Feb. 10, 1970 R. S. KAMPF ET AL 3,494,273

FILM DEVELOPING APPARATUS

Filed July 27, 1967 3 Sheets-Sheet 1

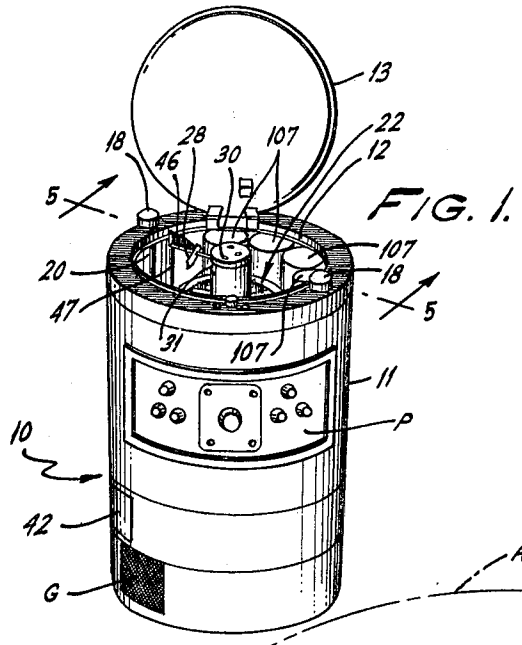


FIG. 1.

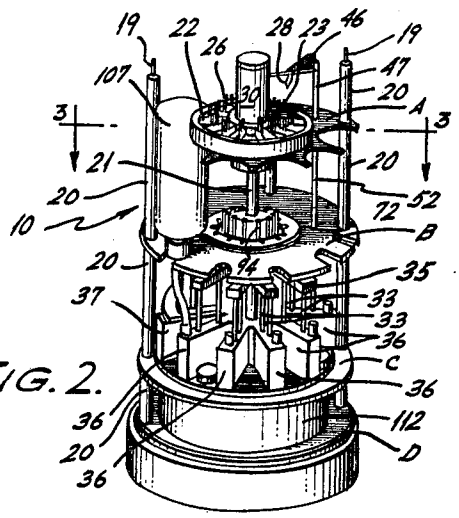


FIG. 2.

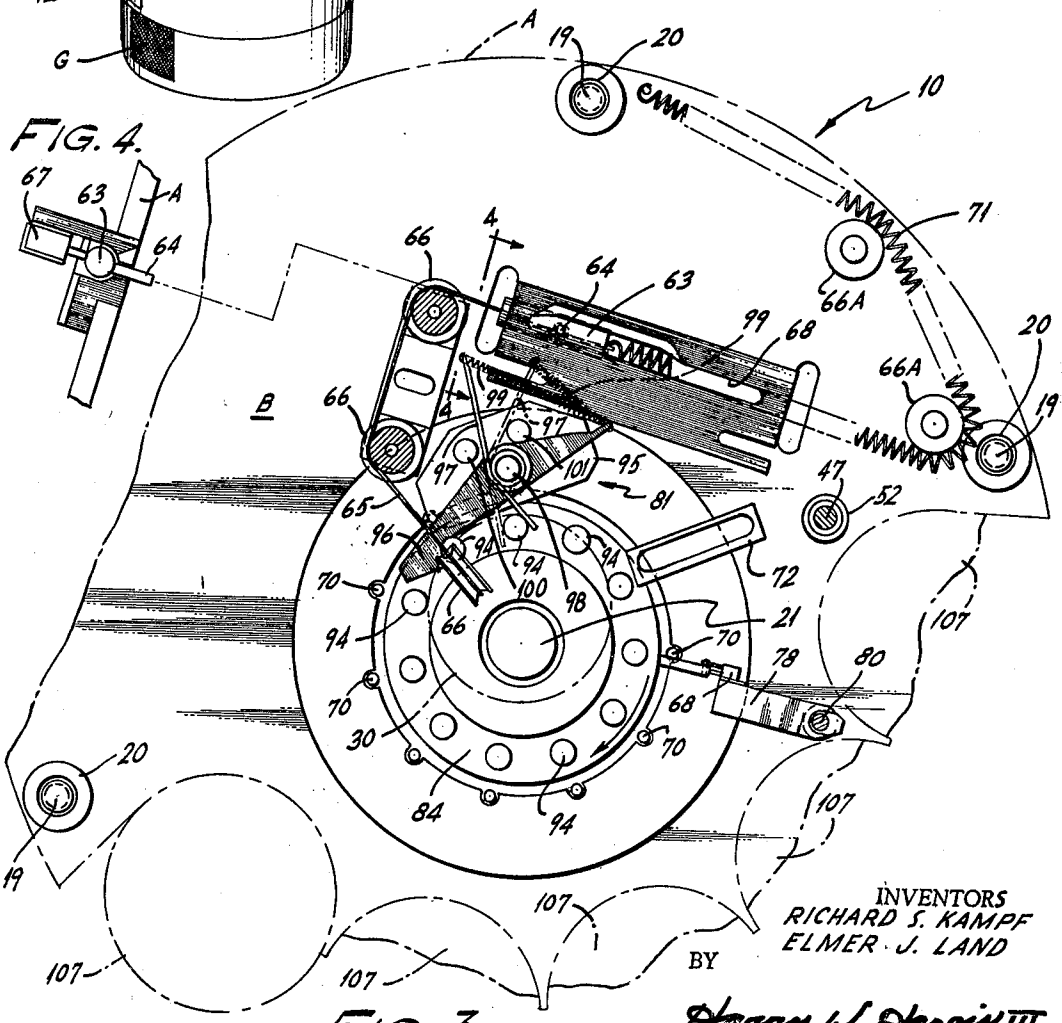


FIG. 4.

FIG. 3.

