Aug. 19, 1969 TOSHIO SHIBATA ETAL 3,462,580

HEATER ASSEMBLY FOR COPYING MACHINES

Filed Nov. 27, 1967 2 Sheets-Sheet 1

FIG. 1

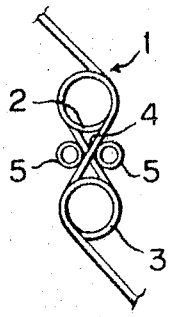


FIG. 2

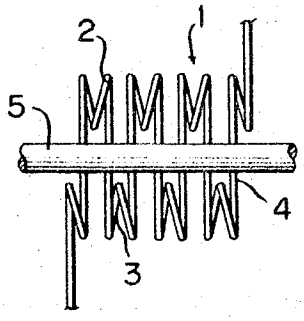
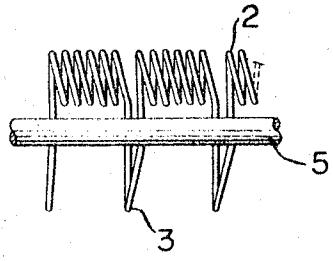


FIG. 4



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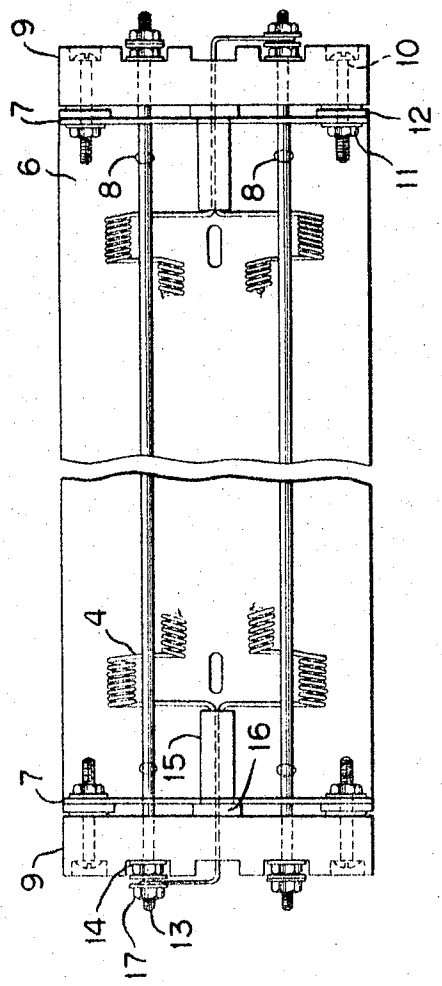
By
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FIG. 3



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HEATER ASSEMBLY FOR COPYING MACHINES

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Claims priority, application Japan, Nov. 29, 1966 (utility model), 41/108,845
Int. Cl. H05b 3/02
U.S. Cl. 219—216 5 Claims

ABSTRACT OF THE DISCLOSURE

A heater assembly for use in copying machines. The heater assembly comprises a heater coil formed of electrical resistance wire. The coil consists of a multiplicity of first helical windings, each having more than one turn and arranged around a first common axis in axially spaced relationship, and a multiplicity of second helical windings, each arranged around a second common axis in axially spaced relationship. The second common axis is parallel to and positioned at a distance from the first common axis. Each of the second helical windings includes end portions interconnecting the ends of two adjacent helical windings in a manner such that the heater coil consisting of the first and second helical windings has an 8-shaped profile in transverse cross-section. A pair of refractory support members extends axially of the coil and engages the end portions from outside thereof.

This invention relates to a heater assembly for use in copying machines.

It has heretofore been conventional to use an infra-red lamp or electrical resistance wire as heater in the developer of thermally developing diazo copying machines or in the fixing unit of electrophotographic copying machines. Infra-red lamps provide a rapid heater in that the lamp becomes usable within one second from application of the voltage thereto, thus minimizing time lag, but are expensive and have small mechanical strength at seal welds. An electrical resistance wire used in the prior art is known to have a relatively large time lag of from thirty seconds to one minute until it can be used as a heater. This is because such wire is usually confined in a quartz tube which represents a large heat capacity so that the heater temperature is not stabilized until the quartz tube itself is heated sufficiently. It has been also proposed, as disclosed in U.S. Patent No. 2,965,868 issued to R. W. Eichler on Dec. 20, 1960, to use a quartz tube which is surrounded by a coil of heater material. Although this arrangement has improved time lag factor, it has not sufficient mechanical strength because the coil is supported in suspended form by the quartz tube at spaced apart points of contact therewith.

