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(54) **Dental X-Ray apparatus**

(57) Intra-oral X-ray apparatus which reduces the number of exposures necessary to obtain panoramic dental radiographs comprises an electron gun 20, a tubular target carrier 24 projecting from the gun along the beam axis 36 and carrying at its distal end a target 23 surrounded by a shield 31 of X-ray opaque material extending forwardly and laterally of the target and having surfaces 80, 81 which define a wedge or cone-shaped radiation pattern delimited vertically substantially by the root tips of the patient's teeth 32 and 33. A film holder 34 is located externally of the patient's mouth. A disposable member can fit on the target carrier to depress the patient's tongue out of the radiation pattern and to further shield the roof of the mouth. The electron beam can be magnetically deflected, Figures 4 and 5, to change the X-ray beam direction.

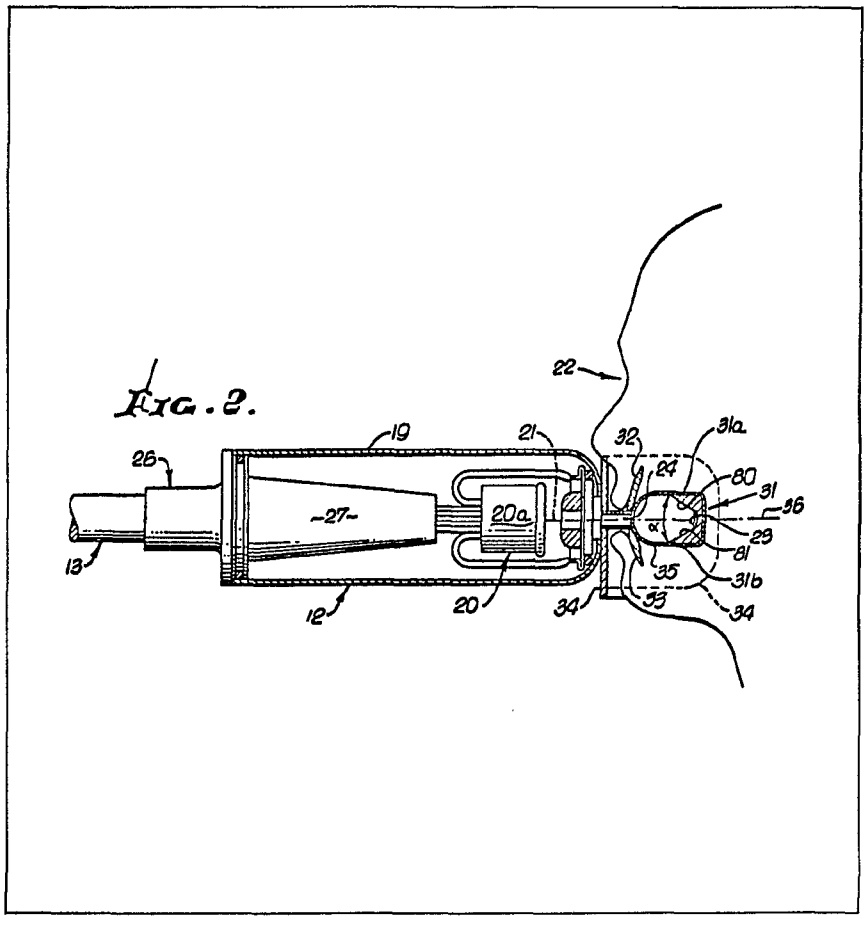

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FIG. 1.

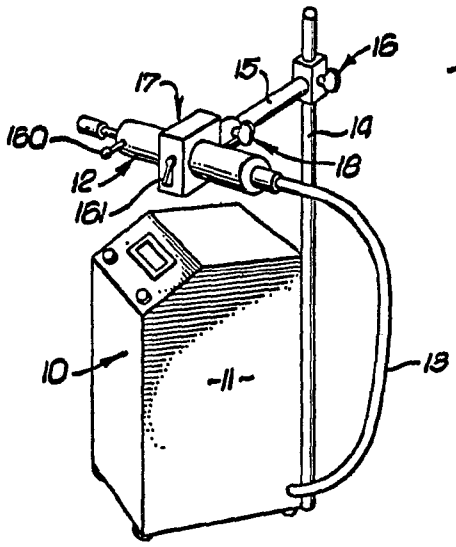


FIG. 2.

