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

(11) Publication number: **0 469 763 A1**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **91306633.8**

(51) Int. Cl.5: **D02G 1/02**, D02J 13/00

(22) Date of filing: **22.07.91**

(30) Priority: **03.08.90 GB 9017087**

(43) Date of publication of application:
05.02.92 Bulletin 92/06

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

(71) Applicant: **RIETER-SCRAGG LIMITED**
Langley
Macclesfield Cheshire, SK11 0DF(GB)

(72) Inventor: **Hinchliffe, Malcolm Geoffrey**
3 Atholl Close
Macclesfield, Cheshire(GB)

(74) Representative: **Graves, Ronald**
Rieter Scragg Limited Langley
Macclesfield Cheshire, SK11 0DF(GB)

(54) Yarn heating arrangement.

(57) A yarn heating arrangement disposed in a straight yarn path crimping zone of a yarn texturing machine (10) comprises a first heater (32) which is maintained at a temperature in excess of the yarn's (13) crimp setting temperature, and may be above the melting temperature of the yarn (13),and heats the yarn (13) rapidly by radiation to a temperature of between 85% and 98% of its crimp setting temperature, and a smoothing heater plate (31) contacted by the yarn and maintained at the crimp setting temperature in order to heat the yarn (13) to that temperature. The overall length of the two heaters (31, 32) is less than that of a conventional contact plate heater, but they provide equivalent yarn temperature control which is greater than that provided by a high temperature non-contact heater alone. The heaters (31,32) are located between a twist-stop (23) and a false-twisting device (17) of the texturing machine (10).

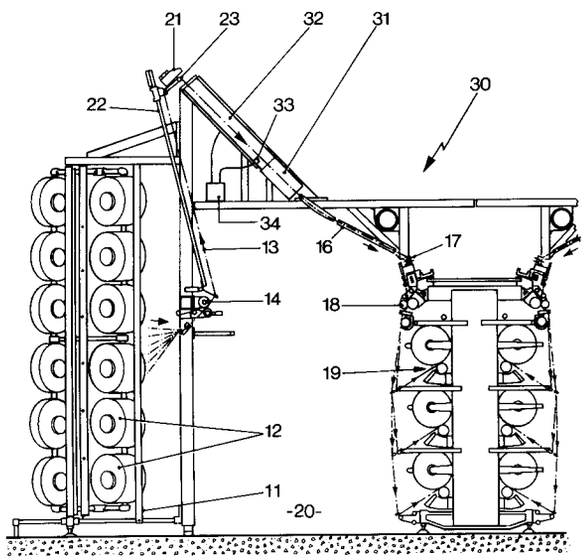

FIG.2

EP 0 469 763 A1

This invention relates to yarn heating arrangements, and in particular to arrangements for heating a textile yarn during texturing thereof.

It is customary to texture continuous filament yarns by withdrawing the yarn from a package, heating and then cooling the yarn whilst a crimp is inserted therein, and winding the textured yarn onto another package. A second heating stage may be included between the crimping and winding stages if set rather than stretch textured yarn is required. Such crimping may comprise inserting a false twist into the yarn whilst it is heated and then cooled, followed by a de-twisting.

In order that the insertion of such a false-twist is effected at the start of the heating zone, it is desirable that the yarn path between the false-twist device and the upstream end of the heater is substantially straight, since changes in yarn direction, particularly around guides, have an inhibiting effect on the passage of twist. At the high yarn throughput speeds of modern texturing machines,it is necessary to have long heating and cooling zones in order that the temperature of the yarn can be raised sufficiently whilst it is twisted, and then lowered sufficiently to withstand the mechanical effects of the false-twist device, as well as to retain the twist memory when it is de-twisted. Such long heating and cooling zones, if defining a substantially straight yarn path throughout, result in the texturing machines being large, and access to all parts of the machines being difficult without the use of ladders, trolleys and/or "remote control" devices.

