(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 607 799 B1

(12) # EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:
01.04.1998 Bulletin 1998/14

(51) Int Cl.[6]: **D02J 13/00**

(21) Application number: **94100099.4**

(22) Date of filing: **05.01.1994**

(54) **Apparatus for heating synthetic yarns**

Vorrichtung zum Heizen synthetischen Garne

Dispositif pour le chauffage des fils synthétiques

(84) Designated Contracting States:
CH DE FR GB IT LI

(30) Priority: **19.01.1993 JP 23712/93**

(43) Date of publication of application:
27.07.1994 Bulletin 1994/30

(73) Proprietor: **TEIJIN SEIKI CO. Ltd.**
Osaka-shi Osaka-fu OSAKA (JP)

(72) Inventors:
- **Naito, Shunzo, c/o Teijin Seiki Co., Ltd.**
Matsuyama-shi, Ehime-ken (JP)
- **Morisaki, Hiroshi, c/o Teijin Seiki Co., Ltd.**
Matsuyama-shi, Ehime-ken (JP)

(74) Representative: **Hoeger, Stellrecht & Partner**
Uhlandstrasse 14 c
70182 Stuttgart (DE)

(56) References cited:
EP-A- 0 469 763 **DE-A- 4 318 674**

EP 0 607 799 B1

Description

Technical Field of the Invention

The present invention relates to an apparatus for heating synthetic yarns, particularly an apparatus for heating synthetic yarns to a high temperature, the heat set or heat treating temperature is higher than the melting point of the synthetic yarns, such as polyester, polyamide, for example, higher than 250°C. The present invention is especially suitable as a high temperature heating apparatus of a non-contacting type disposed in a high speed draw texturing machine. Further, the present invention is also applicable for a heating apparatus used in a drawing machine or a heat setting machine.

Prior Art

EP-A-O 469 763 describes various contact-type and non-contacting type heating apparatus.

It is widely done to dispose a heating apparatus upstream a twisting device so as to heat set twists imparted by the twisting device to a yarn and run back along the yarn, and then the yarn is de-twisted when it passes by the twisting device to obtain a false twist textured yarn. Many proposals have been done with respect to the heating apparatus.

Recently, it is done to heat such a heating apparatus to a high temperature, i.e., a temperature higher than the melting point of the yarn to be processed, more preferably, to a temperature of at least 400°C, and the yarn is heated in a non-contacting condition. In short, as the recent draw false twisting speed increases, a short but high temperature heater of non-contacting type is used in place of a conventional low temperature heating apparatus of a contacting type.

An aluminum alloy may be used for a heater, as long as the heating temperature of the heater is at most 400°C. However, when the heating temperature exceeds 400°C, such an aluminum alloy is not preferred since its melting point is low, and in some cases, such an aluminum alloy cannot be used. In order to overcome such a problem, it may be proposed to use materials having high melting point, such as brass, stainless steel or ceramics, for a material of the heating apparatus which is used at such a high temperature. Further, it may be proposed to use an infrared heater, and to choice far infrared radiation ceramics for a material of the heater or to coat the surface of the infrared heater with ceramics.

However, when a heating plate is made of brass, deterioration during high temperature heating is remarkable, and especially, corrosion becomes remarkable when it is heated to a temperature higher than 400°C.

Further, synthetic yarn is generally applied with finish, i.e., oil, in order to enhance treating conditions. When such a synthetic yarn applied with finish is heated to a high temperature, the finish may be vaporized and decomposed in the heating apparatus. The heater member may be easily corroded by the thus vaporized and decomposed finish and the high temperature. Accordingly, the material of such a high temperature heater is required to be resistant to such vaporized and decomposed finish and the high temperature.

If stainless steel is used for a material of a heater member as described above, its thermal conductivity is very low, for example, about 12,6 J/ms°C (0.03 Cal/cm·s·°C), while its oxidation resistance and corrosion resistance are high. Thus, there are problems that the distribution of temperature along the length of the heater becomes excessively uneven, that the difference between the temperatures of the heating plate and the heating source for heating the heating plate becomes large, and that the life of the sheath heater becomes short since it is heated to a very high temperature in order to heat the heating plate to a desired temperature. In addition, stainless steel has a poor machining capability upon manufacture of a heating apparatus.

If ceramics are used as another material for such a high temperature heating apparatus, the machining capability is very poor while there is no problem with respect to the oxidation resistance and corrosion resistance. Thus, the ceramics are very difficult to form in a complicated shape. In addition, since the material cost of ceramics is expensive, the manufacturing cost of the heating apparatus becomes expensive.

Objects of Invention

It is an object of the present invention to obviate the above-described problems inherent to the conventional apparatus.