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FILM DEVELOPING APPARATUS

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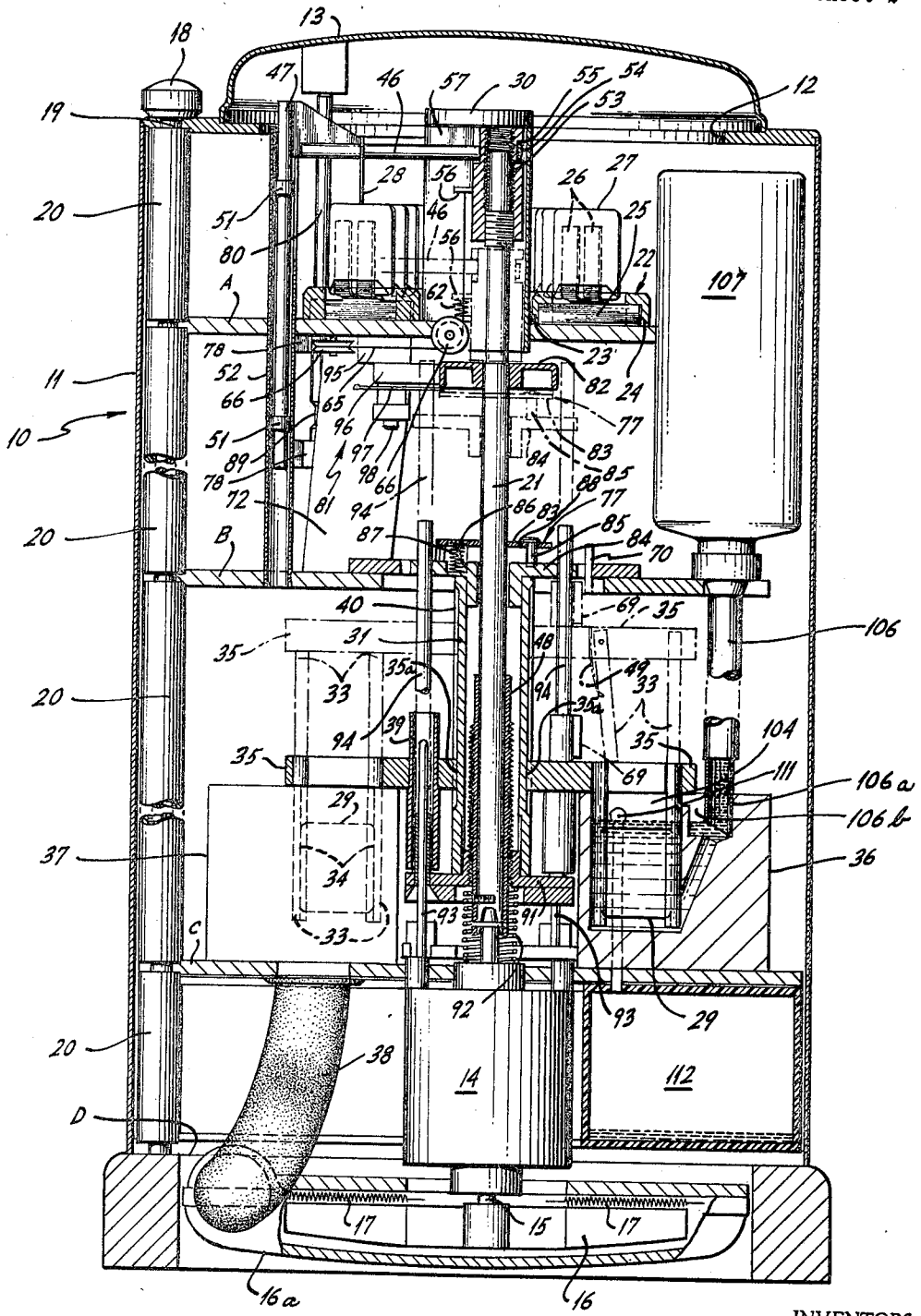


FIG. 5.

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FILM DEVELOPING APPARATUS

Filed July 27, 1967 3 Sheets-Sheet 3

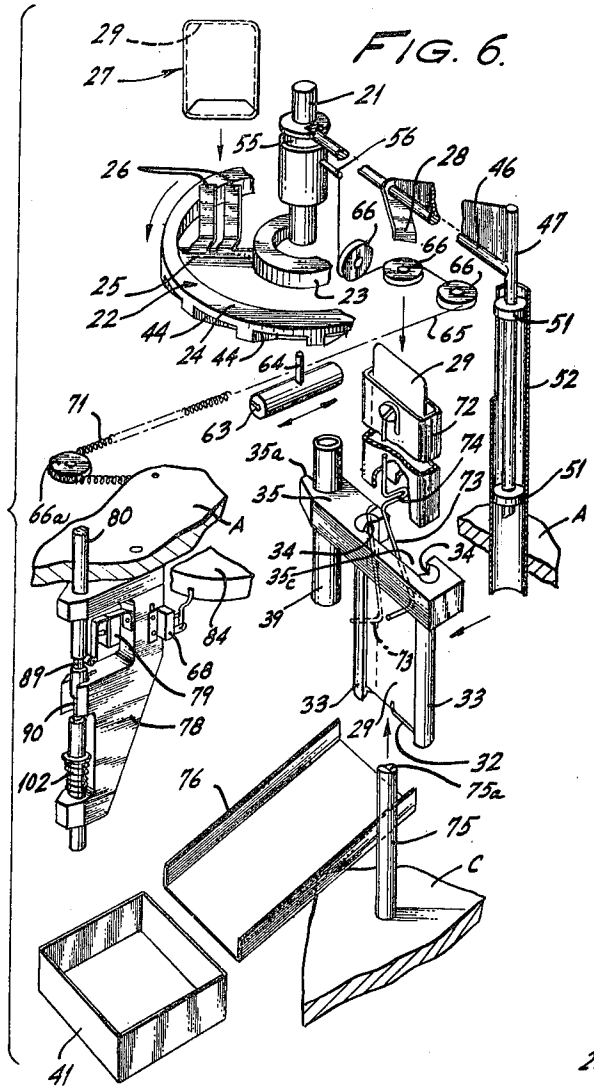


FIG. 6.