It has therefore been desirable to reduce the length of the heating and cooling zones, and various arrangements which reduce either or both of these zones have been proposed. For example,in British Patent No 1136746, heated feed rollers are disposed upstream of a plate heater. The purposes of the heated feed rollers in this case are to enable shrinkage of the yarn to occur, and to preheat the yarn before it enters the crimping zone in which it is heated by the plate heater. This reduces the time taken, and hence the length of the heater plate required, to raise the temperature of the yarn to that required for setting the crimp inserted therein. A twist stop is located between the heated feed rollers and the plate heater, so that the precise length of the crimping,ie twisting, zone is defined, and the processing characteristics of the yarn are carefully controlled. The pre-heating feed rollers are maintained at a temperature of between 56% and 77% of that of the plate heater,ie it would be insufficient to allow the required molecular reorientation in the yarn for setting twist therein if the twist stop were to be dispensed with and the twist could travel around the heated feed rollers. In British Patent No. 1350588,the heating means is divided into two parts. The first part of the heating apparatus, which could take any one of several forms, e.g. plate, rollers or pin, is intended to raise the temperature of the yarn only to that sufficient for drawing, despite it being in the crimping zone. Only at the second part of the heating apparatus, a plate heater, is the temperature of the yarn raised sufficiently for crimp setting. In this case the first heating means is maintained at a temperature of between 45% and 76%, preferably 60%,of the temperature of the second heating means. In the two prior arrangements described above, although the length of the plate heater for crimp setting may be less than would be the case if no preheating were provided, nevertheless the overall length of the preheating and main heating zone is not significantly reduced by comparison with a single plate heater.

In British Patent Publication No 2026560,there is described an arrangement in which the yarn is heated by a heating device incorporating heated rollers disposed upstream of a twist stop, ie outside the crimping zone, and is heated to a temperature which is sufficient for setting the twist subsequently applied. Further heating downstream of the twist stop and in the crimping zone is only required if the yarn has cooled below the necessary twist setting temperature. However, without a heater present in the crimping, ie twisting Zone, precise control of the temperature in that zone, and hence the final characteristics of the textured yarn, is not possible, and without contact with such a heater the long unsupported length of yarn in that crimping zone would lead to process instability. Moreover, heating to such a temperature before twisting causes the yarn molecules to crystalise in the untwisted state, and this is retained in the 'memory' of the yarn when subsequently cooled. Hence the 'twist-memory' of the yarn is compromised and the yarn is not textured in the desired manner. Crimping, such as twist insertion, and drawing tension when required, should be effected before the yarn reaches the required crimp setting temperature, so that the retained 'memory' is only of a crimped state, and drawn state when required. This will occur if the twist stop or other crimp inhibiting means is located upstream of the means which brings the yarn up to the crimp setting temperature, but not with the arrangement described in GB.2026560.

European Patent Publication No 0087124, discloses a pre-heating plate and a main heating plate with a twist stop between them However, the pre-heating plate is disposed so far upstream of the twist stop and the crimping zone,in which the main heater is disposed,that the yarn has cooled before it reaches the latter. In consequence the length of the main heater is not reduced by virtue of the provision of the pre-heating device, and it is stated that the pre-heating effects obtained in the other prior art arrangements are not achieved with this arrangement.

As an alternative to the use of contact heaters, wherein the yarn reaches a temperature substantially

equal to that of the heater, it has been proposed to use non-contact heaters which can be a temperatures considerably greater than the melting temperature of the yarn. Such heaters enable very rapid raising of the temperature of the yarn, and hence a relatively short yarn path in the heating zone can be achieved compared with conventional contact heaters. However, because the yarn temperature rises so rapidly along the yarn path through the heating zone, and small changes in heating zone length or the rate of heat transfer cause large changes in output temperature, it is very difficult to control accurately the actual temperature reached by the yarn and to ensure that it is not significantly above or below the desired crimp setting temperature. In consequence with such heating arrangements it is very difficult to control accurately the final characteristics of the textured yarn. Furthermore lack of support for the yarn in the crimping zone when using non-contact heaters can lead to process instability.