It is another object of the present invention to provide a heating apparatus with high corrosion resistance, good molding characteristics and even distribution of temperature.

Summary of the Invention

According to the present invention, the above-described objects are achieve by a heating apparatus for heat setting or heat treating a synthetic yarn continuously running therethrough in a substantially non-contacting condition, characterized in that a material of a heating plate of the heating apparatus is a copper alloy, the copper contents of which is at least 60%, and the aluminum content of which is at least 3%.

According to the present invention, since the heating plate of the heating apparatus is made of a copper alloy, the copper content of which is at least 60% and the aluminum content of which is at least 3%, the corrosion problem with respect to the heating plate can be overcome.

Further, since the above-described composition is specifically adopted, the thermal conductivity of the heating plate can be high, for example, equal to or more than 41,9 J/ms°C (0.1 Cal/cm·s·°C), and the distribution of temperature becomes even. When the heating apparatus is used for a false twist setting heater, so called a first heater, of a false texturing machine, a heating apparatus can be obtained by which false textured yarns with good yarn quality can be manufactured.

It is preferred that the copper content of the copper alloy is between 60 and 70%, and the aluminum content of the copper alloy is between 3 and 6%, or that the copper content of the copper alloy is between 85 and 90%, and the aluminum content of the copper alloy is between 8 and 11%, in order to enhance the molding characteristics of such copper alloys.

Brief Description of the Drawings

The present invention will now be explained in detail with reference to the accompanying drawings showing some embodiments of the present invention, wherein:

Fig. 1 is a longitudinal sectional view of an embodiment of the present invention;
Fig. 2 is a cross sectional view along line II-II in Fig. 1;
Fig. 3 is a sectional view of a draw false texturing machine provided with a heat treating apparatus of the present invention;
Fig. 4 is a diagram illustrating the distribution of temperature of a heating plate; and
Fig. 5 is a diagram illustrating the influence of the aluminum contents in copper alloys to the weight changing ratio and the thermal conductivity of the heating plate.

Embodiment

In Fig. 3, which is a sectional view of a draw false texturing machine provided with an apparatus for heat treating a synthetic yarn of the present invention, a yarn Y is withdrawn from a supply yarn package 1 by means of first feed rollers 2. The yarn Y is drawn at a predetermined draw ratio between the first feed rollers 2 and second feed rollers 6, and at the same time, twists are imparted to the yarn Y by means of a false twisting device 5, such as a friction belt device, a device with friction discs or a false twisting spindle. In place of the simultaneous false twisting operation with the drawing operation, the false twisting operation may be done subsequent to the drawing operation.

Twists imparted to the yarn Y by the false twisting device 5 run back toward the first feed rollers 2 along the yarn Y. Twists run back along the yarn Y are heat set by a heat treating apparatus 3, and the yarn Y is cooled by stabilizing tracks 4a and 4b disposed downstream the heat treating apparatus 3.

As described above, the yarn Y is imparted with false twists upstream the false twisting device 5 between the first feed rollers 2 and the second feed rollers 6, while it is de-twisted after it leaves the false twisting device 5, and the yarn Y is fed from the second feed rollers 6 to the take-up device 7.

The take-up device 7 comprises a traverse device 8 for traversing the yarn Y to and fro, a bobbin holder 10 for mounting a yarn winding bobbin inserted thereon, and a friction roller 9 pressed to the bobbin or yarn layer wound onto the bobbin so as to rotate the bobbin and the bobbin holder 10.

An embodiment of the heat treating apparatus 3 of the present invention will now be explained in detail with reference to Figs. 1 and 2. The heater body has a total length of between 0.8m and 1.2m, and as illustrated in Fig. 1, in the heat treating apparatus 3 of the present embodiment, the heater body and the heating member which is a sheath heater in this embodiment are divided into two in the lengthwise direction. The heating member may be another known member other than a sheath heater, for example, a plate heater.

More specifically, the heater body comprises the divided heating plates 11 and 21, and sheath heaters 12 and 22 for heating the heating plates 11 and 21 are disposed in the heating plates 11 and 21. Reference numerals 13 and 23 are temperature sensors disposed in the heating plates 11 and 21, respectively. The divided heating members, i.e., the sheath heaters 12 and 22, may be heated to a temperature equal to or higher than 250°C. The condition setting is performed by a control (not shown).

The outside of the heating plates 11 and 21 are covered and insulated by insulator 31, and a insulating cover surrounds the outside of them.

As illustrated in Fig. 2, when the heating plates 11 and 21 are cross sectioned in a plane perpendicular to the yarn passage, grooves 11a and 21a for passing the yarn therethrough are formed on the surface of the heating plates 11 and 21, respectively, and they extend in a longitudinal direction of the heating plates 11 and 21. The sheath heaters 12 and 22 are buried within the heating plates 11 and 21.

