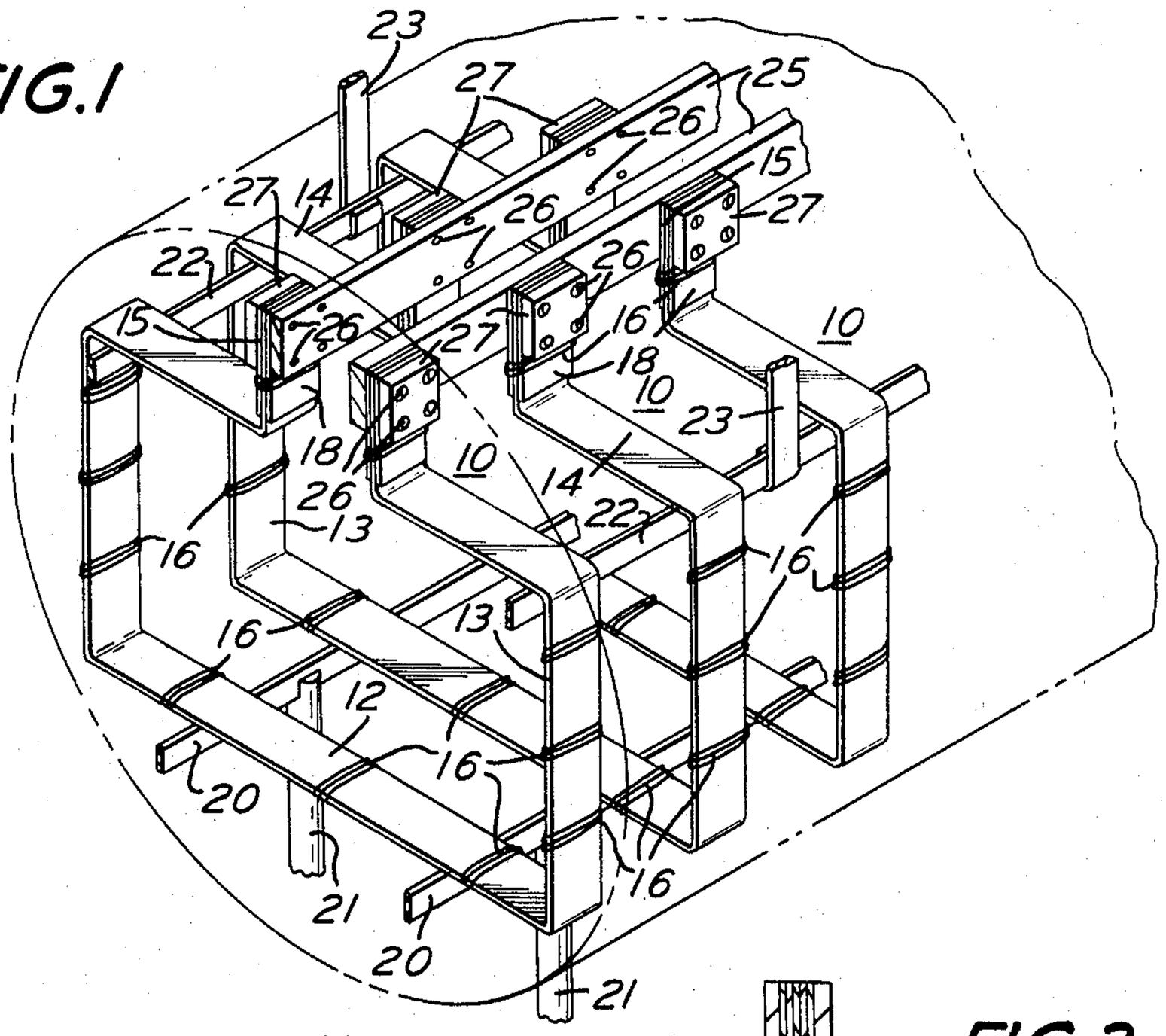
Nov. 4, 1969 E. N. CYRWAY, JR., ET AL 3,476,862