It is an object of the present invention to provide a heating arrangement whereby the length of the heating zone is reduced by comparison with the length of a conventional plate heater when used alone, but in which the disadvantages of the known arrangements for reducing the heating zone length are avoided or minimised.

The invention provides a yarn heating arrangement disposed in a crimping zone, comprising a first heating means maintained at a temperature in excess of the crimp setting temperature of the yarn and operable to heat the yarn to a temperature less than the crimp setting temperature and immediately downstream of the first heating means a smoothing heater maintained substantially at, and operable to heat the yarn to, that crimp setting temperature. The crimping zone may extend between twist stopping means and false twisting means. Preferably the first heating means is maintained at a temperature in excess of the melting temperature of the yarn, and the first heating means may be non-contact heating means operable to heat the yarn by radiation. Preferably also the smoothing heater is a contact heater, which may be a plate providing a substantially straight yarn path.

The first heating means may be operable to heat the yarn to a temperature of between 85% and 98% of the crimp setting temperature of the yarn. Temperature sensing means may be disposed adjacent the exit end of the first heating means,and control means may be provided to control the temperature of the first heating means in response to a signal received from the sensing means if the yarn temperature lies outside that range, whereby the yarn is heated to a temperature within that range as it passes from the first heating means into contact with the smoothing heater. The first heating means may be an infra-red heater. The contact smoothing heater may be heated in any known manner, for example by means of electrical heating elements disposed along its length, or by means of a vapour-phase fluid being in good thermal contact with the heater plate.

The temperature of the first heating means may be at least 350°C, for example 650°C, and the temperature of the smoothing heater may be in the range 180°C to 280°C, for example 225°C. The length of the first heating means may be substantially 0.75mm and the length of the smoothing heater may be substantially 0.25m.

The invention will now be further described with reference to the accompanying drawings in which :

Fig. 1 is a schematic diagram of a conventional false-twist texturing machine incorporating a relatively long heater of the plate type, and

Fig.2 is a schematic diagram of the machine of Fig.1 with the plate heater thereof replaced by a non-contact heater and a relatively short plate heater, in accordance with one embodiment of the invention.

Referring to Fig.1 there is shown a conventional false-twist texturing machine 10 comprising a creel 11 having a supply of yarn packages 12 therein, and in sequence for each yarn 13, a first feed device 14, a long plate heater 15, a cooling plate 16, a false twist device 17, a second feed (and drawing) device 18, and wind-up means 19. The first feed device 14 is operable to withdraw the yarn 13 from a package 12 and feed it to the heater 15. The heater 15 and the cooling plate 16 are aligned with each other to provide a substantially straight, but relatively long, yarn path through-out the heating and cooling zones in which the yarn 13 is false twisted by the false twist device 17, and they extend across the operator's aisle 20. In consequence the inlet end of the heater is located at a point well above the top of the creel 11. In order to guide the yarn 13 from the first feed device 14 to the inlet end of the heater 15, a sledge 21 is mounted on a track 22, and has a twist stopping yarn guide 23 mounted thereon. The sledge 21 can be moved to the bottom of the track 22 adjacent the first feed device 14 for threading purposes, and then moved to its operational position at the top of the track 22 to lay the yarn 13 on the surfaces of the heater 15 and cooling plate 16. The second feed device 18 is operable to feed the yarn 13 from the false-twist device 17 to the wind up means 19 and, if run at a faster yarn throughput speed than the first yarn feed device 14, to draw the yarn 13 between the two feed devices 14, 18.