In this embodiment, yarn guides 14 and 24 are disposed within the grooves 11a and 21a spacing a predetermined distance along the yarn running direction.

The material of the heating plate of the heating apparatus according to the present invention is a copper alloy, the copper content of which is at least 60%, and the aluminum content of which is at least 3%, so that the thermal conductivity of the heating plate can be high, for example, equal to or more than 41.9 J/ms°C (0.1 Cal/cm·s·°C). Especially, it is preferred that the copper content of the copper alloy constituting the heating plates is between 60 and 70%, and the aluminum content of the copper alloy is between 3 and 6%, or that the copper content of the copper alloy is between 85 and 90%, and the aluminum content of the copper alloy is between 8 and 11%.

Unexpected advantages achieved by the present invention will now be explained with reference to the test data obtained by the present inventors. The tests were carried out using a heating apparatus according to the present invention, wherein the material of the heating plate was a copper alloy, the copper content of which is at least 60%, and the aluminum content of which is at least 3%. Especially, when the copper content of the copper alloy constituting the heating plates is between 60 and 70%, and the aluminum content of the copper alloy is between 3 and 6%, or when the copper content of the copper alloy is between 85 and 90%, and the aluminum content of the copper alloy is between 8 and 11%, more preferable advantages will be obtained.

(1) Even Heating of the Heating Plate

The heating plates 11 and 21 of the high temperature heating apparatus according to the present invention have the grooves 11a and 21a extending along the running path of the yarn as illustrated in Fig. 1 and forming a yarn passage on the surface thereof as illustrated in Fig. 2, and the heating plates 11 and 21 are heated by the sheath heaters 12 and 22 extending in the heating plates along the yarn passage.

Upon heating the heating plates 11 and 21, the temperatures of the bottom portions of the grooves 11a and 21a where the yarn passes are usually measured by temperature sensors 13 and 23 at the midpoint of the longitudinal direction, i.e., vertical direction in Fig. 1, of the heating plates, and the temperatures of the heating plates are controlled at predetermined temperatures. In this occasion, in a first heater disposed on a false twist texturing machine, the set temperatures are so selected that the yarn temperature at the exit of the heater coincides a predetermined temperature, for example, 220°C.

A solid line in Fig. 4 shows distribution of temperature in a lengthwise direction of a heating plate of the high temperature heating apparatus of a non-contacting type according to the present invention, wherein the heating plate is set at a predetermined temperature, for example at 500°C, and the temperatures were measured at bottom portions of a groove where a yarn runs. In Fig. 4, a broken line designates a result obtained by a heating plate made of brass, a-dot-and-a-dash line designates a result obtained by a heating plate made of stainless steel.

The present inventors consider that the difference in the distribution of temperature designated by a broken line and obtained by a heating plate of brass and that designated by a-dot-and-a-dash line and obtained by a heating plate of stainless steel was caused by the difference in the thermal conductivities of the materials of the heating plates.

Compared with the thermal conductivity of 108,9 J/sm°C (0.26 Cal/cm·s·°C) for brass, the thermal conductivity for stainless steel is 12.6 J/ms°C (0.03 Cal/cm·s·°C), in other words, the latter is about 1/10 of the former, and accordingly, when stainless steel is used for the heating plate, the distribution of temperature in the lengthwise direction becomes uneven as illustrated in Fig. 4.

If it is required that a yarn adhering to a yarn guide upon yarn breakage is melted and removed so as to enable re-threading operation in a short time, which is a characteristic feature of the high temperature heater, all the portions on the heating plates have to be heated to a sufficiently high temperature, for example, a temperature higher than 320°C, preferably, higher than 400°C, so that the adhered yarn is melted and removed in a short time. Thus, the set temperature of the heating plate has to be enhanced, and accordingly, increased is the difference between the set temperature of the heating plate and the temperature of the sheath heater, which is the heat source.

Further, in this instance, the set temperature of the heating plate has to be enhanced in order to maintain the yarn temperature at the exit of the heater at a predetermined value, and similarly, increased is the difference between the set temperature of the heating plate and the temperature of the sheath heater, which is the heat source.

As described above, the sheath heater is heated to an excessively high temperature in order to heat the heating plate to a predetermined temperature, the life of the sheath heater is shortened. Further, when a yarn is passed through a heater, distribution of temperature of which is uneven, there is a concern with regard to adverse influence to the obtained yarn quality. Thus, it is not preferred to adopt stainless steel as the heating plate of the high temperature heater.

