(12) UK Patent Application (19) GB (11) 2 182 746 (13) A

(43) Application published 20 May 1987

(21) Application No 8627408

(22) Date of filing 17 Nov 1986

(30) Priority data
(31) 67969 (32) 19 Nov 1985 (33) IT

(71) Applicant
Prima Industrie S.p.A.

(Incorporated in Italy)

10121 Torino, Via San Quintino 28, Italy

(72) Inventors
Elvio Berardi
Domenico Russo

(74) Agent and/or Address for Service
Reddie & Grose,
16 Theobalds Road, London WC1X 8PL

(51) INT CL⁴
F16P 1/02

(52) Domestic classification (Edition I):
F2J 2D
U1S 1909 F2J

(56) Documents cited
GB A 2108742

(58) Field of search
G4N
F2J
Selected US specifications from IPC sub-classes G08B
F16P

(54) A protection device for carbon dioxide laser machines

(57) A protection device which can be associated with a machine 1 utilising a carbon dioxide laser 2 to define the working zone for a laser beam and to prevent the beam itself from striking objects disposed outside the working zone 7. The protection device is provided with an inspection window 9 closed by a transparent body 11 made by superimposing at least two layers of polymethyl methacrylate between which there is interposed an electrical conductor constituting part of a safety circuit 17. Change of an electrical parameter of the electrical conductor, upon being struck by the laser beam, is sensed by the circuit 17 which causes the laser to be turned off and/or warning devices to be actuated.