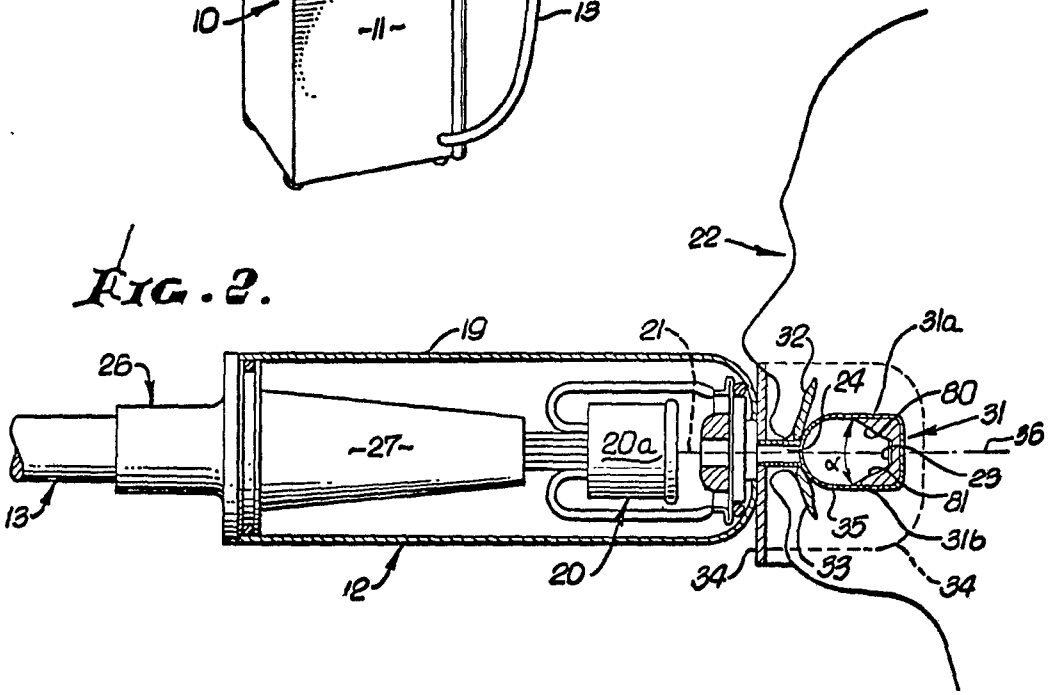


FIG. 3.

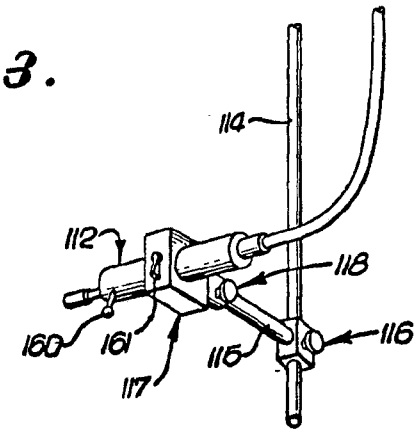


FIG. 8.

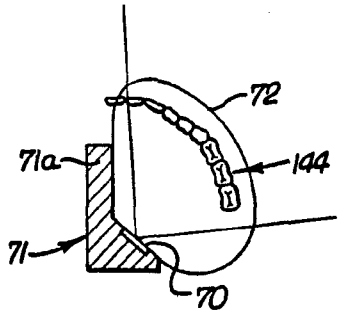


FIG. 4.

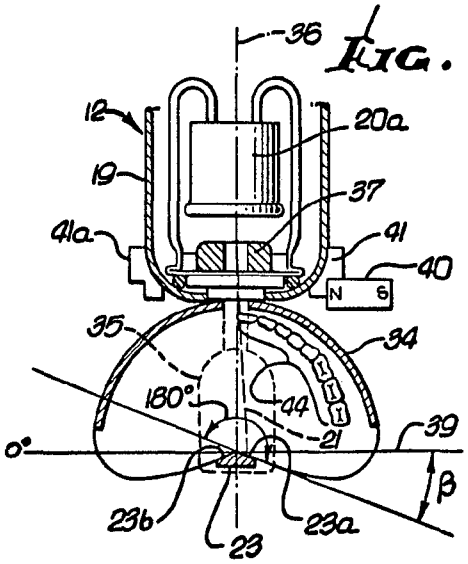


FIG. 5.

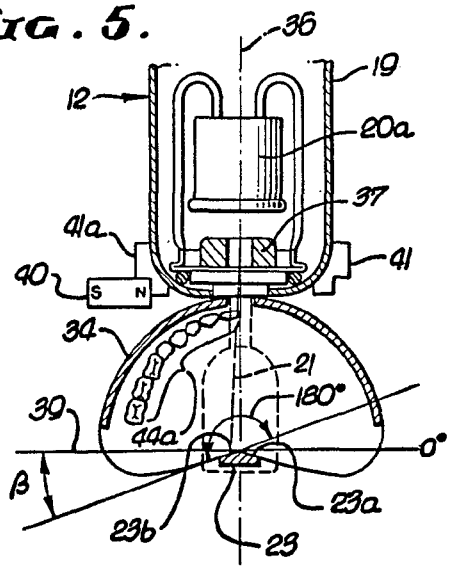


FIG. 7.

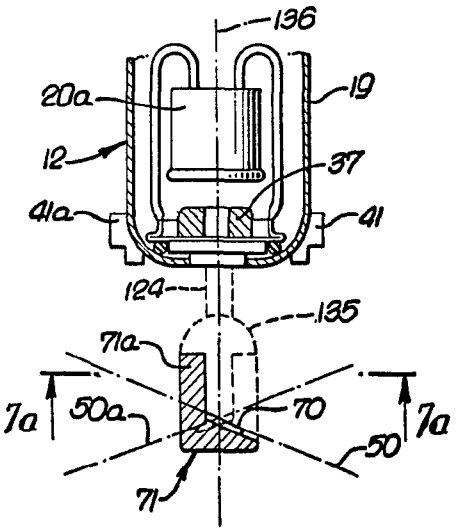


FIG. 6.

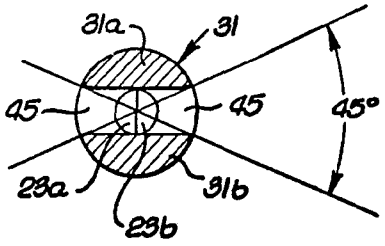


FIG. 7a.

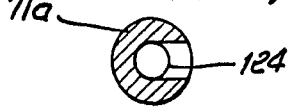


FIG. 9.