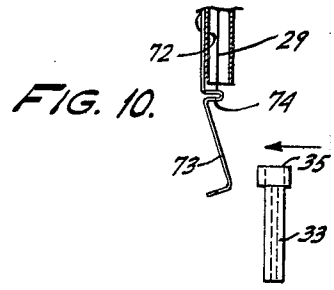


FIG. 10.

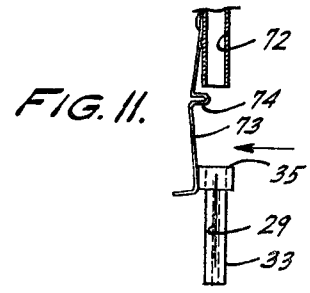


FIG. 11.

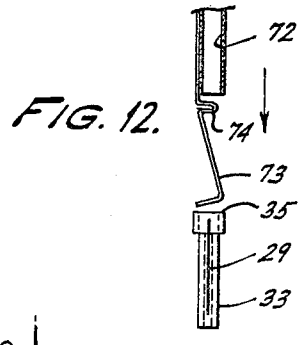


FIG. 12.

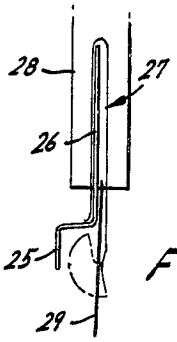


FIG. 9.

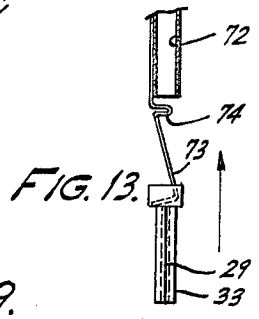


FIG. 13.

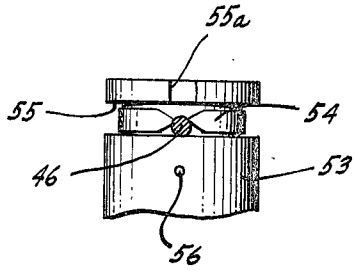


FIG. 7.

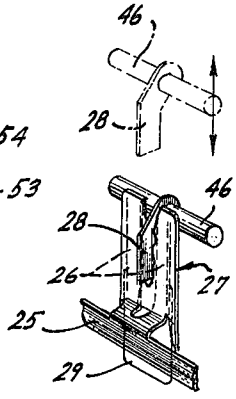


FIG. 8.

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FILM DEVELOPING APPARATUS

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Filed July 27, 1967, Ser. No. 656,381
Int. Cl. G03d 3/10
U.S. Cl. 95—89 11 Claims

ABSTRACT OF THE DISCLOSURE

A dental X-ray film processor adapted to receive exposed X-ray film chips in their packages, and to deliver the dry processed film chips. A rotatable tray is provided with a plurality of film chip extraction forks. Exposed film packs are impaled on the forks, and an extractor is positioned and arranged to strip the film chips from their packs as they are rotated on a tray and presented sequentially to a loading station. The individual film chips are then moved to a developing station and fed into a mechanical holder positioned and operable to immerse the supported film chips sequentially into chambers filled with developing and finished solutions. A drying station provided after the developing station includes means for blowing heated air over the chips, and a terminal station includes means for extracting the film chips from holders and then delivering them to an outlet chamber.

BACKGROUND OF THE INVENTION

The invention herein described was made in the course of or under a contract thereunder with the Department of the Army.

This invention relates to film developing apparatus, and more particularly to apparatus for automatically developing exposed films. While of broader applicability, the invention has particular utility in the developing of dental X-ray film chips.

Heretofore, the processing of dental X-ray film chips has required a number of manual operations carried out by skilled technicians in darkrooms. The present invention has as a general objective the provision of rapid automatic developing apparatus that is self-contained, is characterized by high degree of portability, and requires neither darkrooms nor skilled technicans for carrying out the developing operations.

SUMMARY OF THE INVENTION

The invention comprises apparatus arranged to accept a number of exposed film chip packets, and operable automatically to remove the chips from the packets, chemically to process and dry each film chip sequentially, and to present the dry developed film chips for removal by an operator of the apparatus. A preferred embodiment of the invention comprises a plurality of both vertically and circumferentially spaced processing sections arranged about a centrally located, reversibly rotatable shaft operable by a prime mover. As the prime mover is operated selectively in its forward and in its reverse directions, it effects sequential presentation of the film chips at the appropriate processing stations.

A more complete understanding of the invention will be had by making reference to the following detailed description of the preferred embodiment, taken in light of the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a perspective showing, on a reduced scale, of apparatus embodying the invention;

FIGURE 2 is a perspective showing of apparatus illustrated in FIGURE 1, as seen from the rear, and from which the outer cover, as well as some internal parts, have been removed;

FIGURE 3 is a plan view taken generally in the direction of arrows 3—3 applied to FIGURE 2, with some parts removed and others fragmented for the sake of clarity;

FIGURE 4 is an end view of a portion of the apparatus shown in FIGURE 3, as seen looking in the direction of arrows 4—4 applied thereto;

FIGURE 5 is an enlarged elevational-sectional showing of apparatus seen in FIGURE 1, looking generally in the direction of arrows 5—5 applied to the latter figure;

FIGURE 6 is a generally diagrammatic showing, in perspective, of portions of the apparatus illustrated in FIGURES 3, 4 and 5;

FIGURE 7 is an elevational showing of a portion of the apparatus shown in the preceding figures, and illustrating a feature of construction of such portion;

FIGURES 8 and 9 illustrate features of operation of a portion of the apparatus illustrated in the preceding figures; and

FIGURES 10 through 13 illustrate features of operation of another portion of the apparatus illustrated in FIGURES 1 through 7.

