(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 245 906**
A1

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **87200836.2**

(51) Int. Cl.4: **G03D 13/02**

(22) Date of filing: **07.05.87**

(30) Priority: **13.05.86 IT 2041786**

(43) Date of publication of application:
19.11.87 Bulletin 87/47

(84) Designated Contracting States:
AT BE CH DE ES FR GB GR IT LI LU NL SE

(71) Applicant: **Carozzi S.p.A.**
Via Giacomo Leopardi 5
Milan(IT)

(72) Inventor: **Carozzi, Giorgio**
c/o INT. OCTROOIBUREAU B.V. Prof.
Holstlaan 6
NL-5656 AA Eindhoven(NL)

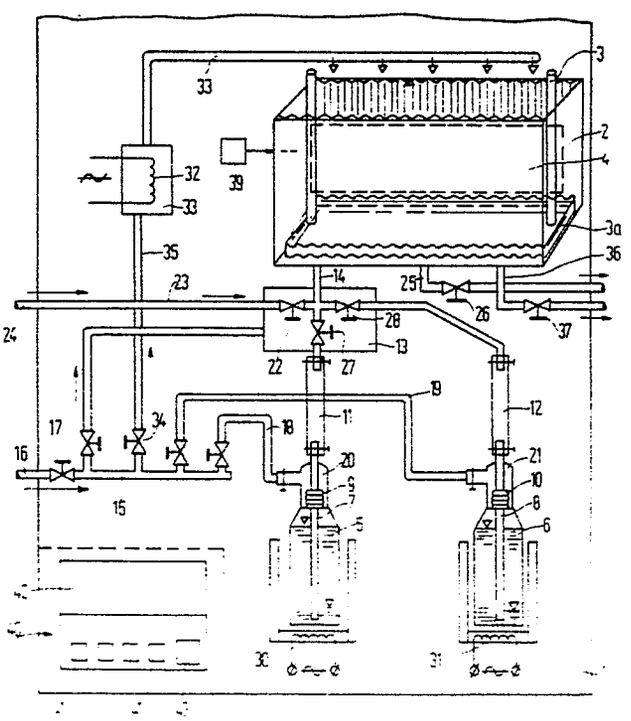
(74) Representative: **Scheele, Edial François et al**
INTERNATIONAAL OCTROOIBUREAU B.V.
Prof. Holstlaan 6
NL-5656 AA Eindhoven(NL)

(54) A device for automatic development of X-ray films.

(57) An apparatus for automatic development of X-ray films, such as large-size endoral panoramic X-ray films and sets of filmstrips, in which means are provided to effect contact between the X-ray films and successive processing liquids by causing the liquids to circulate in succession in a predetermined and programmed cycle into a processing tank (2) adapted to accept X-ray film sheets (4). Containers (5, 6) for the developing and fixing solutions, an linked to the processing tank via a pneumatic valve systems (13), by which pressend air is introduced into either of the said containers for pre-determined periods of time, to force the solutions into the procussing tank, also for pre-determined periods of time, with a preferably gravity actioned, profound return of the solutions after treatment into the respective containers.

A system for injecting water for washing into the processing tank at the end of the treatment cycle or between successive processing steps may be added just as a system for injecting warm iar, if required, to dry the films.

For the control of the apparatus an adjustable electronic switching system (40) for automatic execution the processing, incorporating programmed timers adjustable according to the required duration of individual processing cycles is added.



EP 0 245 906 A1

A device for automatic development of X-ray films.

The invention relates to an apparatus for automatic development of X-ray films.

An apparatus of this kind is known from US 4,422,748. In this apparatus X-ray films, such as sets of endoral X-ray films and simular, and of panoramic X-ray films especially as used in dental surgery, can be developed. The apparatus as described there comprises an enclosure which contains, separately in adjacent containers, for the developing solution, the fixing solution and if necessary the soluation for final washing.

