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(54) Fire suppression system.

(57) A cabinet (5) containing electrical or electronic components or equipment such as printed circuit boards (12) is protected against fire by a water spray system. The water spray system comprises spray pipes (12,14,16 and 18) carrying respective spray nozzles (24) and supplied with pressurised water. Two of the spray pipes (12,14) are arranged across the front of the cabinet (20) so that the water sprays from their respective nozzles (24) are directed towards each other across a void at the front of the cabinet. The sprays from the nozzle (24) on one of these pipes (12) thus collide with the sprays from the nozzles (24) on the other pipe (14). In addition, the sprays from adjacent nozzles collide with each other. The other two spray pipes (16,18) are similarly arranged, and similar collisions occur there. Multiple re-direction of the sprays takes place in response to each such collision and this causes the water sprays to penetrate the interstices between the circuit boards (12) and other components.

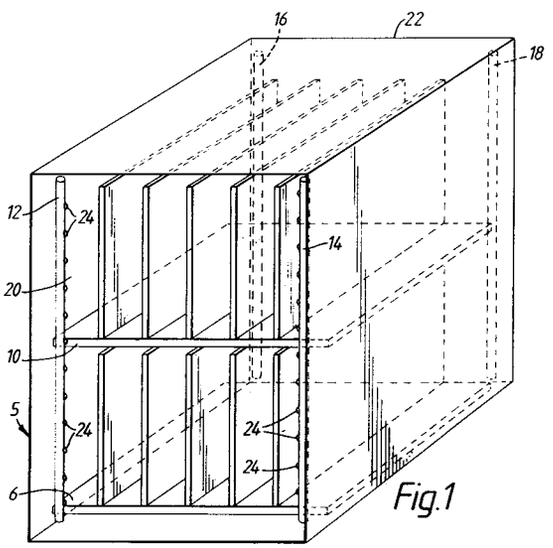

Fig.1

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The invention relates to a fire suppression system for suppressing fires within a cluttered area, comprising nozzle means within the area for producing a plurality of water jets arranged to collide with each other. The invention also relates to a method of fire suppression for suppressing fires within a cluttered area, comprising the steps of producing a plurality of water jets within the enclosure which are arranged to collide with each other.

Such a system and method are known from GB-A-1 483 041. The invention aims to provide a system and method having improved effectiveness.

According to the invention, the known system is characterised in that the nozzle means comprises water spray means for producing the water jets in the form of water sprays, in that at least some of the spray means produce water sprays moving in opposite directions into collision so as to provide at least a partial re-direction of the sprayed water into interstices within the clutter, and in that the area is a walled enclosure.

According to the invention, the known method is characterised in that the water jets are in the form of water sprays, in that at least some of the sprays move in opposite directions into collision so as to provide at least a partial re-direction of the sprayed water into interstices within the clutter, and in that the area is a walled enclosure.

Fire suppression systems and methods according to the invention and for suppressing fires in cabinets containing telecommunications or other electronics equipment will now be described, by way of example only, with reference to the accompanying diagrammatic drawings in which:

Figure 1 is a perspective front view of the cabinet with its door removed;

Figure 2 is a top view of the inside of the cabinet (that is, with the top of the cabinet removed); and

Figures 3 and 4 show diagrams of water sprays in the cabinet (the structure of the cabinet being omitted).

The cabinet 5, in which fires are to be detected and suppressed, is illustrated in Figures 1 and 2 as containing electronic circuits which, in this example, take the form of racks 6 and 10 of printed circuit boards 12. The arrangement of the racks and the printed circuit boards is shown purely by way of example and will obviously vary widely. The Figures show the cabinet as being substantially fully occupied by the racks of printed circuit boards. However, in other examples it would be less fully occupied. Instead of all or some of the racks of the printed circuit boards, there could be other electronics equipment or components.

It is important to be able to detect and suppress fires in such cabinets - both to protect the equipment in the cabinet itself and also, of course, to prevent spread of the fire outside the cabinet.

It is known to use Halon and similar chemical fire suppression agents. Such agents, and other gaseous-type agents, will satisfactorily penetrate most of the interstices between the circuit boards and other components or electronic equipment within the cabinet. However, the production of Halons is to be discontinued from January 1994 under recent amendments to the Montreal Protocol. It is therefore necessary to replace such fire suppressants with fire suppressant agents having zero ozone-depletion potential (ODP).