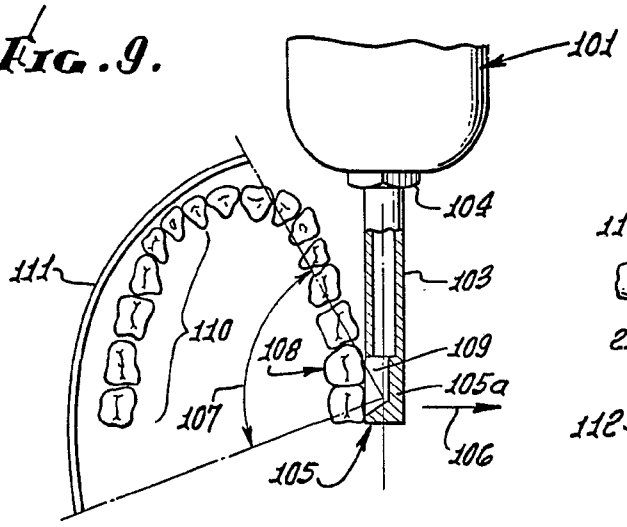


FIG. 10.

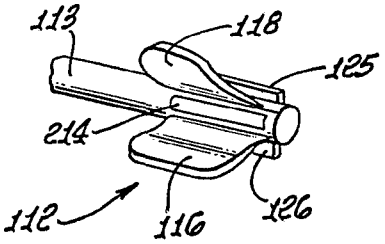


FIG. 12.

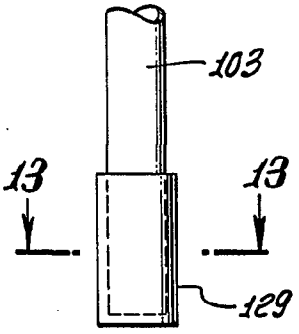


FIG. 11.

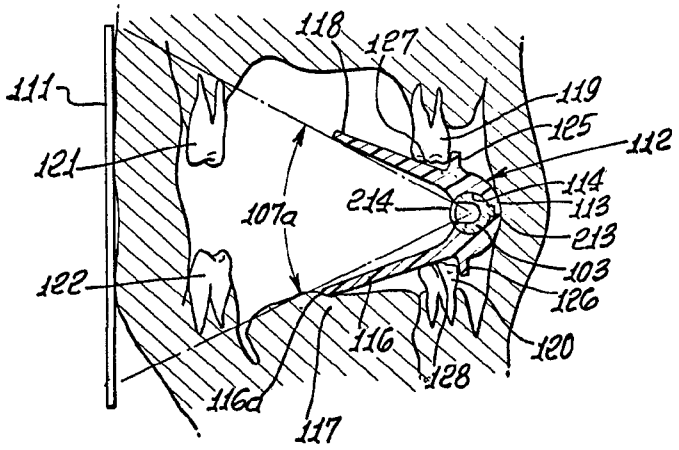


FIG. 13.

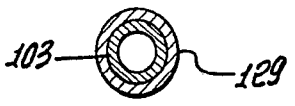


FIG. 14.

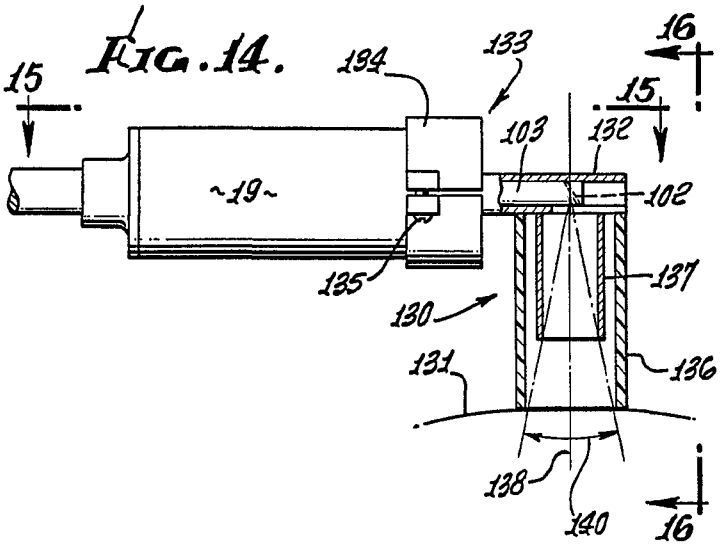


FIG. 16.

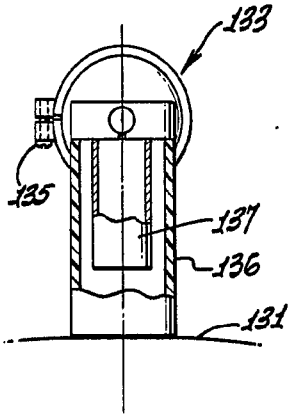


FIG. 15.

