

PATENT SPECIFICATION

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- (21) Application No. 52154/75 (22) Filed 30 Jan. 1973
 (62) Divided out of No. 1 461 781
 (23) Complete Specification filed 23 Jan. 1974
 (44) Complete Specification published 19 Jan. 1977
 (51) INT. CL.² B65H 1/04
 (52) Index at acceptance
 B8R 10A2 10C16 10C1X 10E4 10LX AA6
 G2X 13H5
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(64) DISPENSER FOR SHEET-LIKE MATERIAL

- (71) We, AGFA-GEVAERT/a naamloze vennootschap organised under the laws of Belgium, of Septestraat 27, B 2510 Mortsel, Belgium do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—
- 10 The invention relates to apparatus for loading radiographic film sheet cassettes, and more particularly to apparatus by means of which such cassettes can be loaded in day-light conditions.
- 15 In medical radiography, film sheets are often exposed to the X-ray image while light-tightly enclosed in a cassette, usually together with one or more fluorescent screens.
- 20 The trend towards automation and rationalization in the field of medical photography has prompted development of systems enabling the cassettes containing image-wise exposed radiographic film sheets to be unloaded and the film sheets to be fed into a processing machine, all without need to resort to a dark room (see, e.g., Belgian Patent Specification 792,707).
- 30 Progress towards automation and rationalization can further be promoted if a viable film sheet dispensing apparatus is made available capable of loading cassettes in day-light or in a well illuminated room.
- 35 According to the present invention, there is provided apparatus for use in loading radiographic film cassettes, said apparatus comprising a casing within which there is a film sheet supply section in which a pile of radiographic film sheets can be placed and light-tightly enclosed, a cassette loading section in which a cassette can be placed and light-tightly enclosed and in which there is mechanism for opening a cassette introduced therein, a dispensing mechanism within said casing and operative for dis-

pensing the top sheet of a said pile into a cassette while it is held open in said loading section, and a light-screen movable into an operative position between said supply section and said loading section to prevent access of light to a said pile of film sheets via said loading section when the latter is not light-tightly enclosed, said screen having operating mechanism which automatically causes movement of said screen into operative position as the said loading section is opened to insert or withdraw a cassette.

Preferably the screen operating mechanism is automatically actuated to move said screen into inoperative position as the said loading section is light-tightly enclosed.

In preferred embodiments of the invention, there is a cassette carriage which can be advanced and retracted for advancing and withdrawing a cassette into and from the cassette loading section of the casing via one end thereof; the said carriage has a closure wall which light-tightly closes that end of the casing once the carriage has reached a certain intermediate position during its advance; and said operating mechanism is constructed so that movement of the light screen from its operative to its inoperative position or vice versa takes place progressively in response to retraction or advance movement of the carriage from its fully advanced position towards said intermediate position or vice versa.

The invention includes apparatus as above defined wherein the cassette opening mechanism is constructed so that it is operated automatically to open a cassette by the act of inserting a cassette into the loading section.

It is advantageous for the apparatus to include a magazine for holding a said pile of film sheets, said magazine being insertable into said supply section through

an end opening thereof and having a wall which light-tightly closes such opening when the magazine is thus inserted.

In a preferred embodiment the magazine 5 has a slidable lid portion which is automatically caused to open as the magazine is inserted into operative position in the supply section of the apparatus casing. The light-screen of such an apparatus 10 may be arranged so that when it is in operative position it extends directly between the supply and loading sections of the casing and above an adjacent zone where the pile of film sheets in the 15 magazine is exposed when the slidable lid portion of the magazine is open.

The sheet dispensing mechanism of apparatus according to the present invention preferably comprises a sheet holder adapted to take hold of a sheet by one face thereof, mechanism for imparting to such holder a predetermined cycle of movements including a bodily descent movement for bringing it into contact with a margin of 25 the exposed top surface of the top sheet of the pile, a tilting movement for causing that margin to hinge upwardly relative to the underlying sheet, ascent and advance movements causing further peeling of the top sheet away from the underlying sheet and bodily displacement of such sheet to 30 advance said margin thereof to a sheet take-up position, and movement of return to its starting position; and take-up 35 mechanism which is operative to take up a sheet by its said margin from said holder at said take-up position. Such a dispensing apparatus enables radiographic film sheets to be dispensed with very little sliding contact between the sheets of a kind which 40 would be likely to spoil the light-sensitive coatings. A sheet dispensing apparatus of that kind and which is particularly suitable for embodiment in apparatus according to 45 the present invention is described and claimed in our copending patent application No. 4656/73 (Serial No 1 461 781). The dispensing apparatus used in carrying out the present invention can be constructed as claimed in any of the claims of that co-pending application.