The system to be described uses water as the fire suppression agent.

As shown in Figures 1 and 2, the cabinet incorporates four (in this example) water spray bars 12,14,16 and 18. Spray bars 12 and 14 are vertically disposed on each side of the front 20 of the cabinet, while spray bars 16 and 18 are vertically disposed on each side of the rear 22 of the cabinet. The open front 20 of the cabinet is normally closed by a hinged door, not shown. Each of the spray bars is connected to a source of pressurised water from a water supply reservoir, not shown. This may be pressurised by nitrogen, for example, at an initial pressure of up to 100 bar.

Each spray bar 12,14,16 and 18 incorporates a number of spray nozzles 24. The spray nozzles 24 of spray bar 12 direct their water sprays across the front 20 of the cabinet towards spray bar 14, while the spray nozzles 24 of spray bar 14 direct their sprays in the opposite direction - that is, across the front 20 of the cabinet towards the spray bar 12.

Similarly, the spray nozzles of spray bars 16 and 18 respectively direct their sprays across the back 22 of the cabinet - towards the spray nozzles on the opposite spray bar.

The arrows in Figure 2 show the direction of the water sprays. As is shown in Figure 2, there are voids 26 and 28 at the front and back of the cabinet, thus providing a space for the sprays.

The cabinet incorporates a suitable fire detector. Advantageously, this is a high speed smoke detector. An individual smoke detector may be mounted within the cabinet. However, in a practical example there may be several generally similar cabinets to be protected. In such a case, the atmosphere within each cabinet may be sampled by respective sampling means, the atmosphere samples being conveyed (simultaneously or sequentially, for example) to a central monitoring point which checks each sample for the presence of smoke and is thus able to identify an incipient fire and the cabinet in which it is located.

The system may be arranged so that, in the event of initial detection of an incipient fire, the particular cabinet is shut down electrically, that is, completely disconnected from its power supply and from the external electrical circuits to which it is connected. The detection system will continue to sample the atmos-

phere within this cabinet (and in the other cabinets, of course). In many cases, electrical disconnection will be sufficient to stop the fire. The cabinet is then inspected and rectified as necessary. However, if further sampling shows that the fire is persisting, water spray discharge into the cabinet is then automatically initiated so that sprays are provided by all the spray nozzles 24.

The spray nozzles are narrow discharge angle nozzles arranged to produce generally flat sprays so that there is thus provided a continuous sheet of fine water droplets within the void 26 at the front 20 of the cabinet and within the void 28 of the rear of the cabinet. The spaces within these voids prevent loss of spray by impingement on solid objects within the cabinet. These sprays cool the front and rear of the cabinet and thus protect the cabinet and help to prevent spread of the fire. Such sprays alone, though, will not directly suppress the fire if, as is likely, it is originating on one of the circuit boards or within one of the electrical components, and is thus in a confined space between two such circuit boards or in one of the other interstices between components.

However, this problem is dealt with by arranging for the water sprays to collide with each other.

The primary collision takes place between the sprays emitted by the oppositely arranged spray bars: thus, the sprays from the nozzles of spray bar 12 collide with the sprays from the nozzles of spray bar 14, while the sprays from the nozzles of spray bar 16 collide with the sprays from the nozzles of spray bar 18. In addition, though, collision occurs between the sprays emitted by adjacent nozzles on the same spray bars, and the shapes of the sprays, and the separation between adjacent nozzles on the same spray bar, are arranged to optimise such collisions.

As shown in Figure 3, adjacent sprays 24A and 24B from nozzles 24 on spray bar 12 are fan-shaped and overlap so as to produce the required collisions. The sprays produced by the other nozzles can be similarly arranged.

The effect of all these collisions is to cause scattering of the droplets within each spray and to produce a highly turbulent environment, resulting in multi-directional sprays which thus access the interstices within the "clutter" inside the cabinet, providing very efficient fire suppression even where the location of the fire is deeply hidden. These effects are enhanced by the confining effect of the walls of the cabinet.