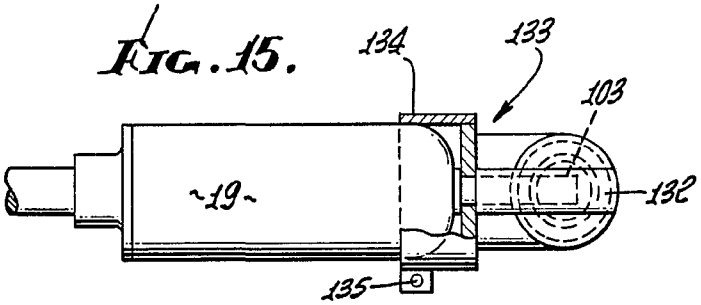
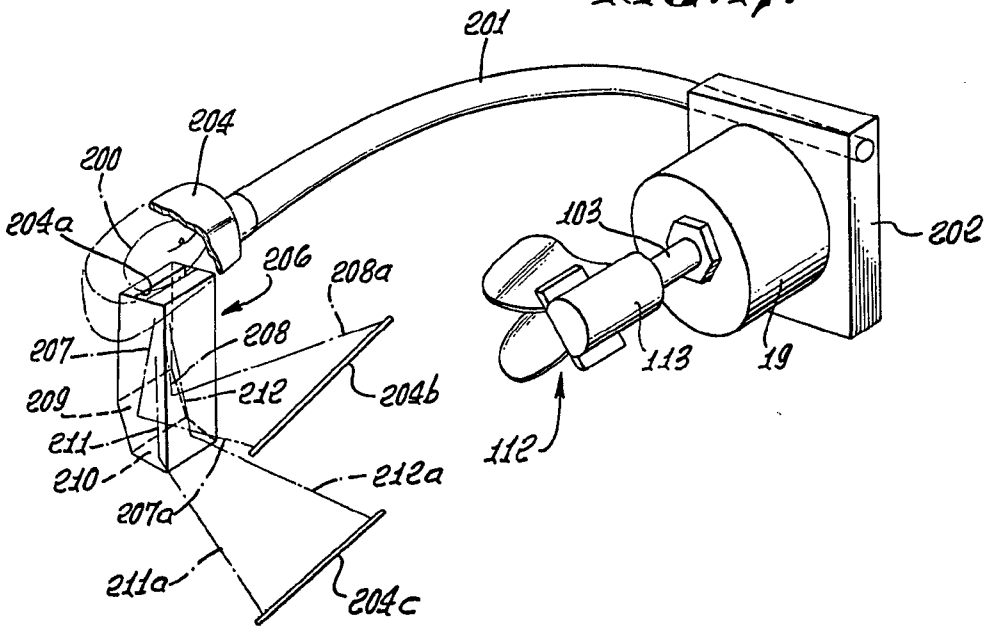


FIG. 17.



SPECIFICATION

Dental X-ray apparatus

This invention relates to dental X-ray apparatus.

Present systems of X-ray examination of human teeth require twelve to fourteen exposures, accompanied by objectionably excessive amounts of side radiation to sensitive areas of the brain, cortex, sinus, throat, optic and auditory nerve centres. Recently, a technique has been proposed according to which an X-ray target is introduced into the mouth, and radiation is directed from the target back through the teeth to film supported outside the mouth, thereby to produce a so-called high resolution, panoramic radiograph. One problem encountered with that type equipment concerns the tendency to produce gagging of the patient, due to the necessity of locating the target sufficiently close to the throat that back teeth will be exposed to produced X-rays. Another problem has to do with the requirement that the upper and lower teeth be alternately exposed to radiation, which in turn requires that the shield associated with the target be re-arranged. This means that the target is removed from the oral cavity after the first exposure (as for example irradiation of the upper teeth), after which the target is re-introduced to enable the second exposure (of the lower teeth) which increases the risk of gagging and otherwise discomforts the patient.

The present invention seeks to provide an improved dental X-ray apparatus which reduces the number of exposures necessary, reduces the tendency of the patient to gag when the apparatus is introduced into the mouth and which protects the upper and lower portions of the mouth and other sensitive areas of the head from direct exposure to the X-rays.

Basically, the invention is embodied in apparatus that includes an electron gun operable to provide an electron beam directed along an axis, a target carrier projecting from said gun along said axis and having a distal end of such a shape as to be receivable into the patient's mouth, a target carried by said carrier at the distal end thereof in line with said axis, and at an angle thereto which is effective to produce a radiation pattern, when exposed to the electron beam, extending forwardly from said target towards the gun and laterally of the beam axis and a shield of X-ray opaque material extending forwardly above and below said target and rearwardly thereof, said shield serving in use to restrict the radiation to a forwardly and/or laterally directed substantially wedge or cone-shaped pattern apexed on the target and delimited vertically substantially by the root tips of the upper and lower teeth.

As will be seen, in the apparatus of this invention the shield projects forwardly both above and below the target to block radiation from passing to patient's head zones above the upper teeth and below the lower teeth; the shield may typically provide lateral openings to pass X-rays toward the back upper and lower teeth; the target may typically be angled rearwardly and sidewardly at one or both sides of the equipment axis so that radiation may pass through one or both of the shield side openings to provide access to the back teeth as well as front teeth; and the radiation pattern produced by the target may be transversely shifted, as for example by sideward deflection of the beam to strike different portions of the target, or by physical rotation of the target, so that the target need not be removed from the mouth between exposure.

A further important additional feature of the invention is the provision of X-ray shielding and tongue suppressor means carried to be received into the patient's mouth, and characterised in that when the target is located in the mouth the shield will protect portions of the head from the X-ray beam and the patient's tongue will be suppressed relative to the X-ray beam. As will appear, the apparatus may include a tubular carrier for the target projecting rearwardly of the X-ray tube itself, and the shielding and tongue suppressor means may advantageously comprise a component having a base defining an opening removably receiving the tubular carrier; further, that component may have arms which project sidewardly of the base with V-shaped configuration, the lower arm extending sufficiently downwardly and sidewardly as to suppress the patient's tongue when the base is received between the patient's upper and lower molars. In this regard, the referenced component may consist of plastic material containing X-ray shielding substance, as for example barium; and it may carry upper and lower projections to fit adjacent the outer sides of the patient's upper and lower molars for positioning purposes, and so that the molars may clench the component to position it for tongue suppression and shielding orientation relative to the mouth and head of the patient; also a longer source to film distance is enabled. Finally, means is provided to visually delineate on the patient's head a zone subjected to irradiation so that film may be accurately located.