DESCRIPTION OF THE PREFERRED EMBODIMENT

With more detailed reference to the drawing, and first with reference to FIGURES 1, 2 and 5, apparatus **10** embodying the invention comprises a generally cylindrical, light-impervious housing **11** supported upon a base portion D and provided at its upper end with an opening **12** over which is positioned a hinged circular lid or door **13**. Housing **11** is removable, as is seen in FIGURE 2, for servicing various operating elements of the apparatus and is held in place by knurled nuts **18** (FIGURE 1) engaging threaded ends of rods **19** (FIGURES 2 and 5) that extend through an upwardly facing annular flange portion of the housing. The rods are supported in base portion D, and have tubular members **20** fitting thereover which serve both as spacers and as supports for vertically spaced, generally disk-shaped decks A, B, and C. The base, rods, and decks comprise the basic frame structure supporting operating elements more fully described in what follows.

A reversible motor **14** (FIGURE 5) including a double-ended shaft **15** is located in the lower region D of housing **11**, and is arranged to drive, from the lower end of its shaft **15**, air impeller **16** of a blower **16***a* operable to direct air over a heating element **17**, for subsequent direction through a discharge conduit **38** leading into film drying chambers **37**. The upper end of motor shaft **15** drives a central, vertically extending shaft **21** that operates mechanism (described later) disposed in the upper main portion of housing **11** and arranged for rotation about the central shaft.

A turntable **22**, also called a film loading tray, is disposed upon deck A in substantial axial alignment with the opening **12** of housing **11**, and is arranged to be rotated in step-by-step manner about a spindle **30**, to move film chip packets **27** past a film chip stripping and loading station. As seen to advantage in FIGURES 5 and 6, turntable **22**

includes an inner hub portion **23**, disposed about spindle **30**, and an outer rim portion **24**, the two portions being interconnected by spoke-like members **25** having upwardly presented forks **26**.

Still with reference to FIGURES 5 and 6, and also with reference to FIGURES 8 and 9, forks **26** are arranged to receive thereon envelopes of film chip packets **27** so that a suitably positioned ejector blade **28**, when moved downwardly against a supported film packet **27**, is operable to tear through the envelope portion of the packet (FIGURE 8) and to force the film chip **29** from an opening in the envelope (FIGURE 9). As film chip **29** is forced from the envelope it is urged through intermediate structure disposed between decks A and B, and fully described below in conjunction with FIGURES 6 and 10 to 13, into slotted portions **34** of a pair of vertically extending rod-like members **33** (FIGURES 5 and 6). These latter members are supported upon arms **35**, including slotted portions **35***c* aligned with members **33**, for both vertical reciprocable and rotatable movements relative to central shaft **21**, between decks B and C. The vertical rod-like members **33** are movable in step-by-step fashion around the inner portion of cylindrical housing **11** and are arranged sequentially to dip the film chips **29** into a series of chambers **36** illustrated in FIGURES 2 and 5, and containing developing and finishing solutions of different types. While the number and contents of chambers **36** may vary, there are five such chambers in the present embodiment. Of this number, one is supplied with a developing solution, two are supplied with fix solutions, and two are supplied with wash solutions.

Following dipping of film chips **29** into the developing solutions in chambers **36**, the chips are inserted into drying chambers **37** through which heated air is forced to flow by operation of blower impeller **16**. After being dried, film chips **29** are moved to an unloading station where they are stripped from the supporting rod members **33** and fed into a small, removable container **41** (FIGURE 6) in stacked sequence corresponding to the order in which they were loaded upon the loading tray. The small container **41** is accessible through an opening (not shown) provided in the side wall of housing **11**, and which can be opened and closed by a hinged door **42** (FIGURE 1).

Considering operating elements of the apparatus in more detail, and with further particular reference to FIGURES 1, 2, and 5, film loading tray **22** is removably mounted upon spindle **30**, and has its inner hub portion **23** and outer rim portion **24** bridged by a number of sets—**18** in this embodiment—of fork supports **25** on which film packets **27** are loaded. From inspection of FIGURE 5 it will be noted that the axis of rotation of tray **22** has slight lateral displacement with respect to the axis of shaft **21** for the sake of convenience of location of the cooperating linkages described below. As is illustrated in FIGURE 6, a plurality of notches **44** are equally spaced on the periphery of the outer rim portion **24** of tray **22**. These notches **44** are positioned for engagement by a movable indexing pin **64** so that tray **22** may be rotatably indexed to position, one packet at a time, beneath film removal blade **28** supported on rods **46** and **47**. Bushings **51** on rod **47** are slidable is slotted tube **52** affixed to decks A and B (FIGURES 2, 5 and 6) and provide for vertical reciprocable movements of the blade support structure. Also, bushings **51** provide for pivotation of the blade support structure, while in its upper position, to accommodate removal and insertion of a film tray **22**. Upon pivotation of the blade support structure, the free end portion of rod **46** is movable horizontally into horizontal groove **31** (FIGURE 1) in spindle **20** to the position shown. In this position, the free end portion of rod **46** engages a traveling nut **53** so that blade **28** will be moved up and down by the nut. As is illustrated in FIGURES 5 and 7, a resilient split ring **54** is seated within groove **55** in nut **53**, and the end of rod **46** is positioned directly under the opening defined by spaced, tapered ends of ring **54** to provide the above-mentioned operating interengagement of the rod **46** with the nut **53**. If blade **28** were to encounter a defective packet **27**, for example one that would not open, the tapered open portion of ring **54**, and the vertical slot **55***a* thereabove, would move downwardly over the end of horizontally extending rod **46** to prevent damage to either blade **28** or forks **26**.