The temperature of the heating plate 15 is arranged to be substantially that at which the false-twist can be set in the yarn 13, and the length of the heating plate 15, typically 1.5m to 2.5m, is such as to enable

the yarn 13 to reach that temperature during its time in contact therewith. The length of the cooling plate 16 is such as to enable the yarn to cool sufficiently to withstand the mechanical effects of the false twist device 17 and to retain the twist memory as it is untwisted between the false twist device 17 and the second feed device 18. Because of these length requirements and the desirability of having a substantially straight yarn path through the heating and cooling zones in order that the twist can run back to the twist stop guide 23, the inlet end of the heater 15 is beyond the reach of an operator standing in the operator's aisle 20, and therefore an upper maintenance platform 24 is provided. This adds to the cost of the machine 10, and contributes to the overall large dimensions of the machine 10.

Referring now to Fig. 2 there is shown a false-twist texturing machine 30 which is generally the same as the machine 10 described above, and corresponding parts of the two machines 10, 30 are identified by corresponding reference numerals. However, in the case of the machine 30, the long plate heater 15 of machine 10 has been replaced by a short plate smoothing heater 31 and a non-contact first heater 32. The combined length of the two heaters 31, 32 is approximately half of that of the single heater 15 of the conventional machine 10,so that the overall dimensions, particularly the height, of the machine 30 of the present invention is considerably less than that of the machine 10. Such a reduction of heater length is demonstrated as follows :

Consider a typical single contact heater 15 having a length L of 2.25m and at a temperature Th of 225°C, operating on 167f34 P.E. yarn travelling at a speed S of 800m/min (=13.3̇m/sec) in an atmosphere with an ambient temperature of 20°C (=temperature Ti of yarn at inlet of heater). Using the relationship

$$\mathrm{Log}_e\left[\frac{Th - Ti}{Th - Ty}\right] = \frac{703L}{CpxDxS}$$ where Log_e = natural logarithm,

Ty = yarn temperature at the exit from the heater, D = yarn decitex and Cp = specific heat of P.E. (=0.45 cal/g°C), gives a yarn temperature Ty of 182.8°C.

Now consider the same yarn travelling at the same speed under the same atmospheric conditions as above, being heated by two contact heaters in series, the first heater having a length of 0.75m and a temperature of 400°C, and the second smoothing heater having a length of 0.25m and a temperature of 225°C. Using the above relationship for the two heaters in succession gives a yarn temperature Ty_1, at the exit of the first heater = Ti_2 at the inlet of the second heater of 175.5°C, and a temperature Ty_2 at the exit of the second heater of 183.5°C.

For a first contact heater at a temperature of 400°C, it can be shown using the above relationship that a 1cm increase in contact length gives an increase in output temperature of 1.6°,whereas with a smoothing heater substantially at the twist setting temperature, 225°C, of the yarn a similar increase in contact length gives an increase in output temperature of only 0.25°C.

Similarly, consider a first non-contact heater having a length of 0.75m and a temperature of 650°C, and a contact smoothing heater immediately downstream thereof having a length of 0.25m and a temperature of 225°C. Using a computer model taking into account heating by radiation and mixed air convection, it is predicted that the yarn temperature at exit from the non-contact heater and inlet to the contact heater will be 176°C. Using the above relationship for the second heater gives a yarn temperature at the exit of the second heater of 183.7°C.

The smoothing heater 31 provides a substantially straight yarn path which is aligned with the path of the yarn 13 through the non-contact first heater 32. This enables the whole of the twisting zone from the false twisting device 17 back to the twist stopping yarn guide 23 to be substantially straight for good twist propagation, but within a reduced overall length in comparison with the prior known arrangements shown in Fig 1.

A temperature sensor 33 is provided adjacent the exit end of the first heater 32 to sense the temperature of the yarn 13 as it leaves that heater and passes to the smoothing heater 31. The sensor 33 provides an output signal proportional to the yarn temperature, and the signal is fed to the control means 34 which controls the temperature of the first heater 32 by adjustment of the electrical input thereto if the yarn temperature lies outside the aforementioned range of between 85% and 98% of the predetermined twist setting temperature of the yarn 13.