Contrary to this, when brass, the thermal conductivity of which is large, i.e., 108.9 J/ms°C (0.26 Cal/cm·s·°C), is used as the heating plate, the problem of uneven distribution of temperature can be substantially obviated. According to the investigation conducted by the present inventors, it seems that stainless steel causes the above-described problem since it has small thermal conductivity, which is about 1/10 of that of brass and that a material which has a thermal conductivity of between 1/ and 1/3 of that of brass may not cause a problem of the uneven distribution of temperature. According to the experience by the present inventors, it is preferred that the thermal conductivity is equal to or more than 41,9 J/ms°C (0.10 Cal/cm·s·°C).

(2) Corrosion Resistance of the Heating Plate

However, according to an investigation conducted by the present inventors, when the heating plate is made of brass, its deterioration is remarkable at high temperature, especially, its corrosion is remarkable when it is heated to a temperature higher than 400°C. Thus, the heating plate made of brass cannot be used in a high temperature heater.

Particularly, synthetic yarn is generally applied with finish, i.e., oil, in order to enhance treating condition. When such a synthetic yarn applied with finish is heated to a high temperature, the finish may be vaporized and decomposed in the heating apparatus. The heater member may be easily corroded by the thus vaporized and decomposed finish and the high temperature. Accordingly, the material of such a high temperature heater is required to be resistant to such vaporized and decomposed finish and the high temperature.

In order to overcome the disadvantage, the present inventors have taken note of increase of corrosion resistance by addition of aluminum (Al) to copper alloys, and have conducted careful investigation with respect to the abilities, i. e, the thermal conductivity and corrosion resistance against finish, by varying the contents of aluminum in copper alloys.

Table 1 shows a part of the investigated various copper alloys, i.e., samples A to H, and the obtained results, i.e, the thermal conductivity and the weight changing ratio.

The weight changing ratio in Table 1 was obtained as follows. A sample was dipped in the condensed finish for treating a polyester yarn, which is a typical synthetic yarn, for 10 seconds, and then it was kept in a high temperature atmosphere, the temperature of which was 560°C. Thus, the above-described dipping and heating operation was repeated for 36 times in 200 hours. The weight of the sample before the treatment is designated by W_0, and the weight of the sample after the treatment is designated by W_1. The absolute value of the weight change (W_1-W_0) between before treatment and after treatment is divided by the weight (W_0) before treatment and is expressed by percentage, i.e., [$100X(W_1-W_0)/(W_0)$], which is referred to as "weight changing ratio". The weight changing ratio thus obtained is considered to be an indicator of corrosion resistance. In short, as the weight changing ratio becomes smaller, the corrosion resistance increases.

Among the investigated results described in Table 1, in sample A, the aluminum content in copper alloy was zero, and the weight changing ratio (indicated by *1 in Table 1) was excessively large as described above, and its measurement was omitted since measurement was considered to be meaningless. Further, the dipping and heating operation was repeated for 16 times for samples D, F and G, respectively. However, there was no significant difference in the weight changing conditions from those for samples E and H until that time, and accordingly, the following dipping and heating operation was suspended with respect to samples D, F and G. Therefore, the weight changing ratios for samples D, F and G are not described (see *2 in Table 1). The present inventors consider that these samples D, E and F may be used as a heating plate of an apparatus for heating synthetic yarns. In addition, since a copper alloy has high melting point, there may be no problem for utilizing the materials of samples D, E or F as the heating plate.

Among the results described in Table 1, Fig. 5 is a diagram illustrating the influence of the aluminum contents in copper alloys to the weight changing ratio and the thermal conductivity of the heating plate. From Fig. 5, it is apparent that the heating plate made of a copper alloy, the aluminum content of which is at least 3%, has high corrosion resistance, good molding characteristics and even distribution of temperature. Further, in view of even heating of the heating plate, it is preferred that the aluminum content is equal to or less than 11%, more preferably, less than 8%, and the thermal conductivity of about 41.9 J/ms°C (0.1 Cal/cm·s·°C) can be obtained. If the corrosion resistance is weighed, the thermal conductivity may be about 29,3 J/ms°C (0.07 Cal/cm·s·°C).

The distribution of temperature of the heating plate made of the material of sample C in Table 1 is designated by a solid line in Fig. 4.

As is apparent from the solid line in Fig. 4, the heating plate made of sample C shows a distribution of temperature similar to that of the heating plate made of brass. Further, as is apparent from Table 1 and Fig. 5, the heating plate made of sample C has small weight changing ratio, and accordingly, it has a good corrosion resistance.

(3) Molding characteristics of the Heater

The heating plate of the high temperature heating apparatus according to the present invention has at least one longitudinal groove for providing a yarn passage extending along the yarn path and formed on the surface thereof. As a result, the heating plate is molded upon its manufacture.