Traveling nut **53** is provided with left-hand threads, and is releasably threaded onto motor-driven shaft **21**, for movements along the latter. Shaft **21** also carries the tree assembly comprising flanged sleeve **31** (FIGURE 5), arms **35**, and vertically extending grooved rods **33**, as described below. Rotation of nut **53** is prevented by pin **56** which is slidably restrained in a vertically extending slot **57** (FIGURE 5) of spindle **30**. For the sake of convenience, there is shown only the rear portion of the spindle structure that defines slot **57**. Rotation of shaft **21** in one direction causes nut **53**, and consequently blade **28**, to be moved downwardly, and, at the same time, causes the tree assembly to be moved upwardly since a sleeve **48** keyed to shaft **21** and the lower flanged portion **91** of the tree assembly are interengaged by means of right-handed threads. Rotation of shaft **21** in the opposite direction returns nut **53** to its upper position and moves the tree assembly to its lower position.

As traveling nut **53** is moved to its upper position illustrated in full lines in FIGURE 5, its threads will run off the end of the upper, left-handedly threaded portion of shaft **21**. Nut **53** wil remain in this position while the tree assembly is in its lower position, illustrated in full lines, in the time period required for any one of the processing functions, i.e. immersion of film in the developing and the drying chambers. Electrical apparatus controlling the functions and duration of various steps is described later. Shaft **21** will rotate freely during this time, while motor **14** drives blower wheel or impeller **16** to direct air into the drying chamber **37**. At the end of the processing time period, motor **14** is reversed, to drive nut **53** to its lower position, illustrated in broken lines in FIGURE 5, where it again runs off the threaded portion of shaft **21**. A relatively weak spring **62** reacting vertically between deck A and pin **56** keeps nut **53** lightly loaded against the threads, so that, when shaft **21** is again reversed, the threads will re-engage to return nut **53** lower position.

As best seen in FIGURES 3, 4 and 6 a horizontally movable slide bar **63** is guided by a slot **68** in deck A and provided with a generally vertically presented pin **64**. Slide bar **63** is linked to traveling nut **53** by means of a cord **65** affixed to pin **64** and which rides over a number of fixed pulleys **66** mounted beneath the top deck A. A microswitch **67** mounted beneath slide bar **63** is actuated by the bar when it is in the position shown, to signal the control system that nut **53** is in its upper position and, consequently, the tree assembly is in its lower position.

Tension spring **71**, also connected to slide bar **63** and extending over pulleys **66***a* to fixed connection with deck A, is operable to move the slide bar to the left, as viewed in FIGURE 6 (to the right, as viewed in FIGURE 3) and also to rotate the bar about its longitudinal axis so as to urge pin **64** against the outer rim **24** of tray **22** for engaging a notch **44**. To achieve such rotation, spring **71** is given an initial twisting before it is anchored to deck A.

As shaft **21** is rotated clock-wise, as seen from its top end in FIGURE 3, nut **53** is caused to move downwardly toward its broken line position shown in FIGURE 5. Blade **28** is moved downwardly by the movement of nut **53**, and is caused to tear through packet **27** (FIGURES 8 and 9) and force film chip **29** from the packet, through the loading tray, after which it falls by gravity into a chute **72** where it comes to rest on stop **74** of resilient

release wire **73** (FIGURES 6 and 10). As nut **53** continues to travel downwardly, cord **65** is slackened, permitting slide bar **63** to be moved to the left (FIGURE 6) by tension spring **71** until nut **53** reaches its lower position, whereupon pin **64** is positioned to engage the next notch **44**.

Also as nut **53** moves downwardly, the tree assembly comprising tree arms **35** is moved upwardly (broken lines, FIGURE 5) and is indexed to move each arm **35** to its next station. Indexing is achieved by means of a clutch and latch mechanism to be explained later in the description of the preferred embodiment.

It is well to explain at this point that each of arms **35** is movable vertically between the limits shown in broken and solid lines in FIGURE 5, attachment of the arms to the threaded member of the tree assembly being provided through the sliding, friction fit of the bores of tubes **39** with guide tubes **94**. Also, each of the arms **35** includes a portion **35***a* slidable in a vertically extending keyway **40** provided on the elongated sleeve or spindle portion **31** of the tree assembly. As indexing of the tree assembly takes place, a tree arm **35** engages and urges resilient release wire **73** to the position shown in FIGURE 11 (broken lines, FIGURE 6), releasing the retained film chip **29** to drop through slotted portion **35***c* of tree arm **35**, and into position between film guide rods **33**. Film chip **29** does not drop into its fully seated position because one of the film guides **33** is pivoted on tree arm **35** and lightly spring-loaded by a leaf spring **49** (see the right-hand upper position of arm **35** in FIGURE 5) so that it may swing to the illustrated dotted-line position (i.e. toward the other guide) when no film chip is present.

Motor **14** is then reversed to drive shaft **21** to move nut **53** to its upper position (full lines, FIGURE 5) and to move slide bar **63** to the right, as viewed in FIGURE 6 (to the left, FIGURE 3), through a pull on cord **65** to rotate the film loading tray **22** (see directional arrow, FIGURE 6) by means of pin **64** being urged against the sides of notch **44**. By this action, another film chip packet is positioned beneath blade **28** (FIGURE 8). Concurrently, the tree assembly is moved downwardly (full lines, FIGURE 5) to position supported film chips **29** in the various processing stations. As this is done, film release wire **73** returns to its position as shown in FIGURE 12 (see also full line showing of **73** in FIGURE 6). Upon the next movement of the tree assembly upwardly, the tree arm **35** is elevated to the position shown in FIGURE 13, whereby spring **73** engages and seats a film chip against wire stop **32** on finger **33** (FIGURE 6). Tree arm **35** is then indexed to the left to a position above a developing chamber **36**, and the adjacent tree arm **35** follows it, as illustrated in FIGUURES 10 and 11, to move the film release wire **73** and its stop **74**, and permit another film chip **29** to drop into the arm.