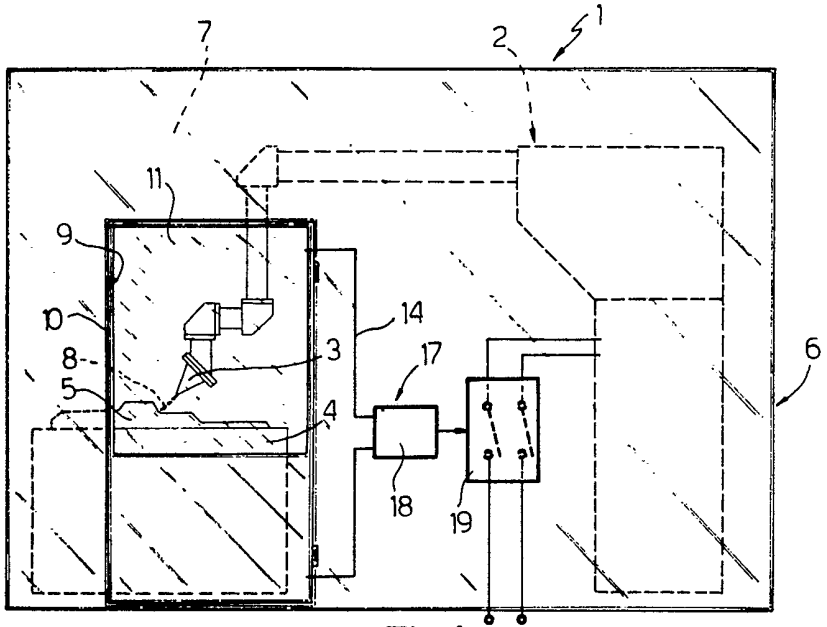

Fig.1

GB 2 182 746 A

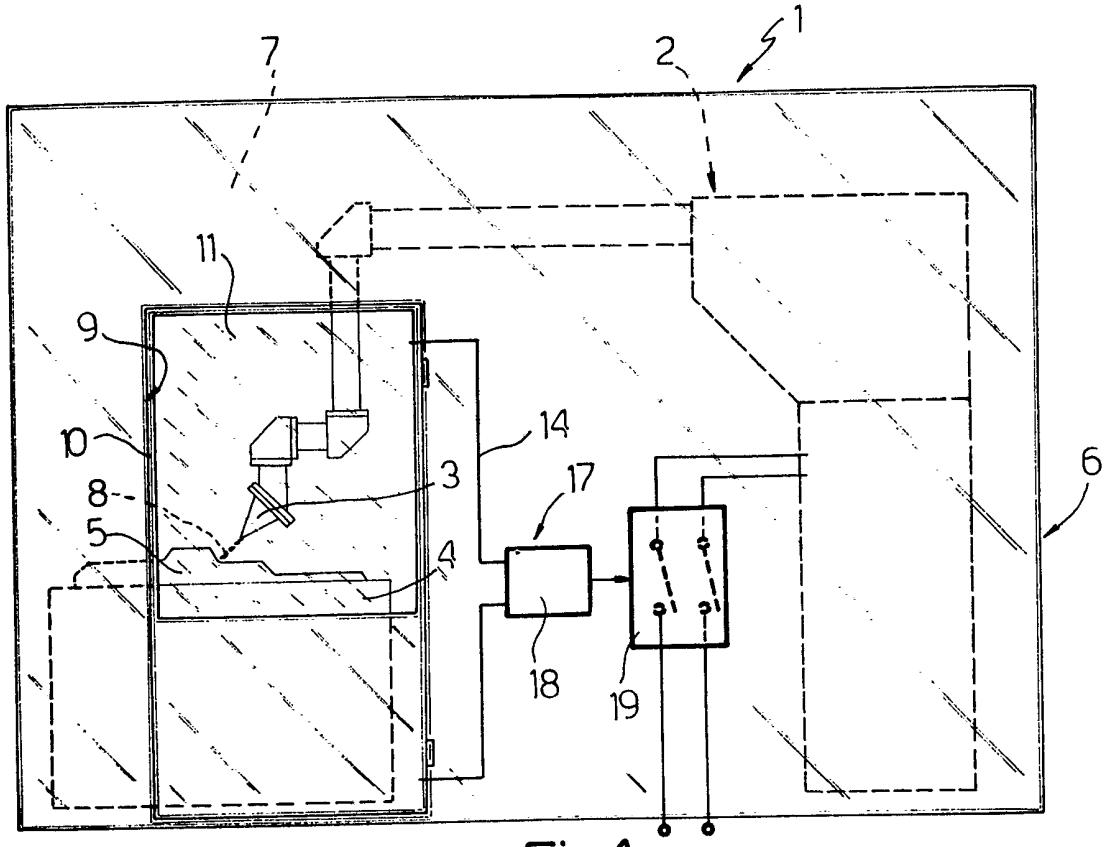

Fig.1

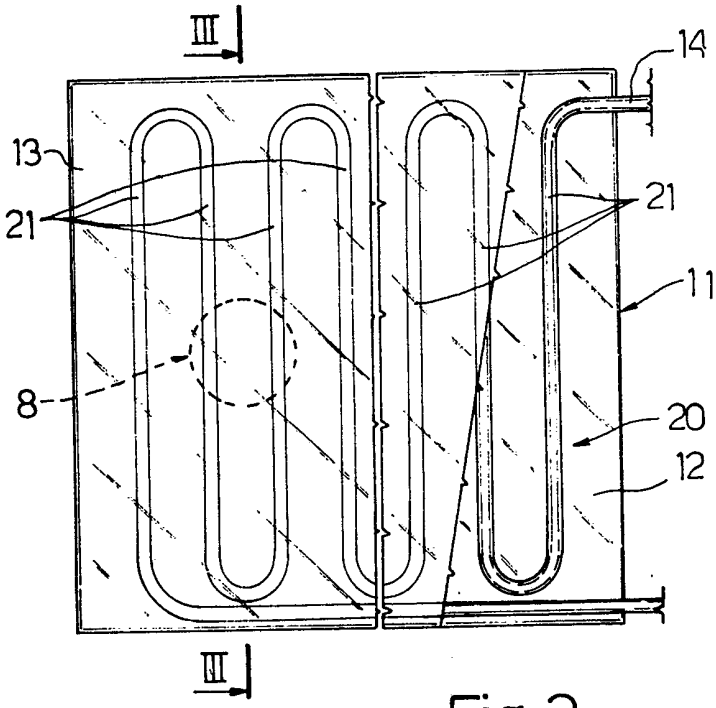

Fig.2

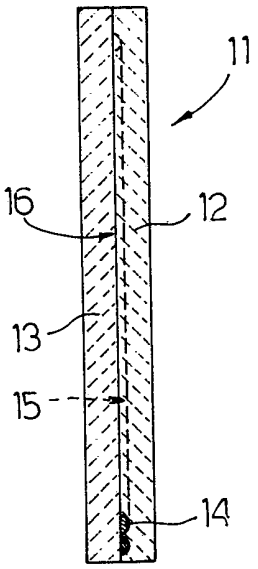

Fig.3

SPECIFICATION

A protection device for carbon dioxide laser machines

The present invention relates to a protection device for a machine, particularly, but not necessarily, a cutting machine, utilising a carbon dioxide laser.

