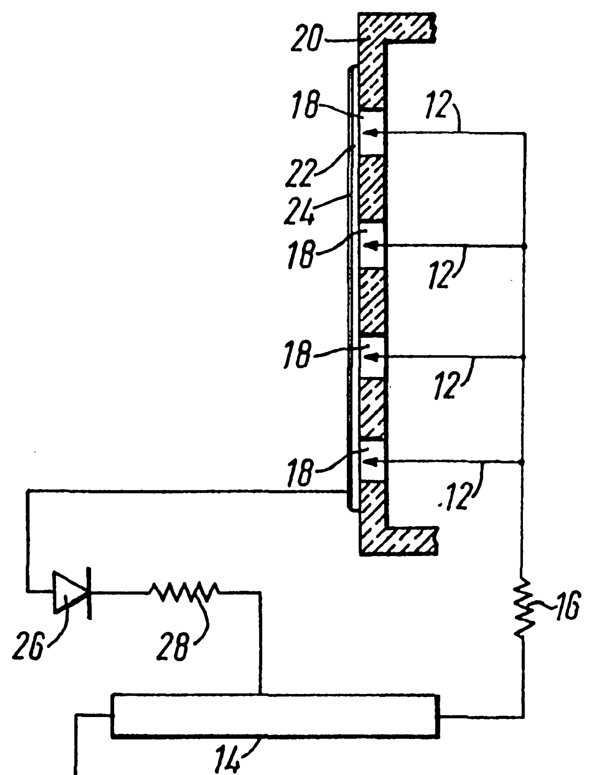
(12) UK Patent Application (19) GB (11) 2 102 214 A

(21) Application No **8214164**
(22) Date of filing **14 May 1982**
(30) Priority data
(31) **8115067**
(32) **16 May 1981**
(33) **United Kingdom (GB)**
(43) Application published
26 Jan 1983
(51) **INT CL³**
H01T 20/02
(52) Domestic classification
H1X 5E
U1S 1018 H1X
(56) Documents cited
GBA 2030008
GBA 2027281
GB 1598957
GB 1589331
GB 1547936
GB 1514279
GB 1424627
GB 1330309
GB 10305382
(58) Field of search
H1X
(71) Applicants
Sidha Technology Limited
(Great Britain),
15 Pit Hey Place, West Pimbo, Skelmersdale, Lancashire WN8 9PS
(72) Inventor
Geoffrey Norman Walter Gay
(74) Agents
Roystons,
531 Tower Building, Water Street, Liverpool L3 1BA

(54) **Air ionization apparatus**

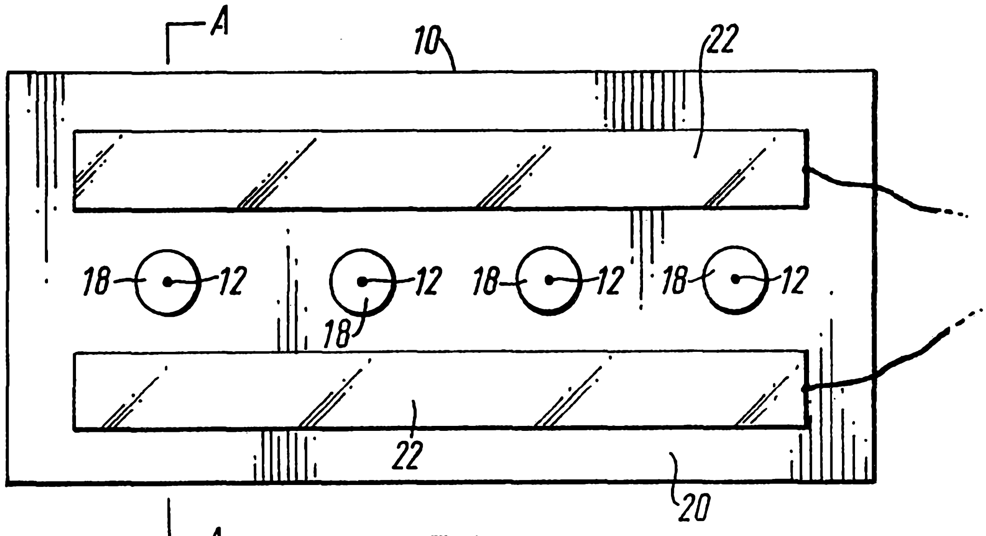
(57) Air ionization apparatus has one or more needles or probes 12 with the tip of each adjacent an aperture 18 in a screen 20 of insulating material and connected to a high voltage source 14, and shielded by conductive material 22 connected to a high voltage source 14. The conductive material 22 may be covered by a layer of high resistivity material 24. The screen may be a flat plate with a plurality of probes, as shown, or a tube with one probe.