It can be seen from the above that the conventional arrangement and the arrangements in accordance with the invention give comparable heating of the yarn, but that the overall length of the heating zone in the latter two cases (1 metre) is appreciably less than that of the former conventional case (2.25metres). In addition to the above-mentioned advantages in reduction in machine dimensions and cost, the arrangement

of the invention provides easier access by the operator and maintenance personnel to the inlet end of the heating zone using a trolley instead of a ladder and upper walkway as is required with the conventional arrangement. Furthermore the output temperature of the yarn from the two heaters in accordance with the invention, i.e. a high temperature first heater and a smoothing heater substantially at the twist setting temperature of the yarn, is more accurately controlled than is possible by using a high temperature heater alone.

Claims

1. A yarn heating arrangement, disposed in a crimping zone, characterised by a first heating means (32) maintained at a temperature in excess of a predetermined crimp setting temperature of the yarn (13) and operable to heat the yarn (13) to a temperature less than the predetermined crimp setting temperature, and downstream of the first heating means (32) a smoothing heater (31) maintained substantially at, and operable to heat the yarn (13) substantially to, that predetermined crimp setting temperature.

2. A yarn heating arrangement according to claim 1, characterised in that the crimping zone extends between twist stopping means (23) and false twisting means (17).

3. A yarn heating arrangement according to claim 1 or claim 2, characterised in that the first heating means (32) is operable to heat the yarn (13) to a temperature in the range from 85% to 98% of the predetermined twist setting temperature the yarn (13).

4. A yarn heating arrangement according to claim 3, characterised by yarn temperature sensing means (33) disposed adjacent the exit end of the first heating means (32).

5. A yarn heating arrangement according to claim 4, characterised by control means (34) operable to receive a signal from the yarn temperature sensing means (33) and to control the temperature of the first heating means (32) in response to that signal if the yarn temperature lies outside that range.

6. A yarn heating arrangement according to any one of claims 1 to 5, characterised in that the first heating means (32) is maintained at a temperature in excess of the melting temperature of the yarn (13).

7. A yarn heating arrangement according to claim 6, characterised in that the first heating means (32) is a non-contact heating means operable to heat the yarn (13) by radiation.

8. A yarn heating arrangement according to any one of claims 1 to 7 characterised in that the smoothing heater (31) comprises a plate providing a substantially straight yarn path which is substantially in alignment with the path of the yarn (13) through the first heating means (32).

9. A yarn heating arrangement according to any one of claims 1 to 8 characterised in that the smoothing heater (31) is maintained at a temperature in the range 180°C to 280°C.

10. A yarn heating arrangement according to any one of claims 1 to 9 characterised in that the first heating means (32) has a length of substantially 0.75 metres and the smoothing heater (31) has a length of substantially 0.25 metres.