The molding characteristics have been investigated with respect to samples A to H, and the results as described in Table 1 were obtained. More specifically, the molding operation is very difficult for the materials with aluminum contents higher than 6% and less than 8%. Accordingly, it is very important to find out preferable aluminum contents with respect to the molding characteristics. It is confirmed that aluminum contents in weight percentage are selected to be at least 3%, more preferably, between 3 and 6% or between 8 and 11%, on the basis of a copper alloy, the copper contents of which is at least 60%.

[Example]

The heating plate of the heating apparatus illustrated in Fig. 1 was manufactured with the material of the above-described sample C, and the obtained heating apparatus was disposed on a draw false texturing machine illustrated in Fig. 3. The upper heating plate 11 was set at a temperature of 550°C, while the lower heating plate 21 was set at a temperature of 255°C. A partially oriented polyester yarn (POY) 137 dtex/36fil of (125 denier/36 fil) was drawn at a draw ratio of 1.78, and at the same time, twists were imparted to the yarn by means of false twisting device comprising three shafts with a plurality of discs. Twists run back along the textured yarn were heat set by means of the above-described heating apparatus, and the yarn was wound into a yarn package at a texturing speed of 1,000m/min. After a utility examination wherein he above described false texturing process was performed was done for six months, there was no problem with respect to the oxidation resistance, the corrosion resistance and yarn quality.

According to the present invention, a problem of corrosion resistance of the heating plate of an apparatus for heating a synthetic yarn inherent to enhancement of the heating temperature can be obviated. The corrosion resistance against finish which will be vaporized and decomposed in the heater is increased by adding aluminum contents in the copper alloys. However, there may occur a problem of molding characteristics depending on the aluminum contents. Accordingly, it is very important to find out preferable aluminum contents with respect to the molding characteristics. It is confirmed that aluminum contents in weight percentage are selected to be at least 3%, more preferably, between 3 and 6% or between 8 and 11%, on the basis of a copper alloy, the copper content of which is at least 60%. If the aluminum content is less than 3%, a problem of low corrosion resistance may remain, and if the aluminum content is more than 6% and less than 8%, molding characteristics may be deteriorated. Thus, the above described range of aluminum contents is recommended.

Further, in view of even heating of the heating plate, it is preferred that the aluminum content is equal to or less than 11%, more preferably, less than 8%, and the thermal conductivity of about 41.9 J/ms°C (0.1 Cal/cm·s·°C) can be obtained. If the corrosion resistance is weighed, the thermal conductivity may be about 29.3 J/ms°C (0.07 Cal/cm·s·°C).

Table 1

Sample	A	B	C	D	E	F	G	H
Al Content (%)	0	0.7	3.8	6.6	6.7	8.5	9.8	10.3
Cu Content (%)	58.5	57.6	64	90	89	88	84	85
Zn Content (%)	40	39	27	0	0	0	0	0
Thermal Conductivity (cal/cm · s · ℃)*	0.26	0.23	0.16	0.12	0.11	0.08	0.07	0.10
Weight Changing Ratio (%)	*1	0.248	0.012	*2	0.003	*2	*2	0.005
Molding Characteristics	Good	Good	Acceptable	Difficult	Difficult	Acceptable	Acceptable	Acceptable
Elongation (%)	32	–	17	37	–	35	–	25
Hardness (HRB)	67	–	89	76	99	78	88	90

* cal/cm · s · °C ≙ 418,7 J/ms°C

Claims

1. A heating apparatus for heat setting or heat treating a synthetic yarn continuously running therethrough in a substantially non-contacting condition, characterized in that a material of a heating plate of the heating apparatus is a copper alloy, the copper content of which is at least 60%, and the aluminum content of which is at least 3%.

2. A heating apparatus according to claim 1, characterized in that the heating plate is made of a copper alloy, the copper content of which is between 60 and 70%, and the aluminum content of which is between 3 and 6%.

3. A heating apparatus according to claim 1, characterized in that the heating plate is made of a copper alloy, the copper content of which is between 85 and 90%, and the aluminum content of which is between 8 to 11%.

4. A heating apparatus according to claim 1, 2 or 3, characterized in that the heating temperature may be set to be at least 400°C.

5. Use of a heating apparatus according to anyone of claims 1 to 4, wherein the apparatus is heated to a temperature higher than 250°C and the apparatus being disposed upstream a twisting device for heat setting twists imparted to the synthetic yarn by the twisting device and run back along the yarn while the apparatus is in a substantially non-contacting condition with the yarn running therethrough.

Patentansprüche

1. Heizvorrichtung zum Thermofixieren oder Wärmebehandeln eines synthetischen Garnes, welches kontinuierlich hierdurch läuft, in einer im wesentlichen berührungslosen Art und Weise, dadurch gekennzeichnet, daß ein Material einer Heizplatte der Heizvorrichtung eine Kupferlegierung ist, deren Kupfergehalt mindestens 60 % und deren Aluminiumgehalt mindestens 3 % beträgt.

2. Heizvorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die Heizplatte aus einer Kupferlegierung hergestellt ist, deren Kupfergehalt zwischen 60 und 70 % und deren Aluminiumgehalt zwischen 3 und 6 % beträgt.

3. Heizvorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die Heizplatte aus einer Legierung hergestellt ist, deren Kupfergehalt zwischen 85 und 90 % und deren Aluminiumgehalt zwischen 8 und 11 % beträgt.

4. Heizvorrichtung nach Anspruch 1, 2 oder 3, dadurch gekennzeichnet, daß die Heiztemperatur auf mindestens 400 °C eingestellt werden kann.

5. Verwendung einer Heizvorrichtung nach einem der Ansprüche 1 bis 4, worin die Vorrichtung auf eine Temperatur aufgeheizt wird, die höher ist als 250 °C, und worin die Vorrichtung aufstromseitig von einer Drallvorrichtung angeordnet ist, um Verdrallungen, die dem synthetischen Garn durch die Verdrallvorrichtung aufgezwungen werden und welche an dem Garn entlang zurücklaufen, Wärme zu fixieren, während die Vorrichtung in einem im wesentlichen kontaktlosen Zustand mit dem darin durchlaufenden Garn ist.

Revendications

1. Appareil de chauffage permettant le thermofixage ou le traitement thermique d'un fil synthétique qui le traverse de manière continue sensiblement dans un état sans contact, caractérisé en ce qu'un matériau d'une plaque chauffante de l'appareil de chauffage est un alliage de cuivre, dont la teneur en cuivre est d'au moins 60% et dont la teneur en aluminium est d'au moins 3%.

2. Appareil de chauffage selon la revendication 1, caractérisé en ce que la plaque chauffante est composée d'un alliage de cuivre dont la teneur en cuivre est comprise entre 60 et 70% et dont la teneur en aluminium est comprise entre 3 et 6%.

3. Appareil de chauffage selon la revendication 1, caractérisé en ce que la plaque chauffante est composée d'un alliage de cuivre dont la teneur en cuivre est comprise entre 85 et 90% et dont la teneur en aluminium est comprise entre 8 et 11%.

4. Appareil de chauffage selon la revendication 1, 2 ou 3, caractérisé en ce que la température de chauffage peut être fixée à au moins 400°C.

5. Utilisation d'un appareil de chauffage selon l'une quelconque des revendications 1 à 4, dans laquelle l'appareil est chauffé à une température supérieure à 250°C et l'appareil étant placé en amont d'un dispositif à retordage per-

mettant de thermofixer les torsions communiquées au fil synthétique par le dispositif à retordage et retournant en arrière le long du fil tandis que l'appareil se trouve sensiblement dans un état sans contact avec le fil qui le traverse.