ELECTRIC RESISTANCE HEATING ELEMENTS

Filed May 16, 1968 2 Sheets-Sheet 1

FIG.1



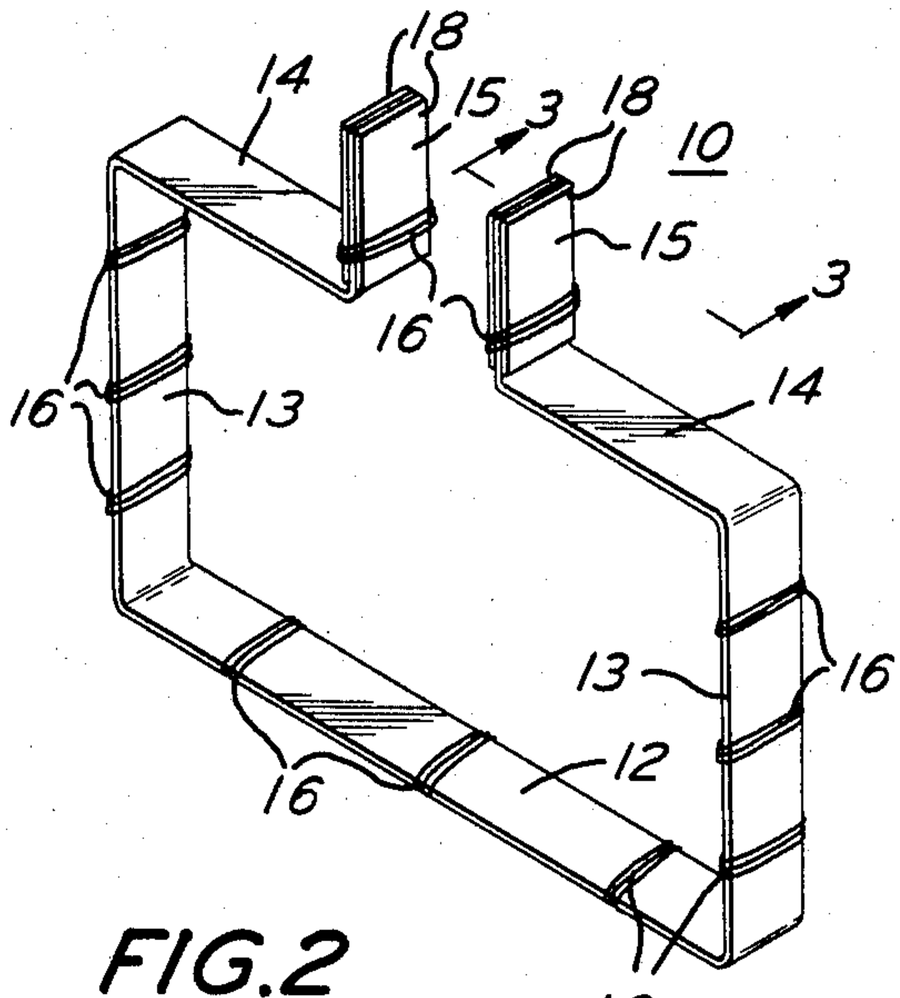
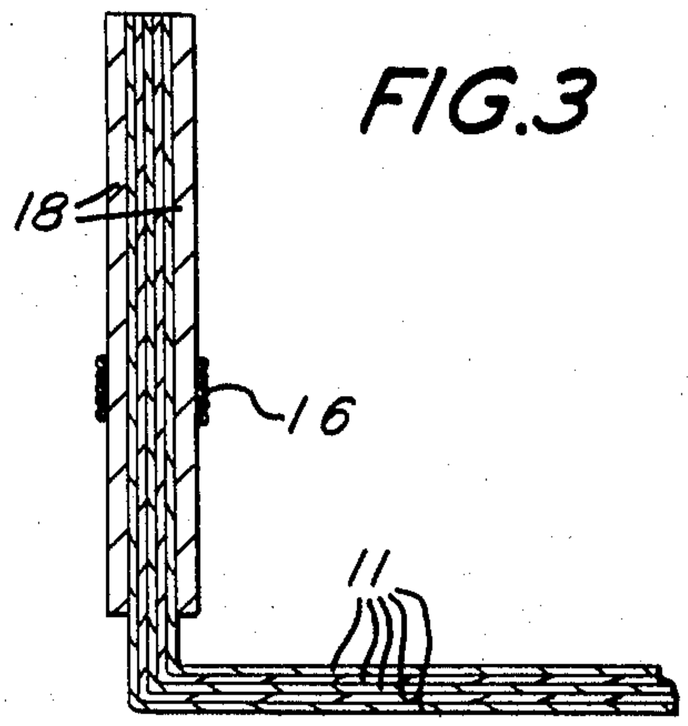