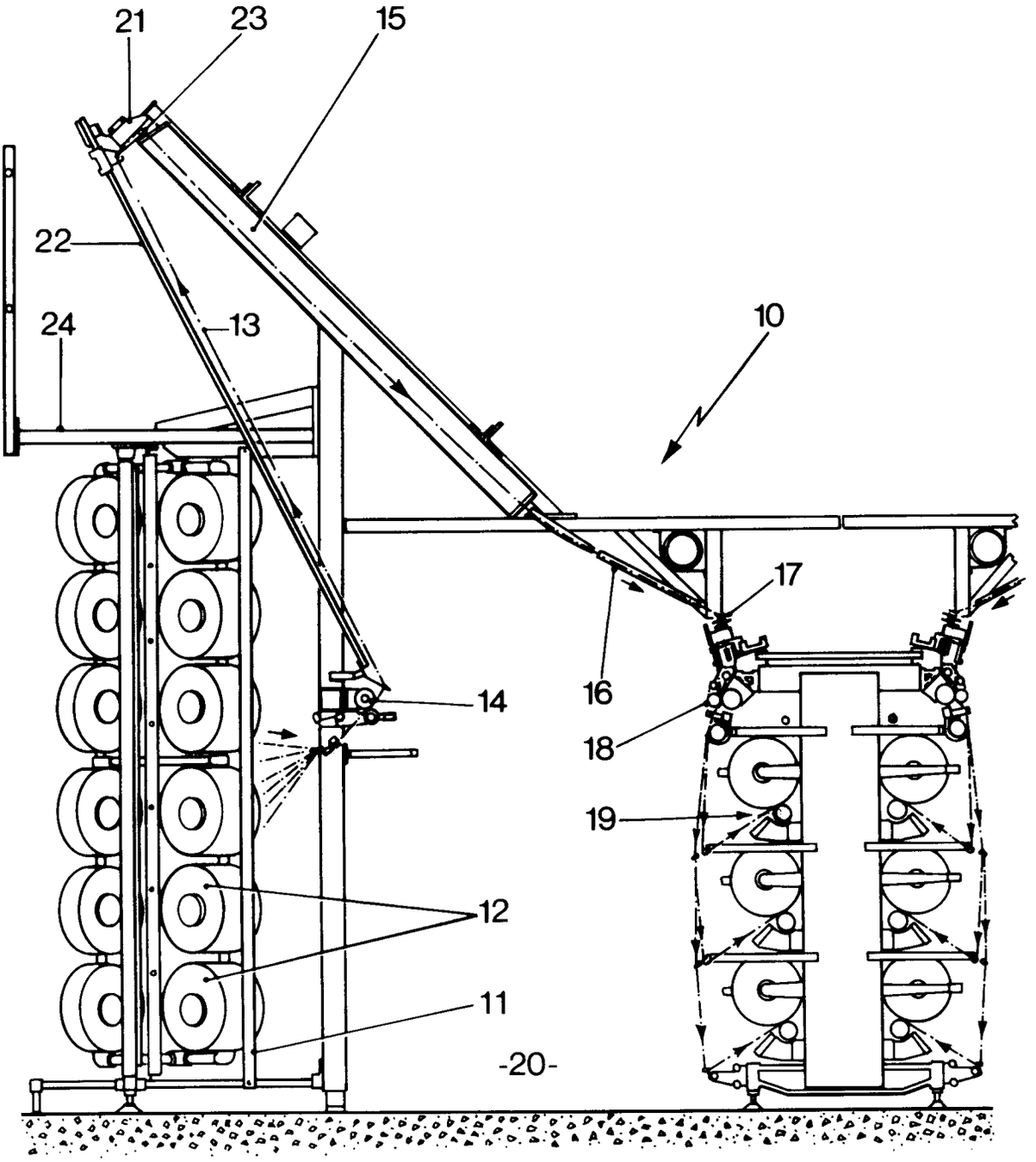

FIG. 1

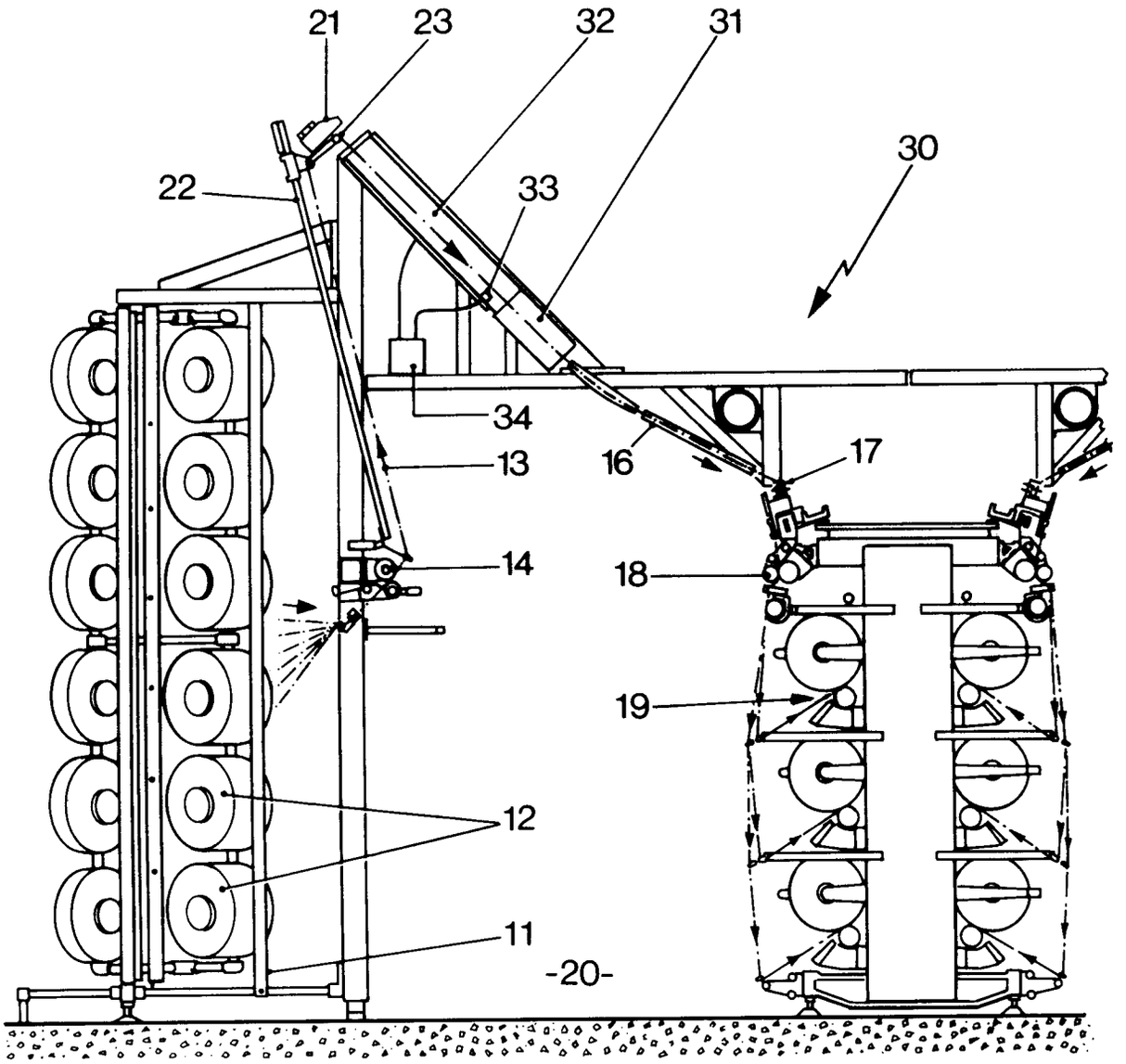

FIG. 2

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 91 30 6633

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
Y	PATENT ABSTRACTS OF JAPAN vol. 14, no. 17 (C-675)(3960) 16 January 1990 & JP-A-63 086 840 (TEIJIN SEIKI CO LTD) 17 October 1989	1,3,6, 7-10	D 02 G 1/02 D 02 J 13/00
A		2	
	– – –		
P,Y	EP-A-0 412 429 (BARMAG AG)	1-3,6, 7-10	
P,A		2	
	– – –		
Y	US-A-3 237 392 (CROUZET) * whole document * *	1-3,6,9	
A		8	
	– – –		
A	DE-A-2 211 658 (DIENES-HONEYWELL GMBH) * whole document * *	4,5	
	– – –		
P,A	DE-A-4 035 698 (DU PONT) * page 2, line 48 - page 3, line 9 * *	4,5	
	– – – – –		

TECHNICAL FIELDS SEARCHED (Int. Cl.5)
D 02 G D 02 J

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
The Hague	25 November 91	HOPKINS S.C.

CATEGORY OF CITED DOCUMENTS

- X : particularly relevant if taken alone
- Y : particularly relevant if combined with another document of the same catagory
- A : technological background
- O : non-written disclosure
- P : intermediate document
- T : theory or principle underlying the invention
- E : earlier patent document, but published on, or after the filing date
- D : document cited in the application
- L : document cited for other reasons

& : member of the same patent family, corresponding document