FIG. 1

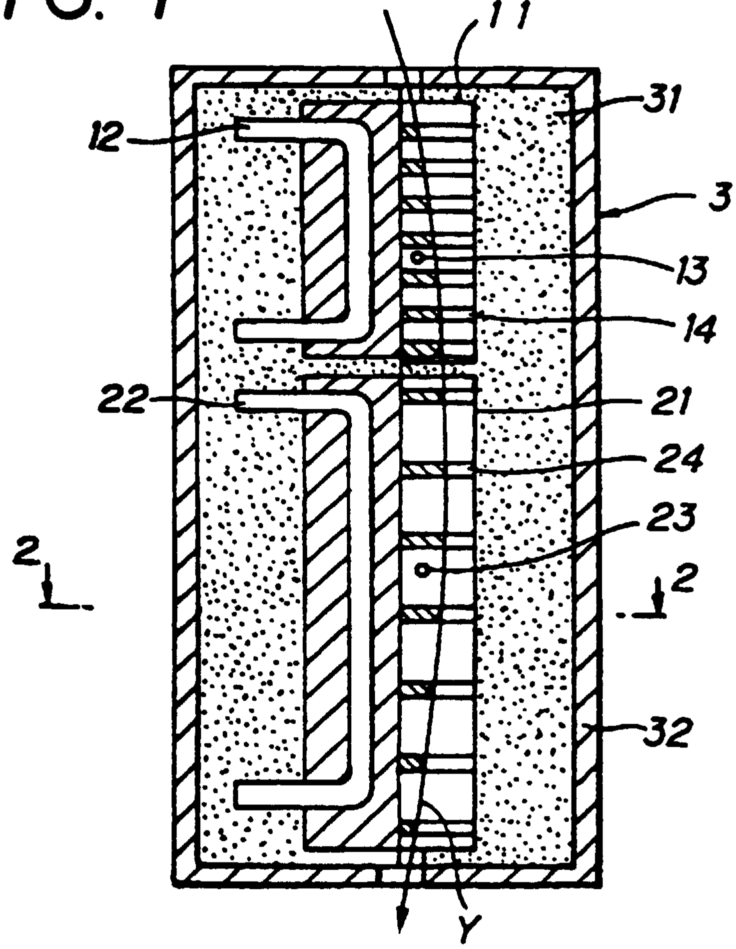


FIG. 2

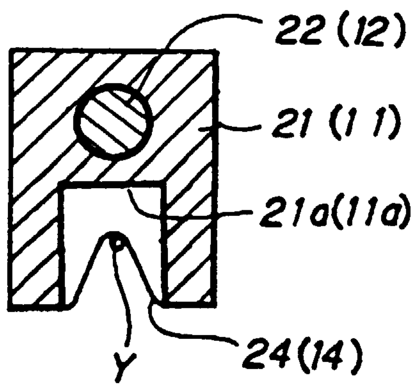


FIG. 3

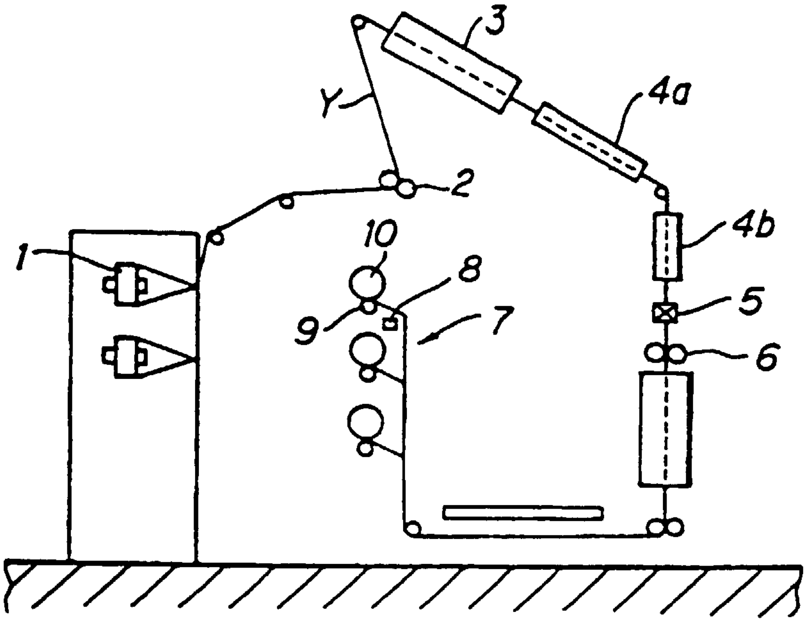

3
4a
Y
2
4b
1
10
8
5
9
7
6

FIG. 4

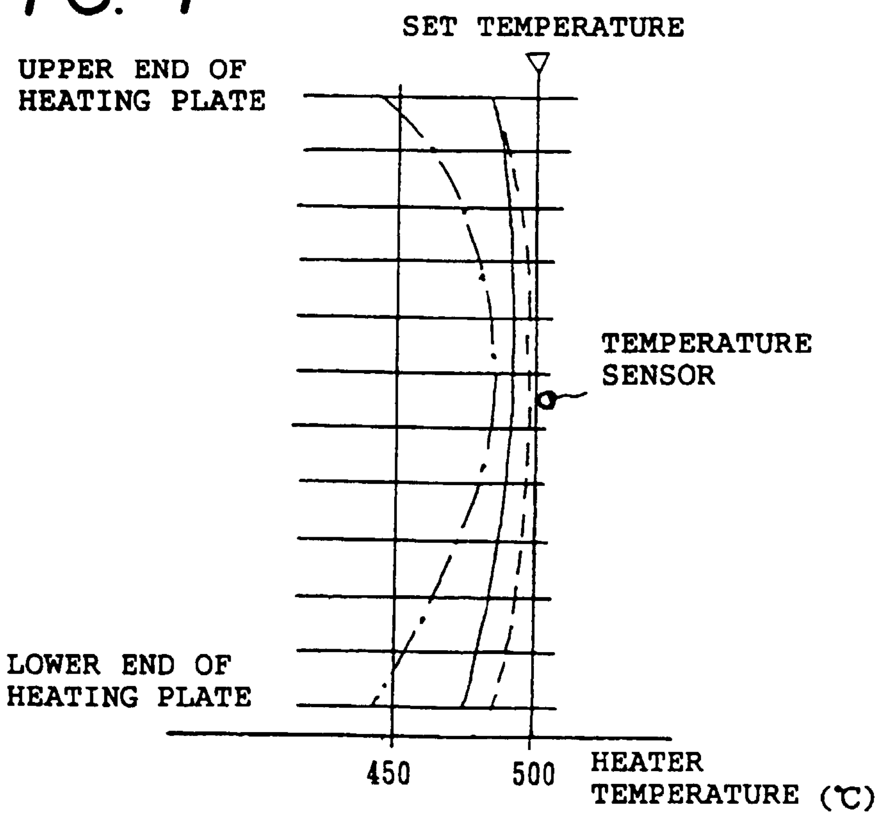