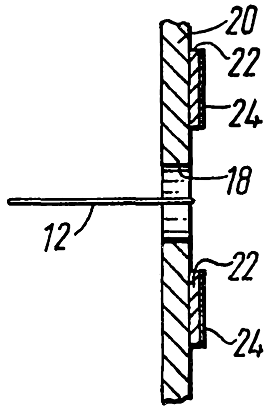
F I G.3

The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

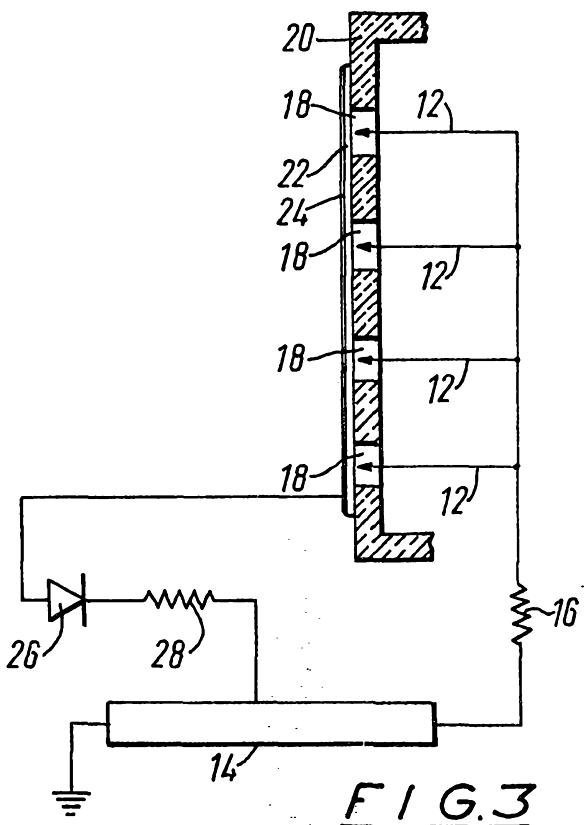
GB 2 102 214 A



F I G.1



F I G.2



F I G.3

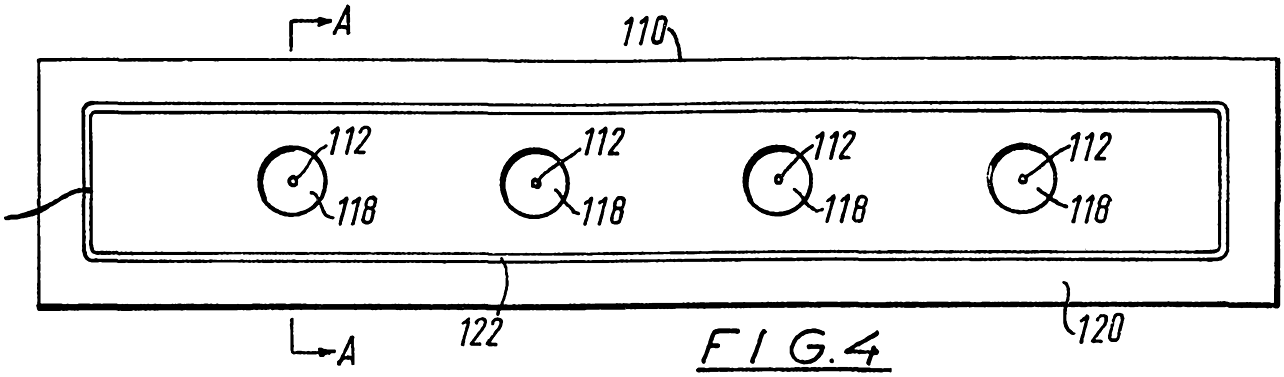


FIG.4

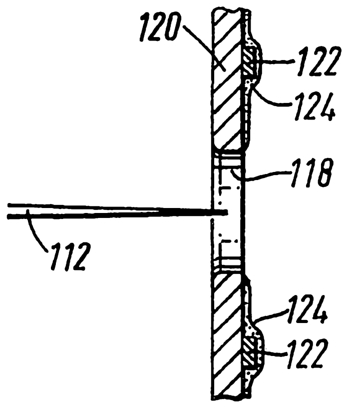


FIG.5

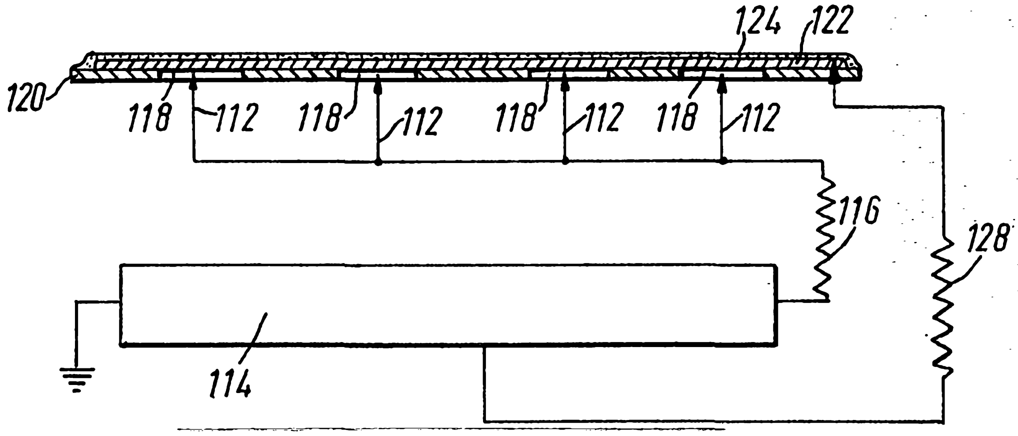


FIG. 6

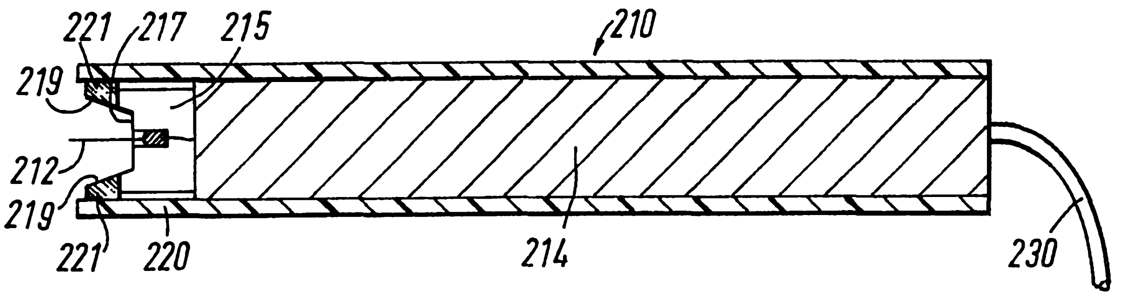


FIG.7

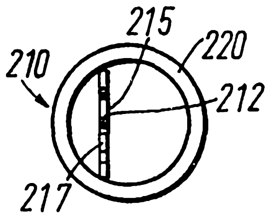


FIG.8

SPECIFICATION
Air ionization apparatus

This invention concerns air ionization apparatus.

In most forms of air ionization apparatus the ions are produced by raising the electrical potential of a sharp conducting needle or probe. The electric field gradient around the tip of the needle or probe is raised sufficiently to cause a corona discharge which produces both negative and positive ions. The needle or probe will usually be raised to a negative potential so that the positive ions produced are attracted to it and so neutralised whilst the physiologically beneficial negative ions are swept away from the needle or probe in a stream.

In practice the needle or probe has to be shielded physically to prevent any danger to the user of the apparatus. Furthermore, the electric field surrounding the tip of the needle or probe should be maintained at a stable strength unaffected by accumulation of static charges on surrounding surfaces or by interference from the electric field components originating from other needles or probes in the same apparatus.

