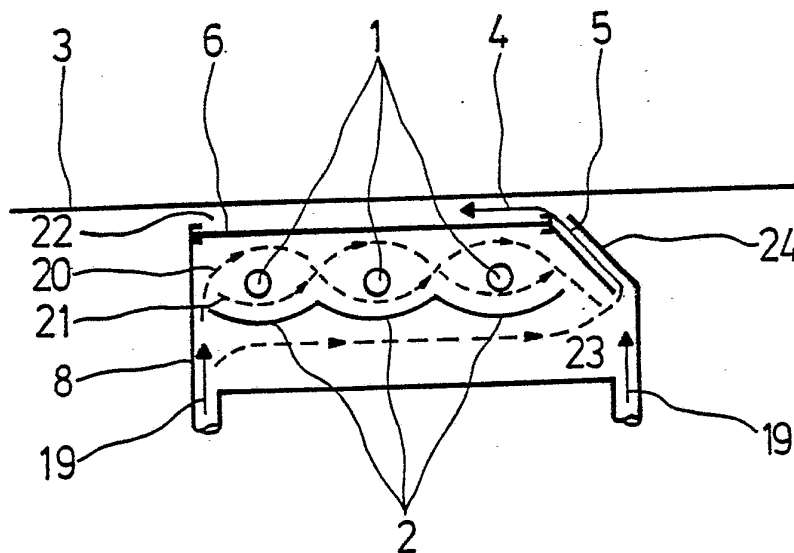




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(54) Title: ARRANGEMENT FOR DRYING A RUNNING WEB



(57) Abstract

An arrangement for drying a running paper web (3) by heat treatment. The treatment is carried out by heat emitting sources, the heat means comprising separate heat units (8) for the emittance of wavelengths in infrared light spectra. The heat unit (8) is provided by light reflecting elements. Said heat unit (8) comprises a closed box-like body member (18), which extends over the web transverse length. The infrared emitter lamp (1) unit is located in said body member (18), as well as air intake (7) and outtake members and guide elements (24; 6) for circulating air streams through the heat unit (8) and guiding the heated air streams in a space between said heat unit (8) and the running web (3). The intake member (7) is connected to an air supply source. The body member (18) comprises a plate-like barrier element (6) located between the web and the emitter lamp (1) unit. The barrier element (6) prevents air to stream from the body interior (23) towards the web and permits the infrared light wavelengths to pass through said barrier element (6). The air supply source, guide elements (24; 6) and barrier element (6) are arranged in cooperation so that the air flow between the running web (3) and the barrier element (6) generates an air cushion effect, a Coanda-effect or the like.

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ARRANGEMENT FOR DRYING A RUNNING WEB
BACKGROUND OF THE INVENTION

The invention relates to an arrangement for drying a running web or the like by heat treatment, which is carried out by means of heat emitting sources, preferably by electrical heat means comprising at least one separate heat unit for the emittance of wavelengths in infrared light spectra. The heat unit is provided by light reflecting elements.

PRIOR ART

The drying of the running web is rather important if the web is coated with a coating substance, which includes water as the fluency element. During the application of coating substance onto the web and the levelling of the coating layer in a levelling member, say a nip member, water maintains the fluency property of the substance and, hence, facilitates an uncomplicated and easy working phase. A commonly used substance concentration includes about 40% of water, which must be removed from the levelled coating layer and the running web, in which a portion of the water amount has penetrated. A typical method to dry the web is to blow air streams either against or parallel to the web so, that the web is maintained contactless from air stream supply boxes, and preferably at a predetermined fixed distance from them. This method is based on the application of unsaturated gas substance, which carries away the vaporized water from the web and the coating layer. And as widely known, the vaporization is speeded up if the temperature of the wet coating or of the air stream is increased, the contact area between liquid and gas phases is enlarged, the saturation degree of the gas phase is decreased, the flow rate in the gas phase is increased or the penetration of the water vapour phase from the web/coating layer is speeded up.