The apparatus is provided with groups of horizontal rollers parallel to each other, positioned above the containers, containing each of the processing solutions in succession. Each group of rollers is made up of pairs of rillers which turn against each other and are positioned at different heights in order to convey the X-ray films from one tank to the next, immersing them and lifting them after each phase of the process. Above the lifting rollers are spatulas to eliminate the residues of the previous bath in order to reduce contamination of the succeeding one; and each group of rillers is operated by a complex system of gearing driven at a programmed constant speed.

The automatic developing systems described above has various limitations in its use and considerable disadvantages as a result of the particular construction.

It is designed to process the film for fixed preset periods of time. It has the disadvantage that the drive gearing and other mechanisms become in contact with the liquids used for the processing so that the mechnanisms become dirty and encrusted, requiring periodic cleaning, or in other words they need a type of maintenance not normally carried out in dental surgeries due to the absence of qualified personnel for the job, resulting in frequent and serious damage to the equipment.

The automatic development equipment as disclosed is further very space consuming, is structurally extremely complex and delicate and therefore also expensive, and is limited to not too high-speed processing cycles. It is therefore an aim of the invention to produce an apparatus for automatic processing of X-ray films to be constructed in such a way as to eliminate the disadvantages inherent in the known apparatus. To this end an apparatus of the type mentioned in the opening paragraph is characterized in that means are provided to effect contact between the X-ray film and successive processing liquids by causing the liquids to circulate in succession in a programmed cycle into a processing tank addapted to accept X-ray film sheets.

In an apparatus according to the invention use is made of a single processing tank in which the different processing agents can be introduced, hold as long as required and removed for storing for a following cycles. For each processing step an independtly choosen processing time can be excerted now and no liquid mixing due to film transport occurs.

In order to execute the liquid movements in a preferred embodiment the apparatus comprises:

-a support on which are placed a processing tank in the form of a flat container;

-containers containing successive processing liquids for the X-ray films. Into each container is inserted a dip tube, connected to the processing tank via a multi-channel valve system to be activated by a source of compressed gas in accordance with an operating programme for successive periods of time, controlled by an electronic control switching system;

-a system to realise gas into the containers holding the processing solutions in order to sequentially a developing and a fixing solution into the processing tank for predetermined periods of time, fully returning processing liquids into their respective containers at the end of the processing time for each liquid.

The use of a valve system pneumatically to be activated and storage tanks for each of the processing liquids a very useful and robuust apparatus is generated. Use can be made in the same system of washing water from a main supply thus without a storage thank therefore. In roughly the same manner use can be made of air for drying the film sheets in the processing tank.

In a further embodiment an electronic control circuitry is provided with means to fix processing periods of time for each processing liquid independently. Preferably, these periods of time can be adapted to facts which have influence on the process such as the kind of films, the temperature of the processing liquids, the status of the processing liquids and so on.

In a further embodiment the storage tanks are provided with controlable heating means such that the temperature fo the liquids can be fixed on a predetermined temperature. Also for the washing water and the drying air heat elements can be added to the apparatus.

In a further embodiment. the processing tank is provided with a film lifting system of which a base rod is provided with a profile cooperating with undulations on inner face-walls of the tank such that film sheets are provided to pass beyond that base rod.

The sole Figure shows, diagrammatically, an apparatus according to the invention.

The apparatus of the drawing shows a support 1 supporting a processing tank 2 having a flattened shape and potentially provided with a movable cover. In the processing tank can be placed X-ray films 4 such as panoramic films or sets of filmstrips which are liftable with the aid of a, preferably automatic, film, lifter 3. The film lifter 3 is of a type suitable to be introduced into the processing tank and is preferably provided with a base rod 3a of a shape adapted to an undulated surface of sidewalls of the tank 2 to prevent any film passage beyond the base rod which in fact act as film lifter. The film lifter is preferably activated pneumatically with the help of pressed air. The support 1 also supports containers 5 and 6 containing, respectively, a developing and a fixing solution. The containers 5 and 6 are here in the form of bottles with narrow and threaded necks, but may have any shape. In the containers dip tubes 7 and 8 are inserted attacked to the necks of the containers by means of ringnuts 9 and 10. Ends of the dip tubes 7 and 8 are connected, via two separate, preferably deformable tubes 11 and 12, to a pneumatic valve system 13, here given as a three-way single system with its control placed below three outlets in order to prevent traces of the solutions remaining in the valve after it has been closed. An outlet 14 of the valve system 13 communicates with the inside of the processing tank 2, preferably via its floor.