Various embodiments of apparatus according to the invention are illustrated by way of example in the accompanying drawings in which:-

Figure 1 is a perspective showing of high voltage generator equipment and X-ray tube mobile or floor mount associated with the invention;

Figure 2 is a cross-sectional view of gun and target apparatus embodying the invention;

Figure 3 is a perspective showing of an alternative X-ray tube ceiling or wall mounting;

Figures 4 and *5* are top plan views of gun and target relationships, in schematic form;

Figure 6 is an enlarged frontal view of the target and shield;

Figure 7 is a view like Figure 4 in Figure 5, but showing an alternative target; and *Figure 8* shows another target;

Figure 7a is a section taken on lines *7a-7a* of Figure 7;

Figure 9 is a view like Figure 5, showing modified apparatus wherein the target is located at one side of the patient's mouth;

Figure 10 is a perspective view of an X-ray shield and tube positioning tongue suppressor attachment;

Figure 11 is a vertical section taken through a patient's mouth showing use of the Figure 10

attachment in conjunction with an X-ray tube, target and carrier as for example is shown in Figure 9;

Figure 12 is a plan view of a carrier for an X-ray producing target, and showing a filter on the carrier;

Figure 13 is a cross-section taken on lines 13-13 of Figure 12;

Figure 14 is a side elevation showing an attachment for the Figure 9 apparatus, enabling its use externally of the patient's mouth;

Figure 15 is a plan view taken on lines 15-15 of Figure 14;

Figure 16 is an elevation taken on lines 16-16 of Figure 14; and

Figure 17 is a perspective view of means to delineate a head zone to be irradiated.

Referring first to Figure 1, X-ray apparatus 10 includes a high voltage generator console 11 to which X-ray tube 12 is electrically connected, as via cable 13. A suitable adjustable support for the tube 12 includes upright post 14 carried by the console; an arm 15 adjustably attached at 16 to the post to rotate about a vertical axis; and a mount 17 for the tube apparatus and adjustably attached at 18 to the arm 15 to rotate or swivel about a horizontal axis.

Extending the description to Figure 2, the tube means 12 includes a housing 19 containing the micro-focus X-ray tube 20 which produces an electron beam 21. A beam target 23 is carried by the tube means and is located axially rearwardly thereof (relative to the patient's head 22) to be inserted or received relatively rearwardly into the patient's mouth. The forward and rearward axis appears at 36. In the example shown, the target 23 is carried by the rearward end portion of a rearwardly axially elongated tubular element 24 projecting into the patient's mouth. The cable 13 is attached to the housing at 26, and passes through an insulator 27 to the gun 20*a*. The inner conductor of the cable is at high potential while the outer cable sheath is at ground potential and is solidly connected to the tube housing. The tube anode is also at ground potential and only the electron gun 20*a* is at high potential, insulated by gas or oil inside the tube housing. This provides the necessary electrically shock-proof mounting for intra-oral radiography.

An alternative ceiling mount for the tube 112 in Figure 3 includes an upright post 114 affixed to or carried by the ceiling of a room. Elements 115-118 correspond to elements 15-18 in Figure 1.

The target 23 may consist of tungsten embedded in a copper shield 31, the latter having upper and lower rearwardly tapering surfaces 80 and 81 which define an angle α therebetween. That angle subtends a zone which encompasses the patient's upper and lower teeth (including root areas) indicated at 32 and 33, but not including the brain or sinus area, the latter as well as the throat being protected from radiation impingement. In this regard, an X-ray film holder 34 is carried by the apparatus 12 to extend at the front of the patient's mouth, and to overlap his cheeks at opposite sides of the mouth. The film holder is also substantially subtended by the angle α. Alternatively, the film may be held in place against the patient's face as by an elastic strap wrapped around his head, or the strap may incorporate VELCRO (Registered Trade Mark) holding means. The target and shield are carried by the anode envelope 35 which is in turn carried by the tubular element 24. The anode envelope material is a low X-ray absorbtion material such as beryllium, titanium or aluminium, and forms the window for radiation emission.

Extending the description to Figure 4, the tube anode 37 is shown axially rearwardly of the gun 20*a*. The target 23, located axially rearwardly of the anode, has surfaces 23*a* and 23*b* angled rearwardly and transversely (i.e. sidewardly) relative to the axis 36. Surfaces 23*a* and 23*b* are transversely symmetrical relative to axis 36, and taper axially forwardly, as shown, at angles β relative to an upright plane 39 normal to axis 36; angle β may for example be about 20°.

In accordance with an important aspect of the invention, means is provided to effect transverse shifting of the radiation pattern produced in response to beam incidence on the target. Such means may comprise a magnet supported to be shifted transversely to deflect the beam transversely relative to the target; for example, Figure 4 shows the magnet 40 suitably supported at 41 by the tube at the right side of the axis 36, and rearwardly of the anode 37, the magnet acting to deflect the beam 21 transversely rightwardly so that it impinges on surface 23*a*. As a result, X-rays are produced to travel forwardly through the upper and lower teeth at the right side of the patient's mouth and to the film in holder 34, such teeth indicated at 44. Actually, radiation may extend transversely over the 180° angle indicated, and defined by the plane of surface 23*a*, and the shield does not interrupt such sideward radiation. See in this regard the shield openings 45 at opposite sides of the target, in Figure 6. Accordingly, the shield has sections 31*a* and 31*b* above and below the target.

Upon completion of exposure of the right side teeth 44 to X-radiation, the magnet 40 is transversely shifted to the left side of axis 36, i.e. to a position as for example appears in Figure 5. In that position, suitably supported at 41*a* by the tube, the magnet acts to deflect the beam 21 transversely leftwardly, so that it impinges on target left surface 23*b*. As a result, X-rays are produced to travel forwardly through the patient's upper and lower teeth to the left side of the mouth, and to the film in the holder 34, such teeth indicated at 44*a*. Here again, radiation may extend transversely over the 180° angle indicated and defined by the plane of surface 23*b*. The shield does not interrupt such sideward radiation, but does limit radiation in upper and lower directions, to remain within the angle α previously described.