Whereas film chip chute **72** taken with film release wire **73** comprises the "pick-up" station of processor, the station just prior to the pick-up station is the "ejection" station. The ejection station comprises a post **75** so positioned that as the tree arm **35** with its film chip **29** is moved down after having left the drying chamber **37**, the lower edge of the film chip engages a groove **75***a* provided in the top of post **75**. The groove is so shaped and positioned as to cause the film chip to be pushed upwardly from between guide slots **34** in rods **33**, until tree arm assembly reaches its lower position. Thereupon film chip **29** is pushed through slot **35***c*, clear of the top of an arm **35** and pivots about its lower edge in the slot **75***a*, falling to one side and moving down a slide **76** into film removal box **41**.

As the tree assembly is moved upwardly to receive a new film chip **29**, it is indexed (or rotated), according to the directional arrows seen in FIGURES 3 and 6, to move all of tree arms **35** to their next stations. Indexing

is provided by means of a clutch assembly **77** illustrated in full and in broken lines in FIGURE 5, and which clutch assembly is operably engaged when the tree assembly is in its upper position (broken lines, FIGURE 5), and a latch assembly **81** (FIGURES 3 and 5) which limits rotation of the clutch assembly **77** to the extent required to move the tree arms **35** from one of their corresponding stations to the next.

The clutch assembly **77** includes a driving ring **82** keyed to shaft **21** for rotation therewith, and a spring-loaded disc **83** which is attached to the top flange **84** of the tree assembly by means of three equally spaced screws **85** (one illustrated, FIGURE 5) extending with clearance through holes **88** in disc **83**. Three compression springs **87** (one shown, FIGURE 5) are equally spaced between the three screws **85**, in cavities **86** of flange **84**. Springs **87** bear against disc **83** urging it upwardly. Disc **83** normally is retained by the heads of screws **85**, when clutch assembly **77** is not operating. As the tree assembly is moved upwardly to the broken line position in FIGURE 5, disc **83** engages ring **82**, and torque is transmitted from the disc keyed to shaft **21**, through the screws **85** to flange **84**. Torque gradually increases, as springs **83** are compressed, reaching a value sufficient to rotate the tree assembly.

When the tree assembly reaches this upper position, the lower threaded flange **91** of the tree assembly runs off the top of the threaded section of the shaft **21**. When rotation of the shaft **21** is reversed, lower flange **91** will run back onto the threads until the flange reaches its lower position, whereupon it runs off the opposite end of the threads. Compression spring **92** reacts between the motor **14** and flange **91**, and is just strong enough to support the tree assembly and to keep flange **91** lightly loaded against the threads so that it will run back on the threads when rotation of shaft **21** is again reversed.

The presence of the tree assembly in its upper position is signalled by means of a microswitch **68** operably engageable by the tree assembly flange **84**. As is seen partly in FIGURES 3 and 5, and also in FIGURE 6, microswitch **68** is supported by a bracket **78** mounted on deck A. Bracket **78** supports an additional microswitch **79** that operable by a vertically movable rod **80** also supported by the bracket for such movement. Rod **80** includes a pair of reduced diameter portions **89** and **90** spaced along its length and serving as camming surfaces for operating microswitch **79**. Rod **80** is urged by a compression spring **102** to an upper position when lid **13** is open, in which position the microswitch arm is actuated by the thicker portion of rod **80** between the reduced diameter portions **89** and **90**, to deenergize the apparatus. Closing the lid pushes rod **80** down, permitting the arm of microswitch **79** to ride into reduced diameter portion **89**, thereby providing for energization of the apparatus. Should it be desired to energize the apparatus while lid **13** is opened or when the entire housing **11** and lid is removed, as may be the case when servicing the machine, the operator moves rod **80** manually to an upper position in which the arm of microswitch **79** rides into reduced diameter portion **90**. Upon completion of servicing, rod **80** is moved manually to its normal rest, or lid open, position where it may be again engaged by the lid when it is closed.

Rotation of the tree assembly is prevented and accurate positioning is provided by means of a fixed pin **93** which extends vertically into one of tree arm guide tubes **94**. When the tree assembly is in its upper position, and the clutch is engaged, the guide tubes **94** rise above the ends of pins **93** freeing the tree assembly for rotation by the clutch.

With reference to FIGURES 3 and 5, the latch assembly **81** is mounted on a block **95**, and includes a hooked catch **96** and a stop **97** rotatable horizontally about a vertically extending pin **98**. The ends of catch **96** and stop **97** are interconnected by a spring **99**, and stop pins **100** and **101** limit travel of the catch **96** and stop **97**.

As the tree assembly is moved to its upper position, tree arm guide tubes **94** will rotate as hereinabove described. Spring **99** is extendable to enable catch **96** to pivot in a right-hand direction (FIGURE 3), and into position to engage a guide tube **94**, as shown, to prevent reverse rotation of the guide tube, while stop **97** (solid line showing thereof) is resiliently urged by extended spring **99** against the adjacent tree arm guide tube **94**. This is the latched position assumed while loading tray **22** is caused to rotate.