The interiors of the solution containers 5 and 6 are in communication with a tube 15 fixed to a compressed air supply 16 via an intercepting valve 17, via tubes 18 and 19 respectively. Connections at the necks of the containers is made by means of air-tight sleeves 20 and 21, aligned on the same axis as the dip tubes 7 and 8.

An outlet valve 22 of the pneumatic valve system 13 is connected to a tube 23 carrying water from the mains supply 24 so that, at the end of, for example the fixing cycle, washing water can be brought into the processing tank 2 via the valve 22 and can be removed via a tube 25 with an outlet valve 26. An outlet valve 27 of the valve system 13 communicates with the container 5 for the developing solution, while an outlet 28 is connected to the fixing solution container 6. If required by the types of solution used and by the prevailing climatic conditions, containers 5 and 6 can be fitted with a thermostatic control system; for this purpose the containers can be fitted with electrical resistance 30 and 31, for example sunk into the bases of the containers, or provided with air spaces for the circulation of air heated by the resistances. Similarly, air. heated by heating element 32, may be sent into the processing tank via distribution tube 33. A container 33 is thereto connected with the tube 15 via a valve 34 and a connecting tube 35. After passing through the processing tank the air can be lead away via a discharge pipe 36 at the base of the tank, provided with an interception valve 37.

A switching system 40 is connected to the apparatus described above to automate the sequence of operational phases, comprising one or more timers 41 which can be programmed to give both fast and normal processing cycles, and which are connected to an electronic circuit 42 controlling the operation of the different valves regulating the compressed air according to the sequence of opening and closing required by the cycle to be performed, as well as the inlet and discharge valves for the supply of water for washing and air for drying.

A particular point is that the said switching system is also fitted with buttons or knobs to allow fine adjustment by hand, to give 10% more or less than the programmed times for example in order to take account of variatins in room temperature and in the reactive properties of the solutions as a result of their repeated use. The switching system is provided with a staring button 43 and may be provided with acoustic and/or lumious signalling means to indicate the successive phases of the cycle, thus eliminating the need for a constant presence of the operator.

The whole of the apparatus described may be enclosed in a rigid housing having on at least two of its sides portholes allowing the hands of the operator to be introduced into the container and enabling the films to be placed into the processing tank 2, without exposure to light.

With the above description in mind, the use and functioning of the apparatus formig the subject of the present application can be briefly summarised as folows:

The X-ray film to be developed, protected in its wrapping, is introduced into the housing. The operator puts his hands through the portholes and in this position removes the protection from the sensitive layers of the film, and puts the film into the processing tank 2 securing it in position with retaining clips or similar. Compressed air is then released into the container 5, previously filled with developing solution, for a predetermined period of time sufficient to allow the solution to rise to a predetermined level in the processing tank 2 via the valve opening 22, keeping all the other outlets of the valve system 13 and the discharge valve 37 closed. A micro switch 39 on the processing tank may be used to indicate the full covering of the films and may prevent futher action before this level has been reached. Valve 27 is then closed, after the time predetermined for the developing phase has elapsed, valve 27 is opened and the

developing solution can then return by gravity into its container 5. compressed air is then relesed into the fixing solution container 6 to bring the level of fixing solution up in the tank and so on, in a procedure analogous to the developing phase, until the fixing solution is returned into its own container when fxing is complete. The valves which functione as outlet valve or also as outlet valve are thus constructed that no residuals of the liquids can remain therein and are of a material resistant to the processing liquids.

The film is then washed by releasing mains water into the tank via pipe 23, and after a predetermined period of time this is drained out 6. If desired, the solutions may previously have been kept at a thermostatically controlled temperature by mean of heating elements 30 and 31 and the washed films can also be dried with heated air produced by the heating element 32, and can then be removed from the tank.