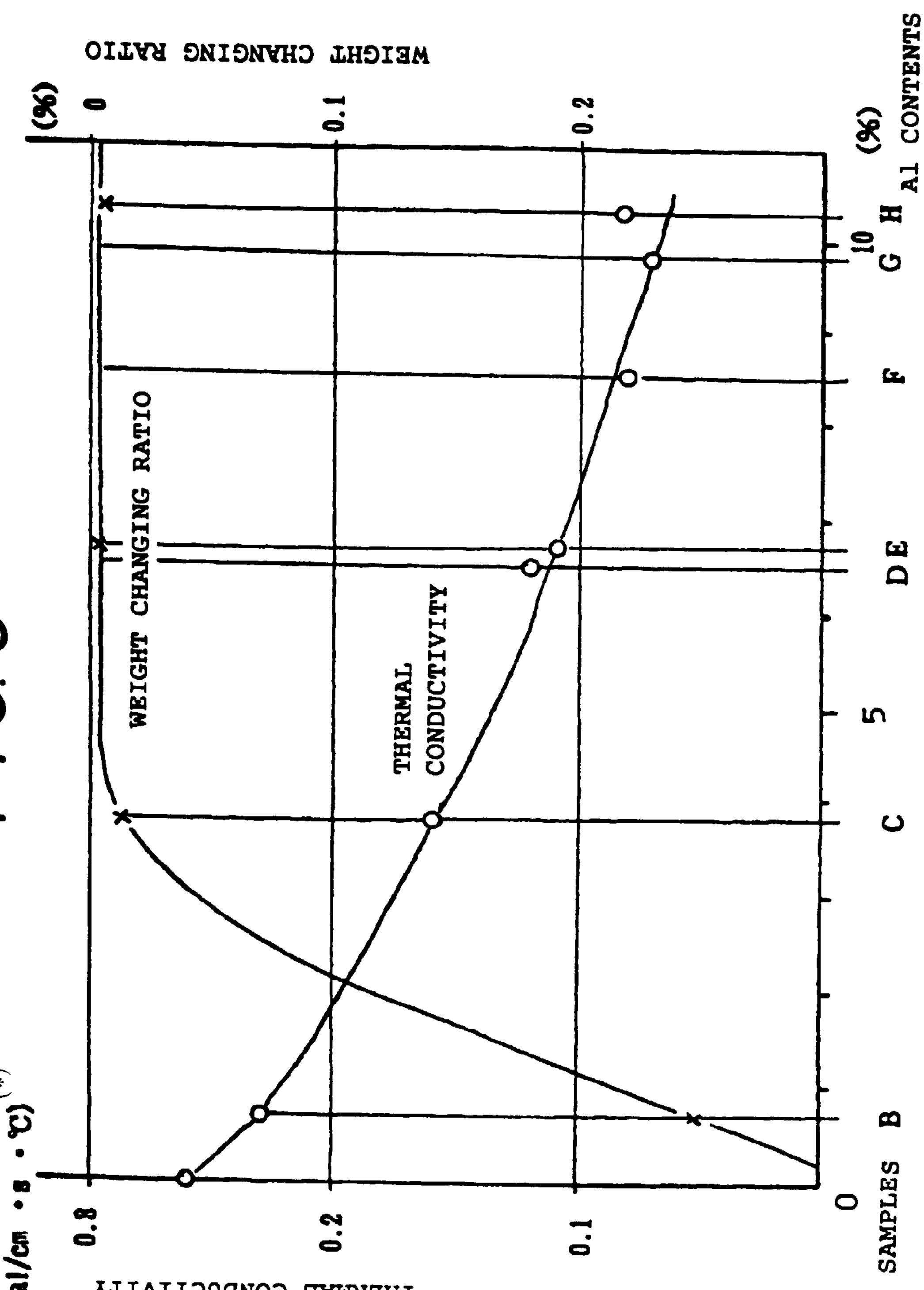

SET TEMPERATURE
UPPER END OF
HEATING PLATE
TEMPERATURE
SENSOR
LOWER END OF
HEATING PLATE
450
500
HEATER
TEMPERATURE (℃)

FIG. 5



(*) 1 cal/cm · s · °C = 418.7 J/m · s · °C