In machines of the type described above, one of the problems which must necessarily be resolved is that relating to the containment of the laser beam within a determined space or working field.

To this end machines of the type described above are normally provided with a protection device constituted by a cage made of material impervious to the radiation emitted by the particular laser utilised, and defining a working space or field entirely around a workpiece support device.

Obviously, the said cage must be provided with one or more inspection windows to allow an operator to supervise the correct performance of the operations which must be effected on the work piece, viewing from the outside. In the case in which a carbon dioxide laser is utilised, these inspection windows normally comprise a transparent body made of a layer of polymethyl methacrylate available under the trademark PLEXIGLASS, which is impervious to the radiation emitted by a laser of the type described above.

Known inspection windows of the above-described type have the disadvantage of resisting for only a relatively short time the direct impact of a laser beam emitted, for example, by a cutting laser of relatively high power. In fact, PLEXIGLASS if struck directly by a laser beam, stops the beam itself, but rapidly sublimes by the effect of the heat which the laser radiation transmits to it. Consequently, an operator located in front of an inspection window directly in the path of a laser beam can be struck thereby before noticing that the said PLEXIGLASS sheet is about to break down.

The object of the present invention is to provide a protection device for laser machines of the type described above, in which the said inspection window is free from the above-described disadvantage.

The said object is achieved by the present invention which provides

a protective window for observing operation of a machine utilising a laser device, the window being transparent to at least some wavelengths of visible light but opaque to the radiation emitted by the laser device, wherein the window comprises two sheets at least one of which, which forms the outer sheet in use, is of material transparent to at least some wavelengths of visible light but opaque to the radiation emitted by the laser and an electrical conductor interposed between the two sheets and connectable into a safety control circuit for the laser device.

The present invention will now be described with reference to the attached drawings, which illustrate a non-limitative embodiment thereof, in which:

Figure 1 is a schematic side view of a protection device formed according to the principles of the present invention;

Figure 2 illustrates in side elevation, with parts removed for clarity, a detail of Fig. 1; and

Figure 3 is a section taken on the line III–III of Fig. 2.

In Fig. 1 the reference numeral 1 indicates, as a whole, the cutting machine including a carbon dioxide laser device 2 one of the cutting heads 3 of which is orientatable and disposed facing a workpiece carrier table 4 supporting a workpiece 5.

The laser device 2 and the workpiece table 4 are disposed within a cage or cell 6 the walls of which are made of a material impervious to the laser radiation produced by the laser device 2. The cage 6 defines a working zone 7 which cannot be passed by a laser beam 8 emitted by the cutting head 3.

Through the walls of the cage 6 there is formed at least one inspection window 9 comprising a substantially rectangular frame 10 closed by a transparent body 11.

As illustrated in Fig. 3, the transparent body 11 comprises an inner sheet 12 facing the working zone 7 and an outer sheet 13, the two sheets being super-imposed and in contact with one another.

The outer sheet 13 can be of "smoked" colour or maybe clear; in this latter case, in a non-illustrated variant, a further sheet (not illustrated) of "smoked" colour can be utilised outside the outer sheet (13).

The transparent body 11 further includes an electrical conductor 14 interposed between the sheets 12 and 13. In the embodiment illustrated in Fig. 3 the electrical conductor 14 is housed within a groove 15 formed on a surface 16 of the sheet 12 facing the sheet 13. Alternativley, in a variant not illustrated, the conductor 14 can be formed on the surface 16 by xerography.

The electrical conductor 14 constitutes part of a safety circuit 17 operable to prevent, for any reason, the beam 8 remaining pointed at the transparent body 11 for a period of time greater than a pre-determined value.