FIG.2

FIG.3



INVENTORS.
EDWARD N. CYRWAY, JR.
WILLIAM J. METALSKY

BY E. J. W. Lewis

ATTORNEY

Nov. 4, 1969 E. N. CYRWAY, JR., ET AL 3,476,862

ELECTRIC RESISTANCE HEATING ELEMENTS

Filed May 16, 1968 2 Sheets-Sheet 2

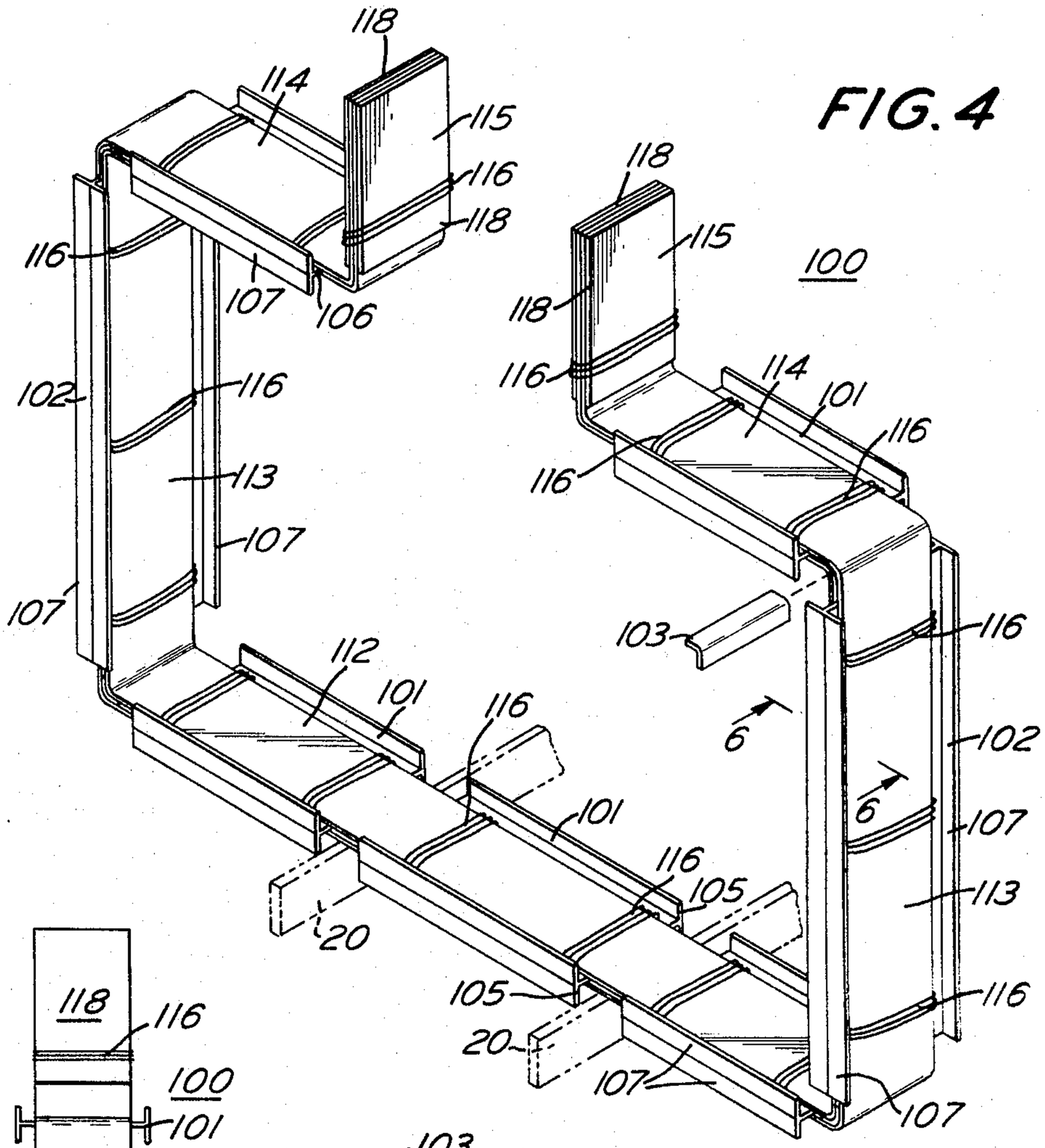


FIG. 4

FIG. 6

FIG. 5

INVENTORS
EDWARD N. CYRWAY, JR.
WILLIAM J. METALSKY

BY B. T. Wolensmith 2nd

ATTORNEY

United States Patent Office

3,476,862
Patented Nov. 4, 1969

3,476,862

ELECTRIC RESISTANCE HEATING ELEMENTS

Edward N. Cyrway, Jr., Levittown, and William J. Metalsky, Elkins Park, Pa., assignors to Abar Corporation, Feasterville, Pa., a corporation of Pennsylvania

Filed May 16, 1968, Ser. No. 729,736
Int. Cl. H05b *3/66, 3/10*
U.S. Cl. 13—25 10 Claims

ABSTRACT OF THE DISCLOSURE

Resistance heating elements particularly suited for use in high temperature vacuum and other furnaces which comprise, for each element, a plurality of thin strips of tungsten metal in laminar arrangement, secured together with tantalum wire and having reinforced electrical contact points.

BACKGROUND OF THE INVENTION

Field of the invention

This invention relates to resistance heating elements for use in vacuum and other high temperature furnaces.

Description of the prior art

In the treatment of metal parts for use in space vehicles and other extreme service applications the parts must be thoroughly and completely heated to a high temperature in a relatively neutral atmosphere or vacuum, and then cooled or quenched at a selected rate.

Heating elements of tungsten have heretofore been used for furnace heating. One example of elements used in vacuum furnaces is that shown in the U.S. Patent to Charles A. S. Hill, No. 3,155,758, where interlocking elements of tungsten strip in a cage like structure are shown. While such a structure is useful in the quantity of tungsten required in a large furnace of the present type with the Hill structure would make it prohibitively expensive.

Tungsten is a very difficult metal to work and cannot be bent unless it is thin. Thick sheets will crack along the bend line rendering them useless for heating. With the elevated temperatures involved and the quantity of heat required a single thickness of element will not provide sufficient heat and may warp or sag under load. The heating element of the present invention provides ample heat, is readily fabricated and overcomes the disadvantage of prior elements.

SUMMARY OF THE INVENTION

The present invention relates to resistance heating elements for use in vacuum and other furnaces where high heat is required which elements are composed of formed strips of tungsten metal secured together in laminar arrangement.

The principal object of the present invention is to provide resistance heating elements for vacuum furnaces that will have a long useful life, are easily fabricated, and will be free from other difficulties heretofore encountered in this field.