Therefore, it is an object of the invention to provide an improved heater assembly which is inexpensive and minimizes distortion of a heater coil, while achieving a high heater efficiency.

According to the invention, there is provided a heater assembly for use in copying machines comprising a heater coil formed of electrical resistance wire, said coil consisting of a multiplicity of first helical windings each having more than one turn and arranged around a common axis in axially spaced relationship and a multiplicity of second helical windings each arranged around another common axis in axially spaced relationship, said another axis being parallel to and positioned at a distance from the first mentioned axis, each of said second helical windings including end portions interconnecting the ends of two adjacent first helical windings in a manner such that the heater coil consisting of the first and second helical windings has an 8-shaped profile in transverse cross-section, and a pair of refractory support members extending axially of the coil and engaging said end portions from outside thereof.

The above and other objects, features and advantages of the invention will become apparent from the following description of embodiments thereof shown in the drawing, wherein

FIG. 1 is an end view of a heater coil according to one embodiment of the invention and showing the profile of the heater coil,

FIG. 2 is a side elevation of the heater coil shown in FIG. 1,

FIG. 3 is a plan view, partly cut away, of a heater assembly incorporating heater coils of the type shown in FIGS. 1 and 2, and

FIG. 4 is a side elevation of another heater coil according to the invention.

Referring to FIGS. 1 and 2, there is shown a heater coil **1** formed of an electrical resistance wire in a configuration as taught by the invention. Thus the coil **1** has upper andl ower helical windings **2**, **3** which are interconnected by substantially straight portions **4**. The upper windings **2** are aligned on an axis indicated by a chain line as are the lower windings **3** on another axis. It will be appreciated that the opposite ends of one upper helical winding **2** lead to one end, respectively, of a pair of adjacent lower helical windings **3** through a pair of wire portions **4** in a configuration such that the coil has an 8-shaped profile in its transverse cross-section, with such wire portions **4** forming a crossing as the coil is viewed in its longitudinal direction, that is, in FIG. 1. A pair of support members **5** whih may be tubes or rods made from electrically insulating and refractory materials such as quartz or ceramics are arranged on both sides of said crossing for engagement with the wire portions **4** so that the support members **5** and hold the coil **1** pinched therebetween. Helical windings **2** and **3** may include more than one turn, as shown in FIGS. 1 and 2, and the number of turns in each individual helical winding is selected to provide a self-holding structure which does not flex upon energization of the heater coil and during use. Although the upper limit on the number of turns in a single helical winding depends upon the wire material and thickness, the diameter of the winding and the heating temperature, it was found that when a Nichrome wire of 0.4 mm. thick was used at a close pitch, as many as 15 to 20 turns provided a self-holding structure. However, when the same total length of Nichrome wire and same diameter of the winding are maintained, the provision of a number of turns in excess of eight turns did not bring about a significant increase in heating temperature achieved, although up to 15 turns may be used effectively with further decrease in diameter of the winding. On the other hand, an appreciable decrease in heating temperature was observed when the number of turns in one helical winding was reduced below five. It is to be noted that the refractory support members **5** have a relatively small diameter so as to contact the coil **1** only at the wire portions **4** thereof and yet are capable of securely holding the coil by virtue of its configuration. The coil configuration according to the invention further provides the advantage that the points of contact between the coil and the support mmebers can be greatly reduced, and the upper and lower helical windings **2**, **3** each comprising a number of turns are effectively exposed for heat radiation without being contacted by support means. This allows the heat assembly incorporating such heater coil to heat up within a shorter time period than when each turn of the coil is contacted by support means.