A typical drying process is based on heated air which raises the temperature of the web and the wet coating substance. The heated air has an increased ability to receive water vapour, that is, the relative saturation of the air stream

is initially lowered by heating. It is important to realize an economical system and at the same time an effective vapour carrier media. A portion of the heated air stream is guided out of the heating process and replaced by an amount of insaturated and heated air. Hereby the total humidity amount carried by the air stream will not result in to a value too near the saturation point. The indirect heating of the wet web by means of the heated air is slow and rather ineffective, since the major part of the heated air hardly comes into contact with the web.

Another method is based on a direct heating of the wet web by means of infrared heating. If a suitable light spectra range is used, a quick and an even vapourization is possible. The direction of the infrared rays is effected by reflecting elements placed in co-operation with light emitting lamps. In this method, however, the air in the vicinity of the heat treated web does not move fast enough, and hence, the air is very near to the saturation point and the vapourization is hampered.

OBJECT AND SHORT DESCRIPTION OF THE INVENTION

The object of the invention is to create a drying arrangement, which includes the favourable properties of the devices of the prior art, and at the same time avoids the drawbacks of the prior art.

The object of the invention is realized by means of the arrangement presented in the main claim. The invented arrangement includes members for a direct heating of the wet web by infrared light and members for keeping the vapor saturation value at low level in the vicinity of the running web. The low level is maintained by a partial recirculation of the heated air streams which receive the heat from light emitter lamps. The air streams are governed to create an air cushion, Coanda or the like effect, so that the web is out of contact with the box-like body member extending over the

web transverse length. The infrared light penetrates through a barrier element located between the web and the lamp.

A portion of the air flow in the air cushion can be directed through recirculation elements back into the body member to be reheated. The heat economy is hereby positively effected. The air outtake members being properly arranged, the running web can be held at a predetermined distance from the barrier element.

A typical barrier element is a glass plate with low infrared light absorption index. The best heat transfer effect, and the cooling of the hot infrared lamp, is possible by guiding the air circulation around the lamp, which can be placed parallel to web running direction or web transverse length. Another possibility is to guide streams around a conversion member of the lamp, said conversion member being a typical electricity-light emittance conversion element producing heat energy with high rate.

The outtake members can be elongated and parallelly placed slots. A favourable set includes at least two separate heat units, placed for instance, so that each web side is treated at least by one unit.

The air streams from two neighbouring units can be either parallelly or oppositely directed. The oppositely directed streams can either approach or move away from each other. If a number of heat units are placed in a row one after another in the web running direction, at least one unit directs air streams in a direction opposite to other streams.

BRIEF DESCRIPTION OF DRAWING

The invention is described more in detail with reference to the attached drawing in which

- fig 1 discloses an embodiment of the invention in a

- general view and partly sectioned,
- fig 2 shows a sectional side view of the device of fig 1,
 - fig 3-6 show some arrangements of a number of devices set in co-operation with a running web.

The heat unit is marked with reference numeral 8. An infrared emitter lamp 1 is provided by a reflector mirror 2 for directing and concentrating infrared light on a running web 3. Air stream 4 is guided through a slot 5 of a box-like body 18 into a space between web 3 and a glass plate 6, which forms the top (or bottom) cover of body 18. Body 18 is provided by an air tube 7 for the air intake into body 18. A favourable arrangement is such that air intake is carried out around the electric-light conversion member 9 of lamp 1. If several units 8 are placed in a row, air flows from two neighbouring units 8 can be directed in several alternative ways 10-13 relative to each other or the web running direction 26. Unit 8 can also be in co-operation with a reflector 14 so that web 3 is running between unit 8 and reflector 14. In certain cases it is favourable to place ordinary air stream boxes 15,16 in co-operation with unit 8, whereby air streams from boxes 15,16 maintain web 3 at a fixed distance from unit 8. At the same time, web 3 is pre- and posttreated with a measure, which accelerates the vapour motion away from the vicinity of the web, which in turn decreases the saturation level near the web.