Holders 41 and 41*a* may suitably releasably retain the magnet, as by detents. If desired, the magnet 40 may be rotatably carried to swing about axis 36 between the positions seen in Figures 4 and 5.

Figure 7 shows an alternative means to effect transverse shifting of the X-ray pattern with a fixed target, seen in Figure 8. In this view, the tube 12 and supported target 170 are rotatable about axis 136 between the solid line and broken line target surface

positions shown at 50 and 50*a*. For example, in Figure 1 the amount 17 may incorporate means to rotatably support the tube 12 to rotate about axis 136. A sidewardly projecting handle to rotate the tube 180° outside the mouth appears at 160. A tube position locking toggle appears at 161. In target position 50, the operation corresponds to that described in Figure 4; whereas in target position 50*a*, the operation corresponds to that described in connection with Figure 5. Envelope 135 and support element 124 correspond to items 35 and 24 in Figure 2.

Figure 8 shows the modified tungsten target 70 supported by shield 71, the latter projecting forwardly at 71*a* sidewardly of the target to block X-ray sideward travel and confine same to the region 72. The latter is related to teeth 144 at one side of the mouth, as shown. Portions of the copper shield 71 not shown extend above and below the target and forwardly as in Figure 6, so that a side opening is formed at only one side of the target. Target 70 and shield 71 rotate with the tube, as explained above.

Finally, it should be pointed out that since the X-ray intensity necessary for the required film density is proportional to the square of the focus-to-film distance, the radiation output of the X-ray source at 5 cm need be only 1/25 or 4% of that required at 25 cm with the conventional extra-oral X-ray tube distance.

The wide-angle radiation pattern of the present tube can expose a panoramic view of half the mouth including upper and lower teeth in one exposure, so that only two X-ray pictures are necessary instead of 12 with conventional extra-oral tubes. When this correction 1/6 is included in the 4% noted above, the total reduction in radiation amounts to only .66% of that required with conventional dental radiography for the same visual information. This is a very significant reduction in radiation dosage which is less than 1% of the present radiation level for whole-mouth dental radiography.

Referring to Figure 9, the modified apparatus 100 includes an X-ray tube means 101, and a target 102 spaced from the tube to be received rearwardly into a patient's mouth. A tubular carrier element 103 for the target is attached to the tube means as at 104 and projects rearwardly. The target may be supported by a shield 105 similar to shield 71 described above. It is carried by the carrier tube 103 and projects forwardly at 105*a* sidewardly of the target to block X-ray sideward travel in the direction 106 and confine X-ray travel to the region designated at 107. The latter is related to teeth 108 at one side of the mouth, as shown. Portions of the shield extend above and below the target (as in Figure 7*a*) and forwardly of the target as at 105*b*, so that a side opening is formed at only one side of the target. The target and shield rotate with the carrier probe or tube 103, and a window 109 is formed in the latter to pass X-rays. With the 30° target oriented as shown, and between upper and lower molars at one side of the mouth, the sidewardly directed wide angle X-ray beam at 107 traverses all the upper and lower teeth 110 at the opposite side of the mouth, a film 111 being located outside or inside the mouth and proximate teeth 110 for exposure to the X-radiation and recordation of tooth and gum images. Accordingly, only two exposures are needed to record images of all teeth, one exposure as illustrated, and an opposite side (mirror image) exposure with the target located between the molars at the opposite side of the mouth and directing X-rays rightwardly.

Referring to Figures 10 and 11, the elements 100-105 and 109 remain as in Figure 9; however, additional and very important structure is provided, namely, X-ray shielding and tongue suppressor means carried by the apparatus to be received into the patient's mouth and characterised in that when the target is located at one side of the mouth to direct an X-ray beam toward teeth at the opposite side of the mouth the shield will protect portions of the mouth from the X-ray beam and the patient's tongue will be suppressed relative to the X-ray beam. While such apparatus may take various forms, that form as illustrated by component 112 in Figures 10 and 11 is of unusual advantage. It includes a base 113 which is rearwardly lengthwise elongated and forms an elongated opening or semi-circular bore 114 sized to snugly receive the tube 103, i.e. with frictional or other (such as tongue and groove at 213) interfit resisting relative rotation of the component 112 and tube 103. Preferably, the component 112 has removable attachment to the tube 103, for ready replacement by another component for use with a different patient. Thus, component 112 may be dispensible, and provides a new, sterile hygienic cover for the tube 103 for each use. Tube 103 may consist of copper or Monel (Registered Trade Mark), and have a titanium window 214 to pass radiation.

The component 112 also typically includes arms projecting sidewardly from the C-shaped base 113 with a V-shaped relative configuration, the radiation passing between the arms. As illustrated, the lower arm 116 extends downwardly and sidewardly sufficiently to extent centrally over the patient's tongue 117 to forcibly suppress same out of the main path of the radiation beam, the vertical path of which may sweep an arc such as at 107*a* in Figure 11. Note the edge 116*a* of arm 116 over the centre of the tongue, with base 113 clenched between the patient's upper and lower molars 119 and 120 at one side of the mouth (the right side, as also related to Figure 9). The upper arm 118 typically extends upwardly and sidewardly toward the root area of the upper molars 121 at the opposite side of the mouth, and in this regard, arm 116 typically extends toward the root area of molars 122. The two arms also function as shields to prevent X-ray travel outisde the path or arc 107*a*, i.e. protecting the palate and below tongue areas of the head, containing sensitive gland, sinus and brain zones. The X-ray paths 107 and 107*a* may include the temporomandibular joint.