Figure 4 shows how the nozzles 24 on spray bar 12 can be aligned with the gaps between the nozzles on spray bar 14. This arrangement may be advantageous in providing a series of collisions across the width of the region 26.

The nozzles on spray bars 16 and 18 could be similarly arranged.

In the foregoing ways, therefore, water (which has a zero ODP) is given the same type of ability for penetrating interstices within internal clutter in the cabinet that a gaseous-type suppressant would have.

Clearly, the system needs to be designed to provide efficient spray collision. It is found that this is optimised by arranging for the separation between opposing spray bars to be not more than about 0.6m, and the maximum separation between spray nozzles on each spray bar should not exceed about 0.2m; these values depend, to some extent, on the design of the nozzles and the water pressure. The minimum effective working pressure has been found to be about 30 bar.

The majority of droplets produced by the spray nozzles are below 100 micrometres in diameter, with the average size about 60 micrometres. In other words, a fine spray is produced, and is generally described as a fog or a mist.

A fine spray of this type is advantageous because:-

(a) Extinction of the fires takes place largely by heat absorption by water due its high heat capacity and latent heat of vaporisation. This process is dependent on the surface area of the water and it therefore follows that a fine spray, having a high ratio of surface area to volume, is more efficient than a more coarse spray.

(b) A fine spray is more readily carried by turbulent air current than a coarser spray, resulting in more effective distribution of droplets within the cabinet.

(c) Smaller droplets are more likely to become entrained and carried into the combustion zone than larger particles.

The maximum separation of the spray bars (not more than about 0.6m as discussed above) means that larger cabinets (those having a cross sectional size greater than about 0.6m x 0.6m) may require more than the four spray bars shown in the Figures. The actual shape of the cabinet may also affect the number of spray bars required. For example, cabinets may not always be rectangular or square in cross-section.

In the cabinet illustrated in the Figures, there are voids 26 and 28 at the front and rear of the cabinets. In other cases, however, the voids may be arranged at the side or in some other way. It is important to arrange the spray bars so that the initial sprays emitted by the spray nozzles 24 are directed towards each other across a void so as to maximise the impact of the collision - that is, so that the primary sprays are not intercepted by any of the internal clutter.

Advantageously, the water used is de-ionised to minimise its electrical conductivity. It is found that the damage caused to the electrical components with such water is not normally significant; after drying out, electronic equipment not actually damaged by the fire will usually be found to work normally. The use of water is also advantageous in that its wetting ac-

tion helps to prevent fires. Furthermore, it will absorb water-soluble gaseous combustion products, thereby removing a number of toxic, irritant or corrosive gases.

Furthermore, infra-red radiation is attenuated by the water mist.

Another advantage of using the water is that the initial sprays are likely to result in electrical short circuits which will activate electrical protection equipment (e.g. circuit breakers), thus automatically electrically disconnecting the cabinet if it has not already been so disconnected.

Although the system described above has been shown as applied to a cabinet incorporating printed circuit boards or other electronic equipment, the application of the system is not limited in this way. It may be used in other applications where fire suppression within enclosures is required and where the enclosures incorporate substantial clutter, producing interstices within which physically obscured fires may arise. Examples of such other applications are engine enclosures or other enclosures incorporating complex machinery such as gas turbine enclosures, and computer disc racks, shelving containing books, video tapes and the like, ducts and other voids containing cable runs, hanging clothes stores, pyrotechnics magazines, laboratory fume cupboards, paint spray booths containing suspended items and ducts featuring multiple fuel pipes. A further application comprises storage cupboard containing gas storage tanks or other vessels with inflammable gases or liquids in them.

Claims

1. A fire suppression system for suppressing fires within a cluttered area (5), comprising nozzle means (12,14,16,18) within the area for producing a plurality of water jets arranged to collide with each other, characterised in that the nozzle means comprises water spray means (12,14,16,18) for producing the water jets in the form of water sprays, in that at least some of the spray means (e.g. 12,14;16,18) produce water sprays moving in opposite directions into collision so as to provide at least a partial re-direction of the sprayed water into interstices within the clutter, and in that the area is a walled enclosure (5).

2. A system according to claim 1, characterised in that the walled enclosure (5) is sufficiently confined to create turbulence within the enclosure.