It is a further object of the present invention to provide resistance heating elements for vacuum furnaces which are sturdy in construction and free from difficulties in use.

It is a further object of the present invention to provide resistance heating elements for vacuum furnaces which accommodate to the elevated temperatures with minimum distortions, and which are fabricated and supported in a manner which decreases the likelihood of failure.

It is a further object of the present invention to provide resistance heating elements for vacuum furnaces which

are free from expansive restraints and which have increased current carrying capacity.

It is a further object of the present invention to provide resistance heating elements for vacuum furnaces which are assembled without welding, brazing, or other metal fusion operations.

Other objects and advantageous features of the invention will be apparent from the description and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

The nature and characteristic features of the invention will be more readily understood from the following description taken in connection with the accompanying drawings forming part thereof, in which:

FIGURE 1 is a view in perspective of a plurality of heating elements of the present invention in place in a furnace;

FIG. 2 is a view in perspective of one form of a single heating element of the present invention;

FIG. 3 is an enlarged vertical sectional view taken approximately on the line **3—3** of FIG. 2;

FIG. 4 is an enlarged view in perspective of another form of a single heating element of the present invention;

FIG. 5 is a side elevational view of the element shown in FIG. 4; and

FIG. 6 is a vertical sectional view taken approximately on the line **6—6** of FIG. 4.

It should, of course, be understood that the description and drawings herein are illustrative merely, and that various modifications and changes can be made in the structure disclosed without departing from the spirit of the invention.

Like numerals refer to like parts throughout the several views.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now more particularly to the drawings and FIGS. 1 to 3 thereof, a plurality of heating elements **10** are shown in place in FIG. 1 in a typical furnace installation with the interior space in the furnace (not shown) indicated in broken lines. The elements **10** are composed of a plurality of strips **11** of thin tungsten metal. in the embodiment illustrated each of the strips **11** is of a thickness of ten one-thousandths (0.010) of an inch and of a width of one and one-half inches. In this thickness the tungsten can be readily formed by bending and without breakage. The strips **11** each have flat horizontal bottom members **12** with opposite vertical side wall members **13** connected thereto, horizontal inwardly extending top members **14** connected to side members **13** and vertical electrical connecting portions **15**. In a particular embodiment there are five strips **11**, as shown more clearly in FIGS. 2 and 3, which are retained or held together at intervals by coils **16** of wire which may be of tungsten or tantalum metal and free to expand when heated relative to the expansion of the strips **11**. The wire may be of approximately thirty-thousandths (0.030) of an inch in diameter in the embodiment illustrated.

The connecting portions **15** are each provided with a pair of contact plates **18** located respectively on the inside and outside strips **11** of the element **10** to provide a reinforced connection for attachment to a source of electrical energy (not shown). As shown in FIG. 1 the bottom members **12** of the elements **10** are supported on horizontal bars **20** which extend lengthwise inside the furnace (not shown) and are engaged by vertical rods **21**. The rods **21** are mounted to the furnace (not shown) in well-known manner and so as to remain stationary and not transfer heat out of the furnace interior.

The elements **10** are additionally supported in suspension at their top members **14** by horizontal bars **22** car-

ried by hangers **23** mounted in the wall of the furnace (not shown). The elements **10** are free to slide along and across bars **20** and **22** during heating and cooling and are not restrained from such movement by the bars.

The vertical connecting portions **15** with contact plates **18** are each engaged by horizontally extending buss bars **25** which are secured to plates **18** by screws **26** and plates **27**. The buss bars **25** extend to a source of electrical energy (not shown) for energizing the elements **10**.

Referring now more particularly to FIGS. 4 to 6 of the drawings another form of heating element **100** is there illustrated. The element **100** is comprised of a plurality of strips **111** like the strips **11** heretofore described and in addition has horizontal and vertical retainers **101** and **102** and spacers **103** to provide enhanced strip retention and performance.