Body 18 can be further provided by air tube 17 for the recirculation of air stream indicated by numerals 4,10-13. The lamp cooling stream is marked with numeral 19, air circulation around lamp 1 by 20,21 and the space between glass 6 and web 3 by 22. The interior 23 of body 18 is not shown in detail. The front plate 24 of body 18 is shaped to guide air stream 4,10-13 in a suitable manner. A portion of air stream 4,10-13 is recirculated in body 18, this portion 25 is mixed in interior 23 with fresh stream 19. Reference numeral 27 refer to the recovery or collector elements of

the air recirculation system or to the outflow of air streams from heat unit 8 to the surrounding.

The invention is not limited to embodiment shown, but several modifications thereof are feasible within the scope of the attached claims.

CLAIMS

1. An arrangement for drying a running paper web or the like by heat treatment, said treatment being carried out by means of heat emitting sources, preferably by electrical heat means comprising at least one separate heat unit for the emittance of wavelengths in infrared light spectra, said heat unit being provided by light reflecting elements, the improvement being in that said heat unit comprises a mainly closed box-like body member, which extends at least mainly over the web transverse length, or comprise a number of separate box-like body members arranged side-by-side to extend over said transverse length, at least one infrared emitter lamp unit in said body member, air intake and outtake members and guide elements for circulating air streams through said heat unit and guiding the heated air streams in a space between said heat unit and said running web, said intake member being connected to an air supply source, said body member comprising a plate-like barrier element located between said web and said emitter lamp unit, said barrier element preventing air to stream from said body interior towards the web and permitting the infrared light wavelengths to pass through said barrier element, said outtake members being extended or distributed mainly over said transverse web length and in co-operation with a first element of said guide elements, said barrier element forming a second element of said guide elements, said air supply source, guide elements and barrier element being arranged in co-operation so that the air flow between said web and said barrier element generates an air cushion effect, a Coanda-effect or the like.

2. Arrangement according to claim 1 in which said air intake members are provided with a connection member including a closure element, said connection member being located in the vicinity of said space between the web and the barrier unit, said connection facilitating a recirculation of said heated air flow, whereby said heated air flow forms a partial source of said air supply source.

3. Arrangement according to claim 1 or 2 in which said air outtake members include at least one, preferably unique, slot-like opening extending over said transverse length, whereby the geometry of said slot-like opening, barrier element and first guide element are so arranged that the distance between said running web and said barrier element is controlled by the air flow speed relative to the web speed.

4. Arrangement according to claim 1 or 2, in which said barrier element is a glass plate or the like.

5. Arrangement according to claim 1 or 2, in which the circulation of air streams inside said body member is guided around said emitter lamp unit, thereby providing a heat transmission effect from said lamp to the air streams.

6. Arrangement according to claim 5, in which the heated air streams are guided to and through said outtake members.

7. Arrangement according to claim 1 or 2, in which said elongated emitter lamps are mounted along said web transverse length.

8. Arrangement according to claim 1 or 2, in which said elongated emitter lamps are mounted in a parallel position relative to the web running direction.

9. Arrangement according to claim 1 or 2, in which said air outtake members comprise a number of parallel slot-like openings, which extend mainly over the body member in a direction parallel to the web running direction.

10. Arrangement according to claim 1 or 2, in which said intake member is connected to a separate air supply source containing air at ambient temperature, air streams from said source being mainly guided around a conversion member of said lamp unit, said conversion member converting electrical energy to light emission and heat generation.

11. Arrangement according to claim 1 or 2, in which said web is treated by at least two separate heat units.

12. Arrangement according to claim 11, in which both opposite sides of said web are faced by at least one heat unit.

13. Arrangement according to claim 11, in which air streams from two neighbouring heat units are parallelly directed.

14. Arrangement according to claim 11, in which air streams from two neighbouring heat units are oppositely directed, either approaching each other or moving away.

15. Arrangement according to claim 14, in which a number of consecutive heat units generate air streams, of which at least one is oppositely directed relative to other air streams.

16. Arrangement according to claim 1 or 2, in which said heat unit is arranged in co-operation with a separate air stream supplying unit, which generates an air cushion effect, a Goanda-effect or the like.