Latch **96** and stop **97** hold the tree assembly in this latched, non-rotatable position as it starts down, until pin **93** again engages its corresponding guide tube **94**, further to prevent its rotation and ensure its continued downward movement. As the tree assembly is moved downwardly, guide tube **94** disengages stop **97**, permitting it under the urging of spring **99** to rotate in a right-hand direction (FIGURE 3) to its opposite rest position (broken line showing). On the next upward movement of the tree assembly, the next guide tube **94** moves up to the right of stop **97**. The tree assembly then rotates until the next pair of guide rods **94** are halted by stop **97** and engaged by latch **96** as hereinabove described.

It will of course be understood that the described functions are controlled by known means, some of which are accessible through a panel P, and including, by way of example, relays, logic controls, and power supply means. The sequence of operation of the apparatus may be controlled automatically by means of a program timing device of well-known type comprising cams, cam actuated switches, and a motor for driving the cams. Adjustable means may also be provided to control the film immersion time, whereby to accommodate different types of films. Also, and as has been discussed in connection with FIGURES 3, 5 and 6, a microswitch **68** is positioned and adapted for engagement by tree assembly flange **84** as indication of its upper position. Independent of this are reed switches **70** (FIGURES 3 and 5), each located in a position corresponding to the indexed position of each tree arm **35**, with the exception of the pickup, or loading, and ejection stations. Reed switches **70** are operable by magnets **69** provided on sleeve portions **39** of each arm to indicate the rotated position of an arm relative to the flange **84**, and hence the remainder of the tree assembly. For example, arms **35** with their switch-actuating magnets **69** remain in an upper position at all processing and drying stations when no films **29** are carried by rods **33**. However, all arms **35** move to down position at the pickup and at the ejection stations. The purpose of the reed switches **70**, which are wired in series electrical circuit, is to complete a circuit when all tree arms, except those at the pickup and ejection stations, are in upper positions and the tree assembly down switch **67** is closed. This condition prevails when processing is complete. Consequently the completed circuit through the reed switches **70** actuates a relay (not shown) to shut-off the apparatus automatically.

Turning now to portions of the apparatus supported on deck C, and seen in FIGURES 2 and 5, each developing chamber **36** comprises a main fluid tank portion **104** open at its upper end, and so shaped and positioned as to receive the rods **33**, for immersion in the fluid, as they are moved downwardly with a film chip **29** supported therebetween. Fluid is supplied by gravity to each tank portion **104** from a bottle **107** through conduit means comprising a flexible tube portion **106**, and a passage portion **106***a* formed in the body of chamber **36** and leading downwardly into the fluid flow communication with the lower region of tank portion **104**. An intermediate portion **106***b* of the conduit means, i.e. the connection between portions **106** and **106***a*, is open to the atmosphere. Flexible tube **106** is attached by a screw cap at its upper end to the neck of an inverted supply bottle **107**. The upper, or film access opening in tank **104** is ported to another conduit **111** that extends down into fluid flow communication with a fluid drain sump **112**. It is seen that in the region of conduit portion **106***b* conduit portion **106***a* is cut on a bias such that the upper lip of the angular opening is substantially at the level of the lower edge of overflow port **111**. The construction and arrangement is such that fluid is fed from a bottle **107** by gravity until its flow is halted by the cut-off of air as the result of the fluid level rising above the upper lip of the angular open end of the tube **106***a*. As a film **29**, and support rods **33** therefor, are inserted in tank portion **104**, the fluid filled chamber is displaced a sufficient amount to cause its level to rise, and small quantity of fluid overflows through port **111** into drain sump **112**. As film **29** and support rods **33** are removed from tank portion **104**, by elevation of the tree assembly, the fluid level falls below the lip of the open end of fluid conduit portion **106***a* allowing air to enter bottle **107**. This causes more fluid to flow from the bottle until the fluid level is raised in both tank portion **104** and conduit portion **106***b* sufficient to cover the lip of conduit portion **106***a* and thereby halt air supply to the bottle. By this construction, a very small quantity of fresh fluid is supplied to the chamber each time a film is removed. Due to the U-tube configuration of the tank portion **104**, with respect to fluid supply conduit **106**, the fresh fluid is always introduced into the lower region of the tank and spent fluid is continually removed from the upper portion of the tank.

Each of the bottles **107**, only one of which has been shown in each of FIGURES 2 and 5 for the sake of convenience, is replaceable, with over **11** removed, merely by removing it from the retaining slots (FIGURES 3 and 5) and unscrewing the bottle from the cap. A new, fluid filled bottle is inserted by screwing it to the cap, with the conduit **106** flexed and the bottle in upright position, followed by restoring the bottle to the positions shown. The developing chambers will then be filled, automatically, as described hereinabove.

Drying chamber means **37** is angularly displaced from the developing chamber and comprises a plurality of film receiving openings defined by an air passage means through which heated air is caused to flow from blower **16** by way of conduit **38**. In-flow and out-flow of air relative to housing **11** is provided by suitable light-impervious grill means such as is seen at G in FIGURE 1.

It will be appreciated that the invention contemplates that the number of developing and drying chambers may be varied as required. Also, the nature of the fluids may be varied at the will of the user.

From the foregoing, it will be appreciated that the invention affords a complete, automatic, dental X-ray film processor which starts with an exposed X-ray film package and delivers a dry, processed negative. The processor is self contained and is characterized by a high degree of portability. It will be understood, of course, that modifications may be made in the illustrated preferred embodiment, without departing from the scope of the appended claims.

We claim:

1. In unitary apparatus for developing film, the combination comprising: means including a first support structure for receiving and retaining film packets including exposed films contained in light proof envelopes; means for stripping said films from said envelopes while retained in said support structure; means defining a second support structure for receiving and retaining said stripped films; means defining a plurality of developing chambers; means defining a film drying station; and means for rotating said second support structure to feed said film sequentially to said developing chambers and to said drying station, said apparatus being further characterized in that said first support structure comprises a wheel rotatable about a substantially vertical axis, said wheel including generally vertical extending, circumferentially spaced rack and guide means for receiving a film packet

and for guiding said stripped film to said second support structure, said last recited structure being rotatable about an axis substantially coinciding with the axis of said wheel.