It is known to provide physical shielding of the needles or probes in two ways. In the first, the needle or probe is placed behind an insulating screen having an aperture directly opposite the tip of the needle or probe. However, the output of ions is considerably reduced the further the tip is placed from the screen.

In the second, the needle or probe is shielded within a cylinder of electrically insulating material having on its outside surface rings of isolated conducting material so design that their potential, caused by the incidence of ions from the probe, deflects or focusses the ions into a beam. This beam can then escape the protective shield without significant attenuation.

However, deposition of moisture on the apparatus can provide an earthing path from the isolated conductive material. More ions are then attracted to the now earthed conductive material so intensifying the corona discharge at the needle or probe tip which may result in production of a high proportion of ozone. Ozone can be physiologically harmful if too large amounts are inhaled.

In apparatus having a plurality of needles or probes, the stability of each needle or probe field is maintained by having a sufficiently large spacing between adjacent ones.

In another known apparatus stabilisation of the ion stream is effected by means of an earthed conductive member in proximity to the tips of the needles or probes and within the shielding screen. However, this is not entirely satisfactory since a large proportion of the ions produced are attracted to the conductive member rather than away from the apparatus. Again the problem of ozone production arises.

A further known apparatus again has an earthed conductive member, usually a wire in proximity to the needles or probes and within the shielding screen. However, the conductive member is covered with an insulating layer which tends to reduce the stabilising effect and because it is behind the screen it does not counteract the effect of charges on the outside surfaces of the apparatus.

According to the present invention there is provided an air ion apparatus having one or more needles or probes, the or each needle or probe being adjacent an aperture or opening in a screen of insulating material, being connectable to a source of high voltage, and being shielded by conductive material connectable to a source of high voltage.

For a multiprobe air ionization apparatus (ionizer), the screen is preferably a flat plate, the tip of each needle or probe being adjacent an aperture or opening therein. The conductive material may then be on the opposite side of the screen to the probes or needles i.e. on the outside of the apparatus, although there may be advantages in having the conductive material on the same side of the screen as the probes or needles i.e. on the inside surface of the screen.

For a single probe ionizer, the screen may advantageously be a tubular member having the needle or probe in the tube with its tip at or near an open end of the tube. The conductive material may, of course, be on the end of the tube but if the tube if of sufficient diameter, the conductive material may actually be inside the tube.

The conductive material may be connected to a high impedance voltage source preferably, via a high resistance path, such as may be provided by a resistor chain or a reverse biassed diode and resistor chain in series. Advantageously, the conductive material is shielded with a layer of high resistivity material which should be relatively thin. Shielding a probe by a conducting surface will cause an almost complete capture of emitted ions if the surface is earthed, or an almost complete suppression of the ion production (due to accumulation of static charge) if the surface is isolated unless a complicated system of electrodes is used.

Shielding the probe with an insulating surface has the same effect as an isolated conducting surface and prevents ion production.

However, if the probe is shielded by a surface which represents a high resistance path to a suitably defined electric potential then the surface potential will depend upon the flux of incident ions. Suitable choice of geometry and materials allows the construction of a stable electrode configuration which is both electrostatically and physically shielded.

When the conductive material is covered by a thin layer of high resistivity material, the electrical potential at a point on the surface of the high resistivity material will depend on the incident ion flux at that point. As the resistivity of the material is high, the ion flux needed to produce a deflecting potential and thus a focussed ion beam, will be low.

As the electrical resistance of a path orthogonal to the surface is much lower than that of a path along the surface, the surface potential can vary from point to point on the surface of the high resistivity material. This is impossible with a conducting surface as such a surface inevitably represents an equipotential, and is undefined and uncontrollable with a completely insulating surface.

This variation of potential determined by incident ion flux sets up a self correcting focussing system. If the ion flux at a point increases unduly then the potential at that point relative to the probe will reduce, tending to reduce incident ion flux and refocus the ion beam. Thus the electric field geometry becomes dynamically determined by the ion beam itself, leading to a stable production of ions substantially unaffected by ambient electric fields or stray electrostatic charges. The probe itself lies behind or inside the focussing surface and is thus shielded physically.

The potential of the conductive material may be defined by a high impedance voltage source with a potential between that of earth and that of the probes (typically, −3.5KV with respect to earth when the probes are maintained at, typically −6KV).