17. Arrangement according to claim 1 or 2, in which said heat unit is applied for treating a running paper or cardboard web in a papermaking machine, a calander, a coater or the like.

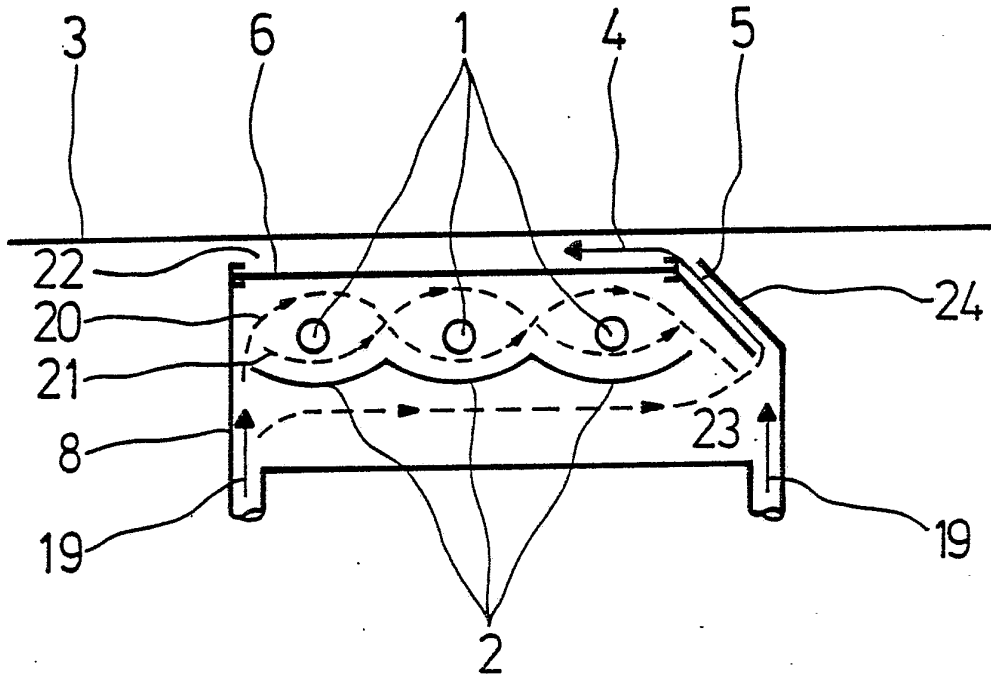


Fig. 2

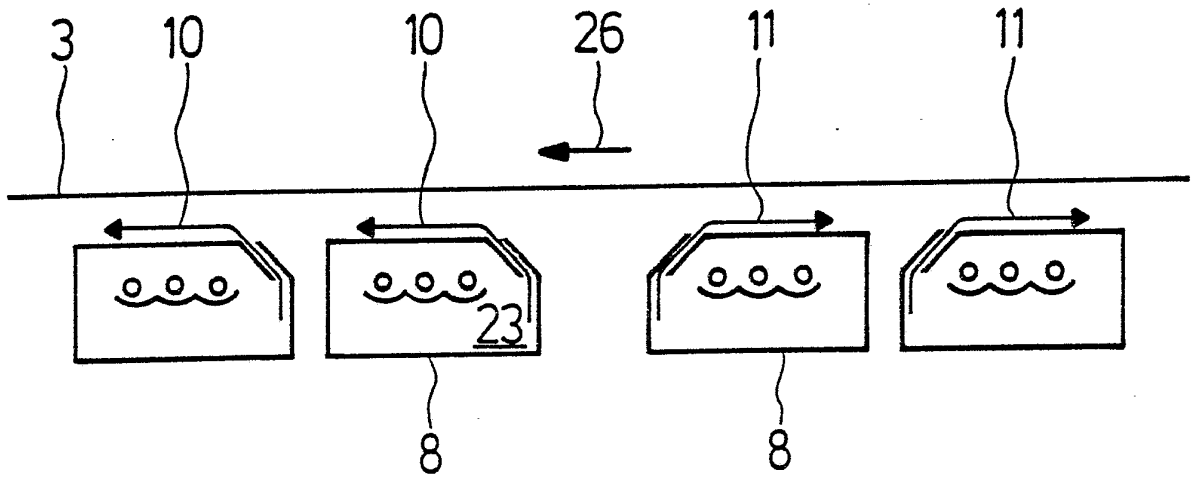


Fig. 3

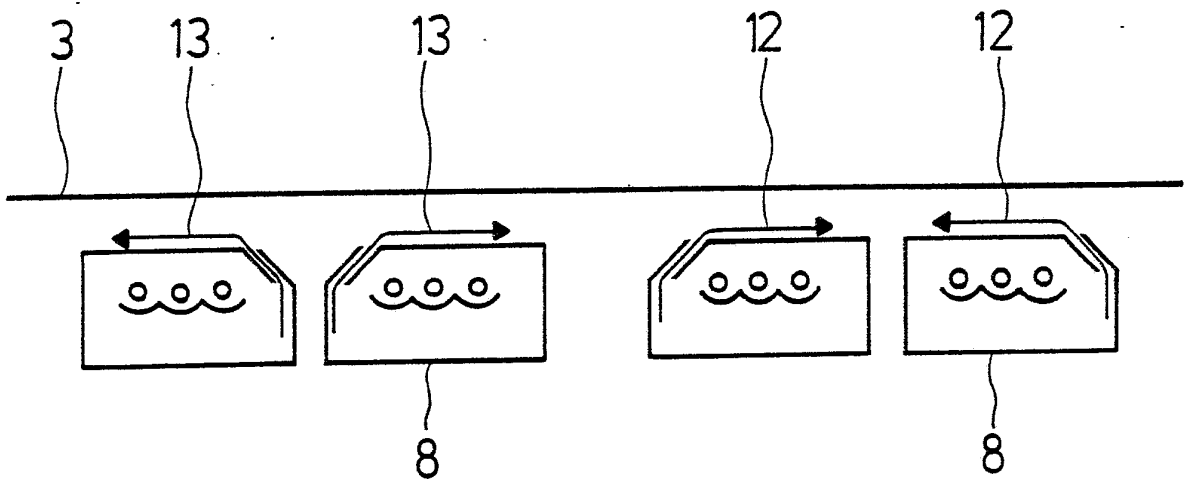


Fig. 4

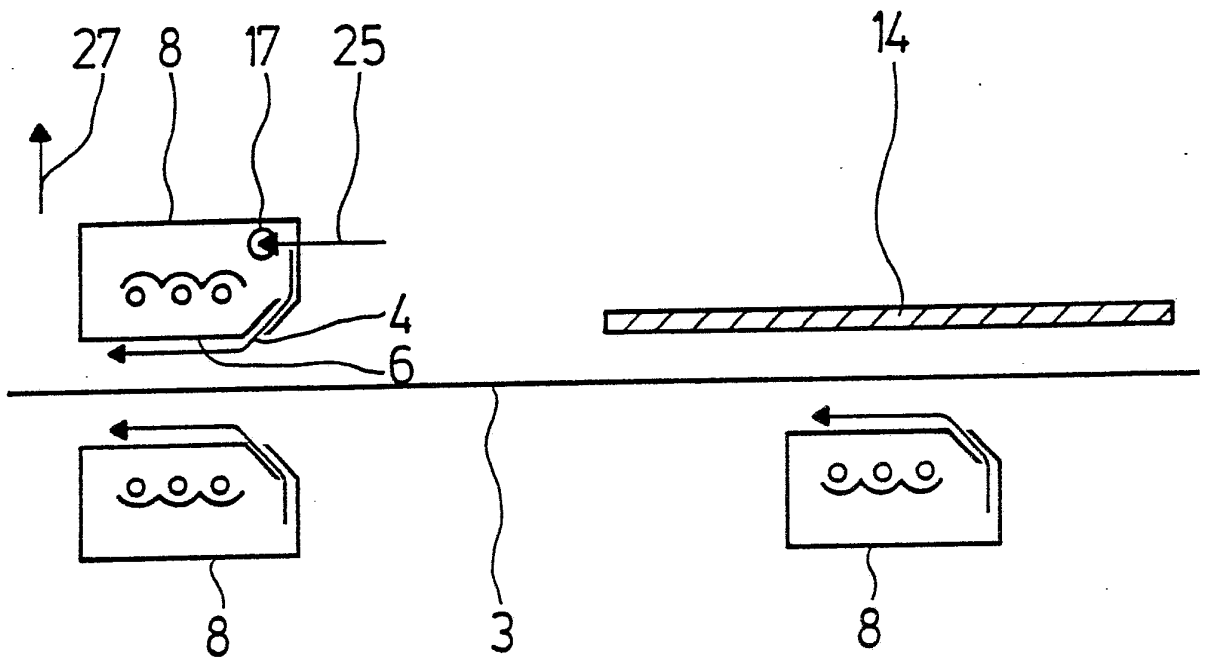


Fig. 5

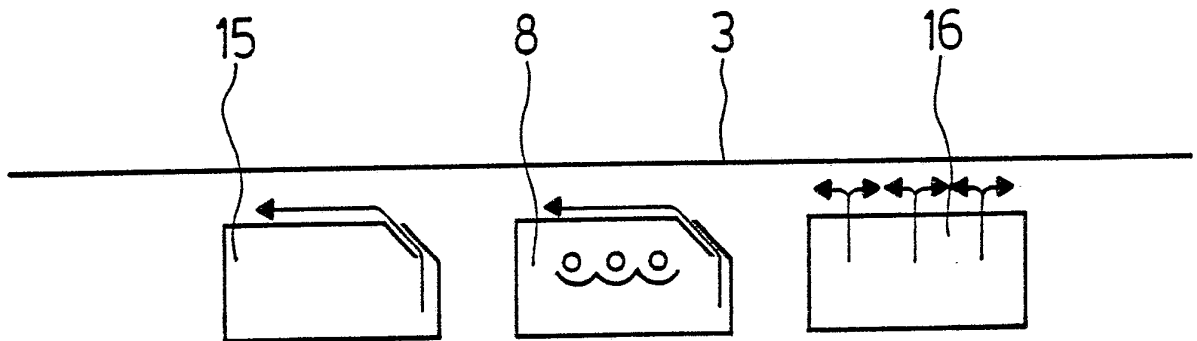


Fig. 6

INTERNATIONAL SEARCH REPORT

International Application No. PCT/FI87/00031

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶		
According to International Patent Classification (IPC) or to both National Classification and IPC ⁴ D 21 F 5/16, 5/18		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