The component 112 may advantageously consist of plastic material (such as polyethylene) containing X-ray shielding material, as for example barium particles dispersed throughout the plastic in as-moulded or formed condition. Other shield substances and component compositions may be utilized.

In the mode of use as illustrated in Figures 9 and

11, with a substantially longer source-to-image distance than is characteristic of Figure 4 use, the magnification, distortion and geometric unsharpness are all reduced to improve the overall resolution of the X-ray beam.

Figure 11 also illustrates the provision of upper and lower integral projections or tabs 125 and 126 on the component 112, to engage the outersides of the posterior molars as shown. They aid in positioning the component relative to the molars when the patient bites down onto the outer surfaces 127 and 128 of the component. Pockets are formed between the lengthwise extending tabs 125 and 126 and arms 116 and 118, to receive and locate the molars, during bite-down, firmly locating the arms 116 and 118.

Figures 12 and 13 show the provision of an additional X-ray filter 129 extending over the tube 103. Tubular filter 129 may consist of aluminium or other shielding material. The filter may form a window to register with window 109.

Figures 14-16 illustrate the use of an extra-oral source adapter removably carried by the tube 103. The adapter structure 130 typically projects sidewardly of the carrier tube 103 and target 102, and is located to pass an X-ray beam sidewardly from the target toward a patient's anatomy, and exteriorly thereof. For example the structure may be placed against the cheek area 131 adjacent the teeth, the X-ray film then being located inside the mouth in a conventional manner. The structure 130 may include a support cylinder 132 removably slipped onto or over the tube 103, and suitably secured to the X-ray tube housing, as at 133. The latter may include a bracket 134 which encompasses the housing 19 and may be clamped thereto as by tightening screw 135.

The structure 130 includes beam collimator means defined by plastic cylinder 136 and internal metallic tubular shield 137. These elements extend generally coaxially with respect to the axis 138 of the X-ray beam embraced by arc 140. Element 136 projects further from the cylinder 132 than element 137, and both tend to limit the beam to a narrow cone circumscribing the rectangular periapical X-ray film used in conventional extra-oral radiography.

Among the advantages of the above apparatus are the following:

1. Increased magnification of the tooth area facilitates diagnosis; for example, detection of pulp in the root area is made easier, and the results of grinding of teeth show up more clearly. Thus, the dentist can more accurately inform the patient of grinding and the deleterious results of same including possibly injury to the jaw hinge point. Splintering of teeth is also more easily detectable, and sinus areas can be X-rayed to show up more clearly.

2. The depression of the tongue prevents obscuration of the film.

3. The aluminium filter on the tubular carrier tends to even out the beam intensity over the film area, producing a better picture.

4. The side-to-side interior X-ray technique enabled by the invention facilitates rapid taking of full mouth X-rays, using only two exposures, which in turn facilitates accurate charting of teeth by the dentist. Also, the patient can be shown the full X-ray picture, and can easily see what dental work needs to be done, so that communication between dentist and patient is improved.

5. The invention used for panoramic radiographs removes need for conventional bite-wings and their holders inserted into the mouth, obviating discomfort and injury that can result from these items.

6. The probe itself (target and carrier) can be used in emergencies such as accidents wherein patients undergo severe facial injury, so as to secure pictures of the extent of that injury. Also, information highly useful for plastic surgery can be easily obtained.

7. Irradiation of sensitive areas of the brain, optic nerve, thalmus and thyroid glands is avoided.

8. Full X-ray data, obtainable through use of the invention, is easily obtained for use as best evidence in legal proceedings.

Finally, Figure 17 illustrates the provision of support operatively connected to the above-described X-ray tube means, together with other means carried by the support at a location to project toward the patient's head an image delineating an area within the main path of the X-ray beam. As illustrated, such other means typically includes a light source 200 carried by the support arm 201, the latter extending from a mount 202 attached to the X-ray tube housing 19. The light source 200 may be suitably shielded at 204.

Light refracting structure is located in the path of light transmitted from the source 200, such structure advantageously taking the form of a double prism 206 attached to the shield 204, for example, and extending in openly spaced confronting relation to the component 112. Light projected downwardly via iris 204*a* and in the prism, as rays 207 and 208 is reflected by prism face 209 as rays 207*a* and 208*a*, and an upper image 204*b* of the iris 204*a* in the shield may be formed between the rays 207*a* and 208*a* as for example on a patient's face. Similarly, light projected downwardly via the iris as rays 211 and 212 is reflected by prism face 210 as rays 211*a* and 212*a* and a lower image 204*c* of the iris may be formed between the rays 211*a* and 212*a* as on a patient's face. Images 204*b* and 204*c* delineate the upper and lower limits of a facial area in the main path 107 of the X-rays from the target. Accordingly, the technician will know precisely where to locate the X-ray film adjacent the patient's face.

CLAIMS:-

1. Dental X-ray apparatus comprising an electron gun operable to provide an electron beam directed along an axis, a target carrier projecting from said gun along said axis and having a distal end of such a shape as to be receivable into the patient's mouth, a target carried by said carrier at the distal end thereof in line with said axis, and at an angle thereto which is effective to produce a radiation pattern, when exposed to the electron beam, extending forwardly from said target towards the gun and laterally of the beam axis and a shield of X-ray opaque material extending forwardly above and below said target and rearwardly thereof, said shield serving in use to

restrict the radiation to a forwardly and/or laterally directed substantially wedge or cone-shaped pattern apexed on the target and delimited vertically substantially by the root tips of the upper and lower teeth.