Instability due to static charge accumulating on the insulating surface of the screen is substantially removed by virtue of the shielding effect of the electric field provided by the conductive material.

This form of stabilisation gives a large degree of freedom to the shape and positioning of the conductive material. Thus, the conductive material need no longer be symmetrically disposed with respect to each ion emitting probe, as with other designs, because the dynamic nature of the stabilisation will allow the conductive material to be of almost any shape and orientation. Thus practical and asethetic design parameters can be easily harmonised with effective ion beam stabilisation.

It is preferred that the conductive material covers an area of the screen having a length and breadth greater than the thickness of the material.

In one preferred embodiment the apertures in the screen are aligned and the conductive material is in the form of strips above and below the line of apertures, either on the outside or the inside surface of the screen.

In another preferred embodiment the apertures are surrounded by a continuous strip of conductive material on the inside or outside surface of the screen.

The screen may be formed from a copper clad laminate on which the conductive material strip or strips is or are formed by etching away unwanted copper.

Alternatively conductive material may be of metallised paper such as aluminised paper and the high resistance coating may be of a high resistivity varnish or lacquer.

The present invention allows the physical shielding of the probes to be effected by means of holes of very small diameter, typically less than 1 cm, preferably less than 8 mm and especially from 5 to 8 mm. Other systems to achieve stability need considerably larger holes or else compromise between ion-beam stability and mechanical shielding.

In the case of the tubular ionizer, the conductive material may be provided on alongside the needle or probe, say on one or more parts extending from the inside surface of the tube or from an apparatus part within the tube. Conveniently, the high voltage source circuitry is formed on a printed circuit board which fits lengthways in the tube, the needle or probe extending from a cut back at one end of the printed circuit board.

The cut back forms two extensions of the printed circuit board alongside the needle or probe. The conductive material may then be a coating, say of copper, on each, extension, which coatings are connected to a high voltage source.

In all embodiments of air ionization apparatus of the invention it is advantageous to encase all circuitry in an epoxy resin for protection and to provide for stability of the apparatus.

This invention will now be further described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a plan view of the front of a first multiprobe air ionization apparatus;

Figure 2 is a section along line AA of Figure 1;

Figure 3 is a circuit diagram of the apparatus of Figures 1 and 2;

Figure 4 is a plan view of the front of a second multiprobe air ionization apparatus;

Figure 5 is a section along line AA of Figure 4;

Figure 6 is a circuit diagram of the apparatus of Figures 4 and 5;

Figure 7 is a longitudinal section of a single probe air ionization apparatus; and

Figure 8 is an end view of the apparatus of Figure 7.

Referring to the drawings an air ionization apparatus 10 has a line of four probes 12 connected to a high voltage source 14, of the order of 5KV via a high resistance 16 of the order of 500 megohms.

The probes 12 have their tips adjacent apertures 18 in a screen 20 of insulating material such as plastics material. Above and below the line of probes 12 on the outer face of the screen 20 are mounted strips of conductive material 22 such as aluminised paper, coated with a layer of high resistivity insulating material 24, such as a high resistivity lacquer.

The strips of conductive material 22 are both connected to the high voltage source 14 via a reverse biassed diode 26 which has in effect a very high resistance and a high resistance 28 of the order of 60 megohms. Thus the strips of conductive material are returned to a potential of about −3KV.

The high voltage source 14 may be any suitable system such as a multistage voltage multiplier powered by domestic mains supply.

Referring to Figures 4 to 6, an air ionization apparatus 110 has a line of four probes 112 connected to a high voltage source 114 of the order of 6KV via a high resistance 16 of the order of 30 megohms.

The probes 112 have their tips adjacent apertures 118 in a screen 120 of insulating material, such as plastics material. Surrounding the apertures is a continuous strip of conductive material 122 on the outer face of the screen 120. The continuous strip of conductive material 122 is formed by etching a copper clad laminate and is coated with a layer of high resistivity material 124, such as a lacquer.

The strip 122 is connected to the high voltage source 114 via a high resistance 128 of the order of 30 megohms. Thus the strip 124 is returned to a potential of about −3KV.

The high voltage source 114 may again be any suitable system such as a multistage voltage multiplier powered by domestic mains supply.

The embodiments of Figures 1 to 3 and 4 to 6 have been described as having the conductive material on the outside of the apparatus. However it should be appreciated that the conductive material could have alternatively been on the inside of the apparatus.