IPC	D 21 F 5/16, /18; F 26 B 3/30, 13/10, 23/04, /06; B 41 F 23/04	
US Cl	34:4, 41, 68, 156	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸		
SE, NO, DK, FI classes as above		
III. DOCUMENTS CONSIDERED TO BE RELEVANT ⁹		
Category [*]	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	
	Relevant to Claim No. ¹³	
E	SE, A, 8600529-5 (ITRONIC PROCESS AB) 7 August 1987	1, 4-6, 8, 11, 13, 17
X	US, A, 4 594 795 (STEPHANSEN) 17 June 1986	1, 4-6, 8, 9, 11-13, 17
Y	US, A, 4 494 316 (STEPHANSEN ET AL) 22 January 1985 & DE, 3317714 SE, 8303172 GB, 2136549 FR, 2542858	1, 14-16
Y	US, A, 4 290 210 (JOHANSSON) 22 September 1981 & EP, 0012731 JP, 55077685 AT, 524 CA, 1129639 SE, 7812565 SE, 429770	1, 14-16
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<p>[*] Special categories of cited documents: ¹⁰</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"&" document member of the same patent family</p>		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search 1987-09-18	Date of Mailing of this International Search Report 1987-09-23	
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III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		
Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No
A	EP, A, 0 009 195 (SIEMENS AKTIENGESELL - SCHAFT) 2 April 1980	
A	US, A, 3 499 232 (E.J. ZIMMERMANN) 10 March 1970	