FIG. 3 shows a heater assembly according to the in-

vention. The heater assembly includes two heater coils of the type shown in FIGS. 1 and 2, but each helical winding of the respective heater coil has eight turns. Two heater coils run parallel to each other and in parallel and spaced relationship to a reflecting metal plate **6** which has flanges **7** at both ends. To hold each heater coil firmly, a pair of refractory support members **5** engage wire portions **4** as before, although this figure shows only one of such members, and two members **5** of the pair are fastened together by wire loops **8** which are arranged at suitable intervals along the length of the members. Preferably such wire loop **8** is formed by surrounding the members with a wire at the position where they engage the wire portion **4** and twisting both ends of the wire. A pair of insulating plates **9** are secured to the flanges **7** by suitable means, such as set screws **10** and nuts **11**, through interposition of spacers and washers **12**. One of the support members **5** of a pair has its both ends extending through openings in the flanges **7** and through aligned bores in the insulating plates **9** to be supported and secured by bolts **13** and nuts **14**. Intermediate between two rows of support members **5**, a pair of sleeves **15** of insulating material such as ceramics extend through openings in the flanges **7** and have their portions **16** of an enlarged diameter held between the flanges **7** and the inner surfaces of the insulating plates **9**. The ends of the two heater coils are passed through the sleeves **15** and aligned bores in the insulating plates **9** to be wound around the bolts **13** and secured by nuts **17**. Thus two coils are electrically connected in parallel.

FIG. 4 shows another form of heater coil according to the invention in which the right-hand helical windings **2** include six turns, but each left-hand helical winding **3** has a single turn. The heater coil thus substantially comprises a plurality of upper helical windings **2** in close succession. A pair of refractory support members **5** engage wire portions **4** extending between the upper and lower windings **2, 3** and firmly hold the coil. This arrangement may be advantageous where space requirement is imposed. Thus although the coils shown in FIG. 3 have their respective axes around which upper and lower windings are wound lying in a plane parallel to the reflector plate **6**, the axes may be disposed so that they lie in a plane perpendicular to the plate while running parallel thereto, with the one-turn windings positioned nearer to the plate **6**.

From the foregoing, it will be apparent that the arrangement according to the invention minimizes the surface of heater element which is engaged and covered by the support members, since substantially the whole length of the heater element is effectively exposed for radiation of heat. This permits to achieve a higher heater efficiency than was achievable with the prior art. Also time lag upon energization of the heater element is greatly reduced. Deformation of the heater coil is minimized and its mechanical strength increased by the positive engagement of the support members in the form of thin rods or tubes with the neck or crossing portions of the coil so that the latter is securely held pinched between the support members. In addition, although in the prior art unit using a tube of quartz or similar material, such tube had to be transparent in order to assure good radiation effect to a predetermined direction, the support members **3** used in the assembly of the invention need not be transparent, but a tube of opaque material such as ceramics may be used, so that the heater assembly may be provided inexpensively. This provides an additional advantage that the support member may be made thin by choosing a refractory material which has a high mechanical strength.

What we claim is:

1. A heater assembly for use in copying machines comprising a heater coil formed of electrical resistance wire, said coil consisting of a multiplicity of first helical windings each having more than one turn and arranged around a common axis in axially spaced relationship and a multiplicity of second helical windings each arranged around another common axis in axially spaced relationship, said another axis being parallel to and positioned at a distance from the first mentioned axis, each of said second helical windings including end portions interconnecting the ends of two adjacent first helical windings in a manner such that the heater coil consisting of the first and second helical windings has an 8-shaped profile in transverse cross-section, and a pair of refractory support members extending axially of the coil and engaging said end portions from outside thereof.

2. A heater assembly according to claim **1**, wherein said support members are quartz tubes having an outer diameter substantially less than said distance, thereby contacting said coil only at said end portions.

3. A heater assembly according to claim **1**, wherein each of said second helical windings has the same number of turns as the first helical winding.

4. A heater assembly according to claim **3**, wherein individual helical windings have a number of turns from five to fifteen.

5. A heater assembly according to claim **1**, wherein each of said second helical windings comprises a single turn thereby providing a substantially continuous arrangement of said first helical windings.

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PETER W. GOWDEY, Assistant Examiner

U.S. Cl. X.R.

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