Turning to Figures 7 and 8, an air ionization apparatus 210, particularly suitable for farming applications, such as in cattle sheds or battery hen houses, has a single probe 212 connected to a high voltage generator 214 encapsulated in epoxy resin within a tube 220 of plastics material.

The probe 212 and high voltage generator 214 are mounted on a printed circuit board 215. The printed circuit board 215 protrudes from the epoxy resin and has a cut back 217 in which the probe 212 is situated so that its tip is rear open end 221 of the tube 220. The cut back 217 forms extensions 219 of the board 215 which extensions are alongside the probe 212. These extensions 219 have on one side thereof a layer of copper 221 formed by etching of the printed circuit board 215. The copper layers are covered by a layer of high resistivity material such as a lacquer and are connected to the high voltage generator 214. The high voltage generator is powered domestic mains supply via mains lead 230.

The single probe ionizer of Figures 7 and 8 is particularly advantageous in that is has its own high voltage generator so can be supplied directly from the mains rather than having to depend on a central high voltage supply via high voltage cable. This is very useful in animal sheds or houses where a large number of ionizers may be needed since high voltage cable does not have to be provided throughout the shed or house for each ionizer.

CLAIMS

1. Air ionization apparatus having one or more needles or probes the or each needle or probe being adjacent an aperture or opening in a screen of insulating material being connectable to a source of high voltage and being shielded by conductive material connectable to a source of high voltage.

2. Apparatus as claimed in claim 1 wherein the conductive material is connected to the high voltage source via a high resistance path.

3. Apparatus as claimed in claim 2 wherein the high resistance path is provided by resistor chain or a reverse biassed diode and resistor chain in series.

4. Apparatus as claimed in claim 1, 2 or 3 wherein the conductive material is covered with a layer of high resistivity material.

5. Apparatus as claimed in claim 4 wherein the high resistivity material is a varnish or lacquer.

6. Apparatus as claimed in any one of claims 1 to 5 wherein the conductive material covers an area having a length and breadth greater than the depth of the material.

7. Apparatus as claimed in any one of claims 1 to 6 wherein the screen is a generally flat plate having the tip of each of a plurality or probes or needles adjacent an aperture or opening in the plate.

8. Apparatus as claimed in claim 7 wherein the conductive material is on the opposite side of the screen to the probes or needles.

9. Apparatus as claimed in claim 7 wherein the conductive material is on the same side of the screen as the probes or needles.

10. Apparatus as claimed in claim 7, 8 or 9 wherein the apertures or openings are aligned and the conductive material is in the form of a pair of strips one above and one below the line of apertures or openings.

11. Apparatus as claimed in claim 7, 8 or 9 wherein the conductive material is in the form of a continuous strip surrounding the apertures or openings.

12. Apparatus as claimed in any one of claims 1 to 11 wherein the conductive material is metallized paper.

13. Apparatus as claimed in claim 12 wherein the conductive material is aluminized paper.

14. Apparatus as claimed in any one of claims 1 to 11, wherein the conductive material is provided by etching of a copper clad laminate, the laminate forming the screen.

15. Apparatus as claimed in any one of claims 1 to 14 wherein the apertures have a diameter of less than 1 cm.

16. Apparatus as claimed in claim 15 wherein the apertures have a diameter less than 8 mm.

17. Apparatus as claimed in claim 16 wherein the apertures have a diameter of from 5 to 8 mm.

18. Apparatus as claimed in any one of claims 1 to 5 wherein the screen is a tubular member having a needle or probe in the tube with its tip at or near an open end of the tube.

19. Apparatus as claimed in claim 18 wherein the conductive material is provided alongside the needle or probe on one or more parts extending from the inside surface of the tube or an apparatus part within the tube.

20. Apparatus as claimed in claim 18 or 19 wherein the high voltage source circuitry is provided on a printed circuit board within the tube,

the needle or probe extending from a cut back at one end of the printed circuit board, the cut back providing two extensions of the printed circuit board on which is a coating of conductive material.

21. Air ionization apparatus substantially as hereinbefore described with reference to and as illustrated in Figures 1 to 3, 4 or 6 or 7 and 8 of the accompanying drawings.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1983. Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.