In variants not illustrated the safety circuit 17 comprises a control block able to measure, for example, the variations in resistance produced in the conductor 14 by an increase in temperature caused by the direct impact of the beam 8 against the transparent body 11, and to actuate acoustic and/or luminous indicators operable to alert the operations to the imminent danger in good time.

Preferably, however, the safety circuit 17 in-

cludes, as illustrated in Fig. 1 a control block 18 connected to the conductor 14 and able to detect, through the conductor 14 itself, the occurrence of the direct impact of the beam 8 against the transparent body 11, and to interrupt, by means of a normally closed switch unit 19, the supply of energy to the laser device 2.

In the illustrated example the situation of prolonged impact of the beam 8 against the transparent body 11 is detected by the control unit 18 following fusion of the conductor 14. The conductor 14 is, in fact, made of a low-melting material such as, for example, a tin alloy, and is disposed between the layers 12 and 13 in a sinuous or serpentine coil 20, the loops 21 of which extend substantially over the whole of the surface of the transparent body 11, and are disposed at a distance from one another such as to eliminate any possibility that a beam 8 directed at the transparent body 11 would not directly strike one of the loops 21.

In particular, the distance between two contiguous loops 21, that is to say the pitch of the serpentine coil 20, is calculated in such a way as to be less both than the diameter of the beam when not focussed, and the diameter of the de-focussed beam 8 in correspondence with the impact zone with the transparent body 11. Preferably the said pitch lies between a third and a half of the smaller of the two diameters mentioned above.

In this way, if, for any accidental cause, the head 3 becomes turned, in use, towards the transparent body 11, the impact between the beam 8 and the transparent body 11 causes, after a certain time, the piercing of the inner sheet 12 and the rupture of the conductor 14, but not the piercing of the outer sheet 13 in that the previous rupture by fusion of the conductor 14 causes the laser device 2 to be stopped.

CLAIMS

1. A protective window for observing operation of a machine utilising a laser device, the window being transparent to at least some wavelengths of visible light but opaque to the radiation emitted by the laser device, wherein the window comprises two sheets at least one of which, which forms the outer sheet in use, is of material transparent to at least some wavelengths of visible light but opaque to the radiation emitted by the laser and an electrical conductor interposed between the two sheets and connectable into a safety control circuit for the laser device.

2. A protective window according to claim 1, wherein the said material is polymethyl methacrylate.

3. A protective window according to claim 1 or 2 wherein the said material is 'smoked' or tinted.

4. A protective window according to any of claims 1 to 3, wherein the said conductor is made of low-melting material.

5. A protective window according to any of claims 1 to 4, wherein the said conductor has a serpentine form with runs extending substantially over all regions of the said window.

6. A machine utilising a laser device and having a protective window according to any of the preceding claims and a safety circuit for the laser connected to, and responsive to discontinuity of, the said conductor.

7. A machine according to claim 6 as appendant to claim 2, wherein the laser device is a carbon dioxide laser device.

8. A machine according to claim 6 or 7, wherein the said conductor is secured to the inner sheet of the window.

9. A machine according to claim 8, wherein the said inner sheet has on its surface facing the said outer sheet, a groove housing the said conductor.

10. A machine according to any of claims 6 to 8, wherein the said conductor has been formed by xerography on the surface of the said inner facing the said outer sheet.

11. A machine according to any of claims 6 to 10, wherein the said safety circuit is a circuit for controlling a power supply line to the said laser device.

12. A machine according to any of claims 6 to 11 as appendant to claim 4, wherein the said serpentine coil has a smaller pitch between its runs than both the diameter presented by the beam when not focussed and the diameter presented by the de-focussed beam in correspondence with a zone of impact with the said window.

13. A machine according to claim 12, wherein the pitch of the said serpentine coil lies between one half and one third of the smaller of the said two diameters of the non-focussed beam and, the de-focussed beam respectively.

14. A protection device for a machine utilising a carbon dioxide laser device to define a working zone impassable by an emitted laser beam, substantially as described with reference to the attached drawings.

Printed for Her Majesty's Stationery Office
by Burgess & Son (Abingdon) Ltd, Dd 8991685, 1987.
Published at The Patent Office, 25 Southampton Buildings,
London, WC2A 1AY, from which copies may be obtained.