The processing cycle is thus completely automated, without use of moving mechanical parts in the processing tank, without danger of damage to such mechanical parts and without even minimal risk of contamination between the processing solutions, since the said three-way pneumatic valve system 13 has its control positioned below the outlets, thus eliminating the possibility of traces of the solutions remaining inside the valve. In addition the device forming the subject of the invention has the advantage of making use of supplies such as water and compressed air which are always already available and in normal use in dental surgery, without therefore requiring the installation of new and expensive systems for the operation of equipment.

It is obvious that a practical realisation of the invention described above may incorporate further structural and fuctional equivalent and variations, without departing from the protected overall concept of the invention itself.

Claims

1. An apparatus for automatic development of X-ray films, characterized in that means are provided to effect contact between the X-ray films and successive procesing liquids by causing the liquids to circulate in succession in a programmed cycle into a processing tank (2) adapted to accept X-ray film sheets.

2. An apparatus as claimed in Claim 1, characterized in that it comprises:

-a support (1) on which are placed a processing tank (2) in the form of a flat container;

-containers (5, 6) containing successive processing liquids for the X-ray films. Into each container is inserted a dip tube (7, 8), connected to the processing tankt (2) via a multi-channel valve system (13) to be activated by a source of compressed gas in accordance with an operating programme for successive periods of time, cotrolled by an electronic control switching system (40):

-a system to realise gas into the containers holding the processing solutions in order to sequentially a developing and a fixing solution into the processing tank for predetermined periods of time,- fully returning processing liquids into their respective containers at the end of the processing time for each liquid.

3. An apparatus as claimed in Claim 2, characterized in that it comprises:

-a system for forcing washing water into the processing tank at least of the fixing cycle and to emply the processing tank after the washing cycle.

4. An apparatus as claimed in Claim 2 or 3, characterized in that the electronic control switching system for automatic operation of the successive processing cycles, incorporating programmable timers adjustable according to the required length of the processing cycles and according to the characteristics of the processing liquids to be used.

5. An apparatus as claimed in Claims 1, 2 or 3, characterized in that use is made of compressed air from a mains supply for the circulation of processing liquids.