3. A system according to claim 1 or 2, characterised in that the water spray means (12,14,16,18) includes spray means (12,14,16,18) for producing adjacent water sprays colliding with each other while moving in the same direction.

4. A system according to any preceding claim, characterised in that the water spray means comprises first (12 or 16) and second (14 or 18) pluralities of water spray nozzles (24), the first (12 or 16) and second (14 or 18) pluralities of nozzles (24) being mounted within the enclosure (5) so that the water sprays from each of the pluralities of nozzles (24) are directed across a region (26,28) within the enclosure (5) towards and into collision with the water sprays from the other plurality of nozzles (24).

5. A system according to claim 4, characterised in that the said region (26,28) of the enclosure is substantially free of the said clutter.

6. A system according to claim 4 or 5, characterised in that the water spray from each said nozzle (24) is directed partially into the path of, so as to collide with, the water spray from an adjacent one of the nozzles (24).

7. A system according to any one of claims 4 to 6, characterised in which the first (12 or 16) and second (14 or 18) pluralities of nozzles (24) are arranged adjacent a face (20 or 22) of the enclosure (5) so as to produce a combined spray of water over the inside of that face.

8. A system according to any preceding claim, characterised by pressurising means for pressurising the sprayed water.

9. A system according to any preceding claim, characterised by fire detecting means for detecting a fire within the enclosure and for initiating the said water sprays.

10. A system according to any one of claims 4 to 9, characterised in that each said plurality (12,14,16,18) of nozzles (24) is mounted on a respective substantially rectilinear pipe (12,14,16,18) supplying all that plurality of nozzles (24).

11. A system according to claim 10, characterised in that the separation between the pipes (12,14,16,18) is not more than about 0.6 metres.

12. A system according to claim 10 or 11, characterised in that the nozzles (24) on each pipe (12,14,16,18) are separated by not more than about 0.2 metres.

13. A system according to any preceding claim, characterised in that the water is de-ionised.

14. A method of fire suppression for suppressing fires within a cluttered area (5), comprising the steps of producing a plurality of water jets (12,14,16,18) within the enclosure (5) which are arranged to collide with each other, characterised in that the water jets are in the form of water sprays, in that at least some of the sprays move in opposite directions into collision so as to provide at least a partial re-direction of the sprayed water into interstices within the clutter, and in that the area is a walled enclosure (5).

15. A method according to claim 14, characterised in that at least some of the water sprays are adjacent to each other and collide while moving in the same direction.

16. A method according to claim 14 or 15, including the step of directing the water sprays from each side of and across a region (26 or 28) within the enclosure (5) towards and into collision with each other.

17. A method according to claim 16, characterised in that the said region (26 or 28) of the enclosure (5) is substantially free of the said clutter.

18. A method according to claim 16 or 17, characterised by the step of causing a water spray from each side of the region (26 or 28) to collide with a water spray from the same said side.

19. A method according to any one of claims 16 to 18, characterised in that the water sprays on each side of the region (26 or 28) are arranged adjacent a face (20 or 22) of the enclosure (5) so as to produce a combined spray of water over the inside of that face (20 or 22).

20. A method according to any one of claims 14 to 19, characterised by the step of detecting a fire within the enclosure (5) and initiating the said water sprays.