2. Apparatus according to claim 1, and further characterized in that said wheel is removable, and is constructed and arranged to provide for mounting of film packets thereon prior to mounting of said wheel on said apparatus.

3. Apparatus according to claim 1 and further characterized by the inclusion of means for guiding said film from said wheel to said second support structure, upon stripping of said film from said packet.

4. Apparatus according to claim 3, and further characterized in that said second support structure comprises a plurality of radially extending, circumferentially spaced arms each including slot means for receiving film in a generally vertical plane, and having aligned therewith a pair of vertically extending rods having film receiving grooves, one of said rods being fixed and the other pivotally mounted for movement toward and away from the other rod, insertion of a film into said grooves being operable to pivot said rod away from the other and means for resiliently urging said pivotally mounted rod toward the other rod.

5. Apparatus according to claim 4, and further characterized in that each said developing chamber includes aperture means for receiving said vertically extending rods when a film is supported thereby, said other rod when pivoted toward the one rod, in the absence of a supported film, being positioned for abutting engagement with said chamber, whereby insertion of the rods into a chamber is prevented.

6. Apparatus according to claim 4 and further characterized in that said spaced arms are mounted also for vertically reciprocable movements, toward and away from said guide means, said latter means including a generally vertically extending chute arranged at its upper end to receive a film from said wheel and at its lower end to deliver a film through a slot to said rods, said chute having affixed thereto a generally vertically extending wire spring supported from its one end toward the upper end of said chute, said spring further including an intermediate offset portion extending normally into the path of a film sliding down said chute, and a lower bent portion extending beyond said chute and into the path of rotational movement of said arms while in an upper position, said arm being operable to flex said spring and move said offset out of the path of a film, permitting it to slide into said slot as said arms are elevated.

7. In a unitary apparatus for developing film, the combination comprising: means including a first support structure for receiving and retaining film packets including exposed films contained in light proof envelopes; means for stripping said films from said envelopes while retained in said support structure; means defining a second support structure for receiving and retaining said stripped films, and including a plurality of pairs of substantially parallel vertically extending rods having confronting longitudinal slots for receiving and retaining the stripped films; means defining a plurality of developing chambers, each including a pair of generally vertically extending conduits interconnected at their lower ends whereby fluid will fill both conduits to a predetermined level, one of said conduits being open at its upper end to receive a film and its support rods, an overflow port in the region of the upper end of said one conduit, at a level above the upper portion of an immersed film, whereby the level of fluid will be established at the level of said port and an immersed film and its rods will displace a small volume of fluid for overflow through said port, and means for automatically feeding makeup fluid through said other conduit as the level of fluid drops below the overflow port upon removal of a film and its support rods from said one conduit; means defining a film drying station; and means for rotating said second support structure to feed said film sequentially, to said developing chambers and to said drying station.

8. Apparatus according to claim 7, and further characterized in that said means for feeding fluid comprises a closed fluid supply container disposed at a level above the level of said conduits and said overflow port, and tube means interconnecting said supply container and said other conduit, said tube means being open to atmosphere at a level corresponding to the level of the effective opening of said overflow port, whereby a drop in fluid level will cause fluid to flow from such supply container until the recited opening of said tube means is reached by the fluid level, the flow of fluid thereupon being halted.

9. In unitary apparatus for developing film, the combination comprising: means including a first support structure for receiving and retaining film packets including exposed films contained in light proof envelopes; means for stripping said films from said envelopes while retained in said support structure; means defining a second support structure for receiving and retaining said stripped films; means defining a plurality of developing chambers, each said developing chamber comprising a first, generally vertically extending film receiving portion and a second generally vertically extending treatment fluid supply portion, said first and second portions being disposed in fluid flow communication in lower regions thereof, whereby fluid will rise to substantially the same levels in both portions, and means for establishing and maintaining a fluid level in said first portion including a fluid overflow port at a level above the level of immersion of a film carried by said second support structure, and means responsive to a drop in fluid level in said second fluid supply portion to introduce makeup fluid to said first treatment portion in its lower region, upon immersion of a film and said second support structure to cause overflow of fluid, followed by a drop in fluid level upon withdrawal of said film and its support from the second, treatment portion; means defining a film drying station; and means for rotating said second support structure to feed said films sequentially to said developing chambers and to said drying station.

10. Unitary apparatus for developing film including means defining a film loading station, means defining a film developing station, means defining a film drying station, and rotatable means operable to receive a film at said loading station, and to feed said film sequentially thereafter in incremental angular movements, to said developing station and to said drying station, said apparatus being featured by provision of frame structure for supporting the recited elements in vertically spaced relation, and comprising: a base portion; a plurality of vertically extending rods supported upon said base portion; a plurality of vertically spaced deck portions disposed above said base portion; and spacer means on said rods, each engaging a deck portion to support the latter upon said base portion and to maintain the recited spaced disposition of said deck portions.

11. In unitary apparatus for developing film, the combination comprising: means defining a packaged film loading station; means defining a film developing station; means defining a film drying station; and means operable to strip film from its package at said loading station and to feed such film sequentially thereafter, in incremental angular movements, to said developing station and to said drying station, said last recited means including a wheel for supporting packaged film and rotatable about a substantially vertical axis, said wheel including generally vertically extending, circumferentially spaced rack and guide means, and a plurality of vertically reciprocable rotatably mounted film support arms substantially coaxial with said wheel, and motor means rotatable about an axis substantially coinciding with the axes of said wheel and said support arms, for rotating said wheel and said arms in an opposite sense relative to one another to ac-

commodate guiding of each said film from said wheel to a support arm for feeding the film to said film developing and drying stations.

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