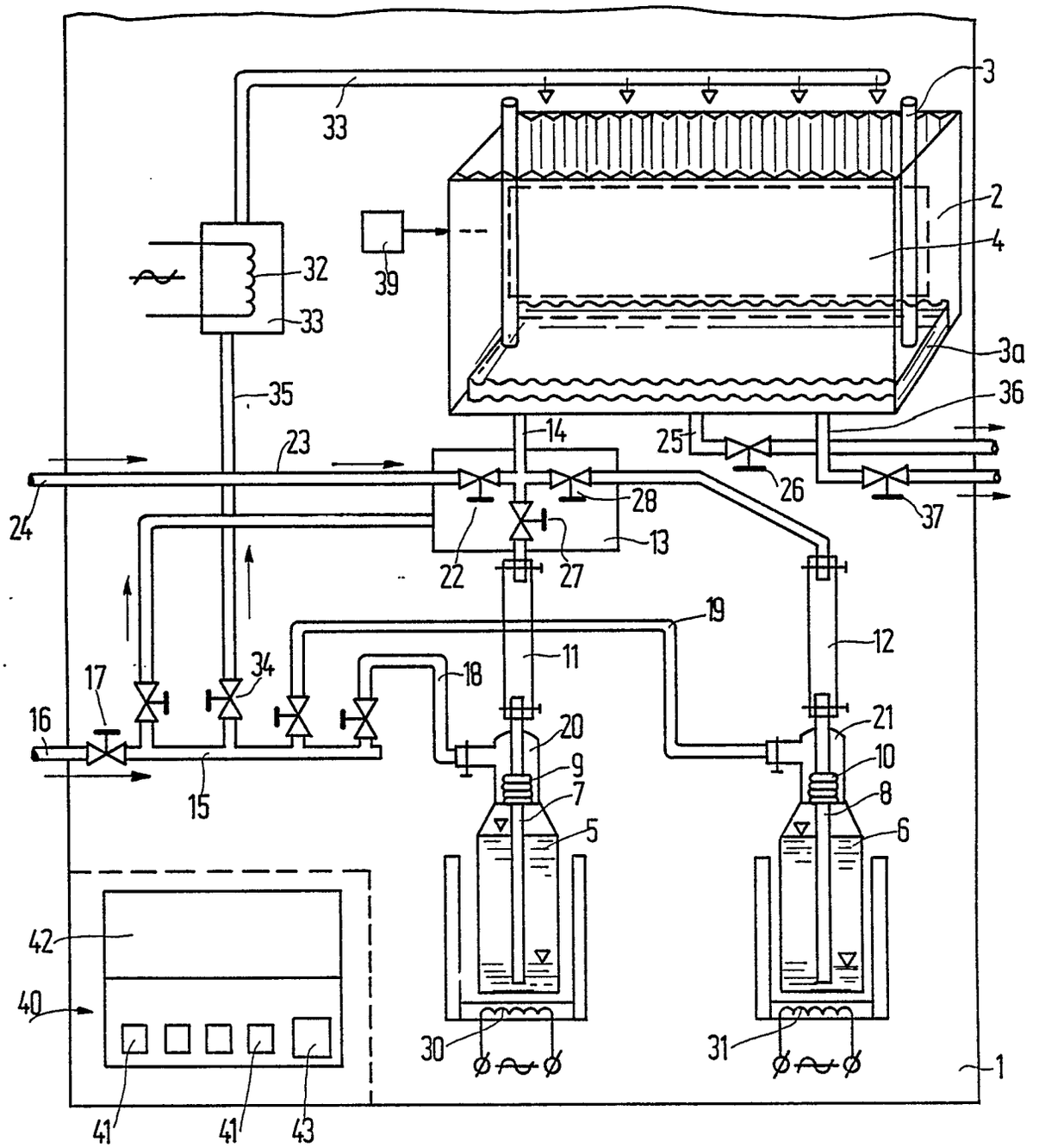
6. An apparatus as claimed in Claim 2, 3, 4 or 5, characterized in that the multi-channel valve system is of the pneumatic type, preferably a three-way system, in order to prevent traces of the processing liquids to remain within the valve system after each of the solutions has been let out.

7. An apparatus as claimed in any one of the preceding claims, characterized in that containers for solutions are fitted with thermostatic controls, by incorporating of heating elements (30, 31).

8. An apparatus as claimed any one of the preceding claims the processing tank can be heated by means of warm air supplied from a flow-through (33) provided with a heating element (32).

9. An apparatus according to any one of the preceding claims, characterized in that an electronic switching system (40) operates to control elements thereto allowing periods of immersion of the films in each of the processing liquids to be varied, in order to take account of the variations in temperature and of variations in the chemical properties of the solutions as a result of their repeated use.

10. An apparatus according to any one of the preceding claims, characterized in that the processing tank is provided with indulated side walls, a film lifting system being adapted to said indulating walls.


3
33
2
4
32
39
33
3a
35
36
14
25
23
26
24
28
37
13
22
27
19
12
11
17
34
18
16
20
21
9
10
15
7
8
5
6
42
40
30
31
1
41
41
43

European Patent Office

EUROPEAN SEARCH REPORT

Application number

EP 87 20 0836

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.4)
X	US-A-3 508 483 (A.B. WEIDER et al.) * Claims 1-5; figures 1-3 *	1-4,7-9	G 03 D 13/02
X	US-A-4 097 884 (D.J. LASKY) * Claims 4-12; figures 1-3 *	1-4,9	
X	US-A-3 739 705 (D.J. LASKY) * Claims 3-7; figures 1-7 *	1-3,5	

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

G 03 D 13/02
G 03 D 13/04
G 03 D 3/06

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	24-08-1987	BOEYKENS J.W.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO Form 1503 03 82