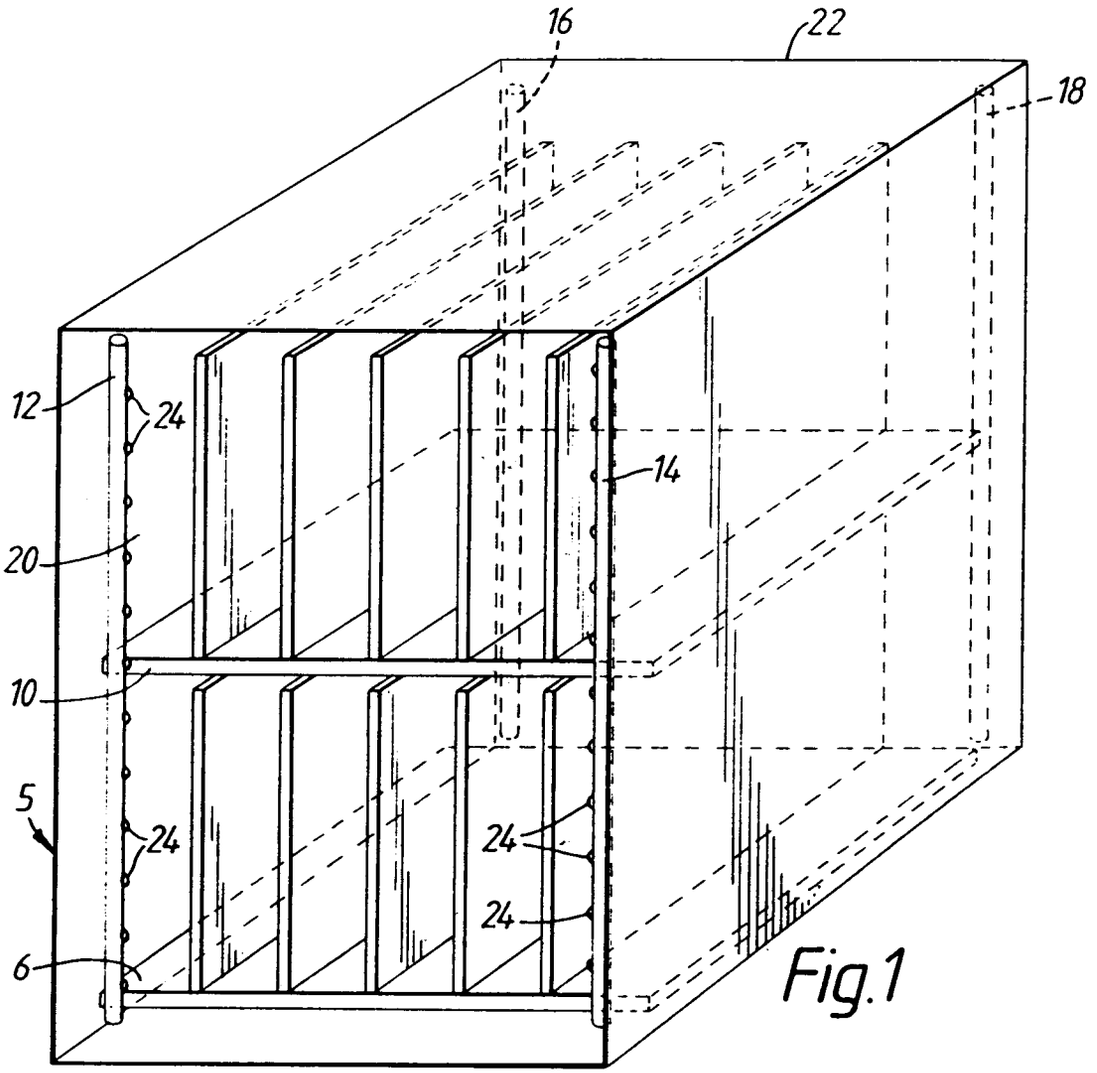

Fig.1

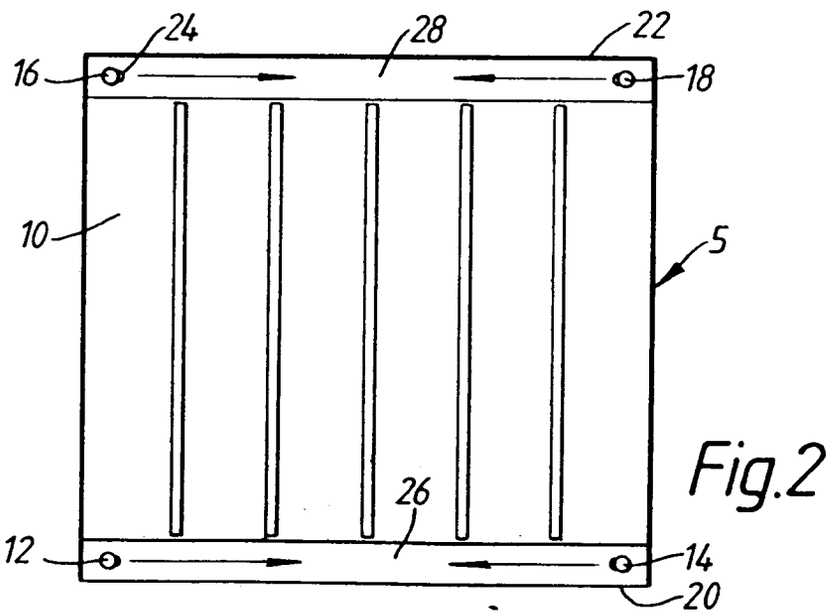

Fig.2

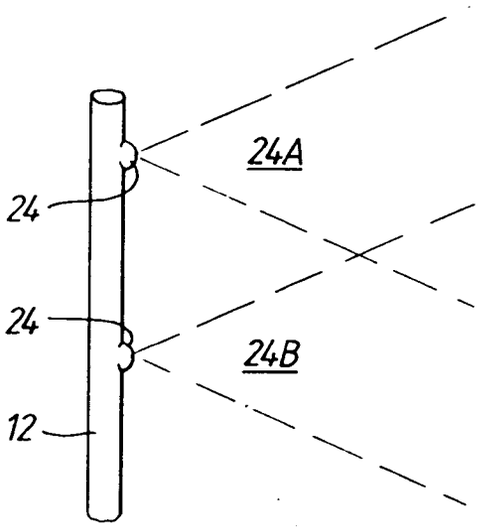

Fig.3

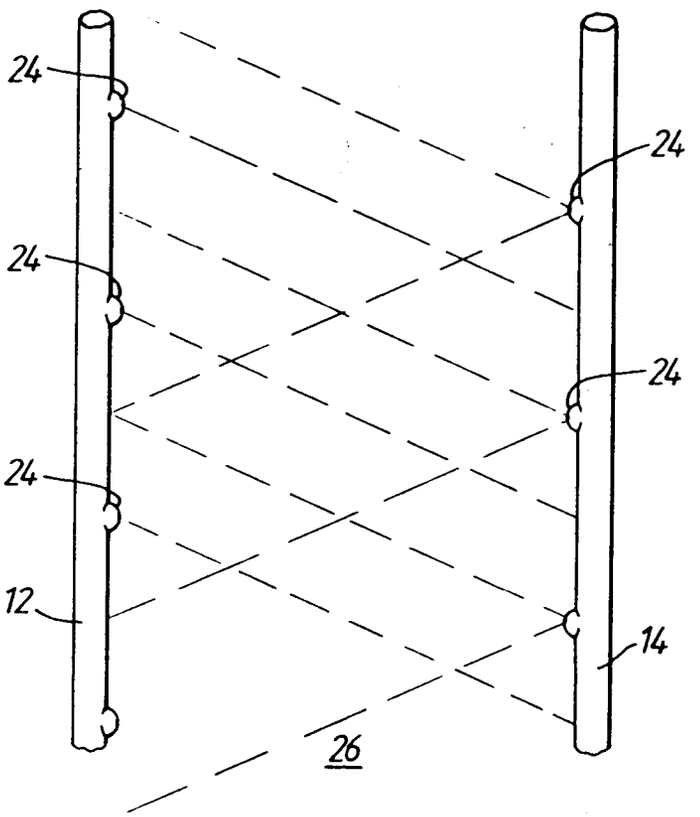

Fig.4

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 94 30 8037

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.6)
P,X	WO-A-93 25276 (SUNDHOLM) * page 3, line 9 - page 4, line 9; figures 1,2 *	1-6, 8-10, 14-18,20	A62C39/00 A62C3/16
A	US-A-3 684 019 (EMMONS) * column 3, line 30 - column 6, line 27; figures 1-7 *	1-6,9, 10, 14-18,20	
A	US-A-3 702 159 (LIVINGSTON) * column 3, line 17 - column 6, line 28; figures 1-4 *	1-6,9, 10, 14-18,20	
A	US-A-5 083 618 (HAYES) * column 1, line 66 - column 4, line 13; figures 1-6 *	1,3,14, 16	TECHNICAL FIELDS SEARCHED (Int.Cl.6) A62C
A,D	GB-A-1 483 041 (NASH)	1,14	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	13 February 1995	Triantaphillou, P

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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