2. Apparatus according to claim 1, comprising a film holder designed and mounted on said apparatus so as to be located externally of the patient's mouth, when said target carrier and target are received therein, said film holder being adapted to receive and position an unexposed X-ray film within the wedge or cone-shaped radiation pattern.

3. Apparatus according to claim 1 or 2, wherein the target comprises two substantially planar surfaces rearwardly and symmetrically inclined on opposite sides of said axis, and wherein means are provided selectively to shift the electron beam transversely to either side of said axis so as to impinge at will on one or other of said two surfaces.

4. Apparatus according to claim 3, wherein said means comprise a magnet selectively positionable on one side of the beam axis or the other.

5. Apparatus according to claim 3 or 4, wherein said surfaces are inclined at an angle of about 20° to the perpendicular to the beam axis.

6. Apparatus according to claim 1 or 2, wherein the target comprises a single substantially planar surface intersecting said beam axis but inclined at an angle thereto and means are provided selectively to rotate the target through 180° about said axis.

7. Apparatus according to claim 6, wherein the X-ray opaque shield is rotatable with said target and comprises a portion extending forwardly from the leading edge of the inclined surface of the target towards the electron gun parallel with said axis thereby substantially restricting the radiation pattern from said target to one side or other of the beam axis.

8. Apparatus according to claim 7, wherein the X-ray opaque shield comprises a blind cylinder of X-ray opaque material axially aligned on said beam axis with its open end directed towards the electron gun, said target being positioned in the bore of said cylinder adjacent the blind end, and said cylinder having longitudinally extending slot in a wall portion thereof on one side of the axis opposite the inclined surface of the target to provide a window for the passage of radiation from the target through the shield.

9. Apparatus according to claim 1 or 2, wherein the target carrier comprises a generally tubular member projecting from the electron gun coaxially along the beam axis, and positionable in use between the molars on one side of the patient's mouth, said tubular member having an end closure member with a target interiorly mounted in said tubular member adjacent said end closure member, said target having a forwardly directed surface intersecting said beam axis and inclined at an angle relative thereto, and said tubular member having at least the end portion thereof adjacent the target and extending forwardly therefrom formed of an X-ray opaque material but with a longitudinally extending window on one side of the beam axis opposite the inclined surface of the target for the passage of radiation from the target to the teeth on the opposite side of the mouth to that in which the target and target carrier are, in use, positioned.

10. Apparatus according to claim 9, wherein means are provided for selectively rotating the target and said window through 180° about said axis.

11. Apparatus according to claim 9 or 10, additionally comprising means effective, when the target carrier is positioned between the molars on one side of the mouth, to depress the patient's tongue substantially out of the path of radiation emanating from said target.

12. Apparatus according to claim 11, wherein said tongue depressing means additionally comprise a shield of X-ray opaque material extending upwardly above the tongue depressing means to shield the roof of the mouth from said radiation.

13. Apparatus according to claim 11 or 12, wherein said tongue depressing means and/or said shield are detachably mounted on said tubular target carrier.

14. Apparatus according to claim 13, wherein said tongue depressing means and said shield are integrally formed of X-ray opaque material and comprise a sleeve slidably engaging over the end of the tubular target carrier, said sleeve having an X-ray transmitting window which aligns with the window in the target carrier, and upper and lower arms diverging in substantially V-form from said sleeve, said lower arm in use serving to depress the tongue substantially out of the radiation path and the upper arm serving to block passage of radiation to the roof of the mouth.

15. Apparatus according to claim 14, wherein said sleeve is provided externally with one or more tooth locating abutments which serve to locate the target carrier, when the sleeve is mounted thereon, between the molars on one side of the mouth by engagement of the molars with said abutment(s).

16. Apparatus according to any one of claims 9-15 additionally comprising an adapter removably connectible to the tubular carrier to direct an X-ray beam from said target laterally of the electron beam axis towards an external surface of the patient's face, the target carrier and target, in use, then being located externally of the patient's mouth, and an X-ray film internally.

17. Apparatus according to any one of the preceding claims additionally comprising means operable to depict on an external surface of the patient's face, the areas exposed to said wedge or cone-shaped radiation pattern.

18. Apparatus according to claim 17, wherein said depicting means comprise a light operable to depict externally by illumination those areas of the patient's face which are to be exposed to said radiation.

19. Apparatus according to claim 1 or 2, additionally comprising means to depress the patient's tongue substantially out of the path of radiation emanating from said target.

20. Apparatus according to claim 19, wherein said tongue depressing means additionally comprise a shield of X-ray opaque material extending upwardly above the tongue depressing means to

shield the roof of the mouth from radiation emanating from the target.

21. Apparatus according to claim 20, wherein said tongue depressing means and shield are detachably mounted on the target carrier.

22. Apparatus according to claim 21, wherein the tongue depressing means and shield are integrally formed of an X-ray opaque material.

23. Apparatus according to claim 22, wherein said X-ray opaque material is a plastics material containing an X-ray shielding substance.

24. Apparatus according to claim 23, wherein said substance is barium.

25. Apparatus according to any one of claims 22-24, wherein the target carrier is tubular and said tongue depressing means and shield comprise a sleeve which is slidably receivable on the tubular carrier, said sleeve having a pair of arms diverging therefrom in substantially V-form, one arm, in use, serving to depress the patient's tongue, and the other serving to shield the roof of the patient's mouth from said radiation.

26. Apparatus according to claim 1, substantially as hereinbefore described with reference to the accompanying drawings.

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