The retainers **101** and **102** and spacers **103** are formed of tungsten metal and may be of twice the thickness of one of the strips **111**. The retainers **101** are located between the innermost second and third strips **111** at their top members **114** and also at their bottom members **112** between the horizontal furnace bars **20**. The retainers **101** are formed of two U-shaped plates **105** which have center section **106** and vertically extending flanges **107** on each side of section **106**. The retainers **101** have the plates **105** oriented so that the pairs of flanges **107** on sections **106** extend in opposite directions. Holes **108** are provided in center section **106** adjacent flanges **107** to permit coils **116** of tungsten or tantalum wire to pass therethrough and retain the strips **111** and retainers **101** together.

The retainers **102** are of the same configuration as retainers **101** but of greater length and with an additional pair of holes **108**. The retainers **102** are located between the innermost second and third strips **111** at the side members **13**.

The spacers **103** are located at the four corners of the element **100**, are of L-shaped configuration and of the same thickness as retainers **101** and **102**.

The spacers **103** contact the ends of the elements **101** and **102** serving to hold them in place and provide support for the strips **111** at the corners.

The elements **100** have connecting portion **115** with contact plates **118** thereon for connection to a source of electrical energy (not shown) as described for element **10**.

It should be noted that the elements **10** or **100** and strips **111** or **11** may be used for temperatures from room temperature to about 4,000° F. and the elements **10** or **100** and strips **11** or **111** do not sag or droop from the heat. The elements **10** and **100** have been observed to sustain an electrical energy input of 70 kw. without distortion.

In fabricating the elements **10** and **100** the strips **11** or **111** are individually bent to the configuration shown and described in the specification and drawing and the strips **11** or **111** assembled together by securing with coils **16** of tungsten or tantalum wire. The plates **18** are also secured with a coil **16** of tungsten or tantalum wire, the resulting elements **10** and **100** since they did not require welding or fusion treatment, permits of long continued operation as no strain points are present and therefore there is no failure due to expansion and contraction of the strips **11** or **111**.

It will thus be seen that structure has been provided with which the objects of the invention are attained.

We claim:

1. A resistance heating element for use in a high temperature furnace which comprises

a plurality of continuous strips of metal in laminar arrangement,

said strips each having a horizontal bottom portion, opposite vertical side portions extending upwardly from the bottom portion, horizontal portions extending inwardly from the side portions, and vertical electrical connecting portions extending upwardly from said horizontal portions, and

retaining means at spaced locations on said strips holding the strips against relative displacement.

2. A resistance heating element as defined in claim **1** in which

said metal strips are of tungsten.

3. A resistance heating element as defined in claim **2** in which

said strips are of a thickness of the order of ten one-thousandths of an inch.

4. A resistance heating element as defined in claim **3** in which

said strips are of a width of the order of one and one-half inches.

5. A resistance heating element as defined in claim **1** in which

said retaining means is coils of tungsten wire.

6. A resistance heating element as defined in claim **1** in which

said retaining means is coils of tantalum wire.

7. A resistance heating element as defined in claim **1** in which

said electrical connecting portions at their upper ends have at least one plate of tungsten secured thereto.

8. A resistance heating element as defined in claim **1** in which

said electrical connecting portions have supporting members connected thereto.

9. A resistance heating element as defined in claim **8** in which

said horizontal portions have additional supporting members in engagement therewith.

10. A resistance heating element as defined in claim **1** in which

said retaining means is a plurality of spaced retainers of U shape with coils of wire extending through holes therein and around said strips; and

spacers are provided to bridge the space between said retainers.

References Cited

UNITED STATES PATENTS

3,263,015 7/1966 Hill ---------- 13—25

BERNARD A. GILHEANY, Primary Examiner

H. B. GILSON, Assistant Examiner

U.S. Cl. X.R.

219—552