Various other advantageous optional features are disclosed hereafter in the context of a detailed description of certain embodiments of the invention. 55

These embodiments, selected by way of example, will be described with reference to the accompanying drawing in which:

Figure 1 is a cross-sectional elevation of an apparatus according to the invention; 60

Figure 2 shows a detail of that apparatus;

Figure 3 shows a mechanism for opening cassettes; and

65 Figure 4 illustrates a detail of Figure 3.

The loader 30 illustrated in Figure 1, comprises a magazine 37 which holds a pile of radiographic film sheets 10 and is capable of being inserted into a receptive passage in a main housing 31 and of light-tightly sealing such passage against the 70 entry of light. Within the housing 31 is a sheet dispensing mechanism 12, 13, and also a movable carriage 36 for supporting a cassette to be loaded. 75

The top of the magazine 37 comprises spaced fixed wall portions between which a lid 38 is slidable. At a moment during insertion of the magazine into the housing 31, a spring 45 mounted within such housing engages a projection 48 at the front 80 edge of the lid and causes the lid to be pushed back into its open position as insertion of the magazine into the housing is completed. The lid opens far enough to expose the pile of sheets 10 over about half 85 their length.

In order to avoid exposure of the films sheets in the magazine in the event that it is withdrawn before it is empty, e.g. for replacing it by a magazine containing film sheets of a different sensitivity, the apparatus is constructed to cause automatic closure of a magazine during its withdrawal. To this end, a lever 39 is provided 90 having a pivot pin 71 which extends through a slot 70 in the interior of the housing 31. The nose of lever 39 engages behind the projection 48 on the magazine lid and as the magazine is withdrawn the lever pushes against that projection, causing the lid to close. On further retraction 95 of the magazine the lever 39 is pivoted upwardly by a roller 47 which is fixed to the frame of the housing and makes contact with the sloping bottom edge of the lever nose. 100

The carriage 36 runs on rollers 49 and can be retracted from its illustrated position to enable a cassette 32 to be placed 110 thereon. The cassette 32 comprises a container portion 33, a lid 34 and latch levers 35 (one on each side of a centre line of the cassette). Although the loader 30 can be used for loading most existing standard 115 cassette models, the use of cassettes according to Belgian Patent Specification 792,707 as mentioned above is preferred.

As the carriage 36 bearing the cassette is pushed back into the housing 31, a latch 120 release member or roller 50 which extends transversely over the full width of carriage 36 enter the space between the cassette container portion 33 and the projecting portions of the latch levers 35 and in consequence these levers are hinged upwardly 125 towards their release positions during the continued movement of the carriage into its closed position. Thus the cassette is unlocked and its lid 34 is hinged slightly 130

open as indicated in Figure 1. At a given moment during the further closing movement of the carriage 36 into housing 31, the latch levers 35 collapse into fully released position causing further opening movement of the cassette lid. At a following stage in the movement of the carriage the raised front edge of the cassette lid encounters a second rabbet 51 which is pivotally suspended within the housing 31 and hooks under the said front edge of the lid. As the cassette is pushed into its fully inserted position the lid is pulled further open by the rabbet 51, sufficiently to permit a film sheet 11 to be fed into the cassette by the dispensing mechanism 12, 13. The final position of the lid is determined by a stop 52 having a portion 53 against which the rabbet 51 abuts.

In the embodiment illustrated, the sheet dispensing mechanism 12, 13 is constructed as described and claimed in our co-pending patent application No. 4656/73 (Serial No 1 461 781). This apparatus accordingly has a suction type sheet holder 13 which is automatically displaced through a cycle of operations such that after descending into contact with one margin of the top sheet of the pile, the holder is tilted to cause that sheet margin to hinge upwardly away from the underlying sheet. Hereby air is permitted to enter beneath that margin and the holder is subsequently raised causing further peeling of the top sheet away from the underlying one. The holder is further moved to carry the said sheet margin into the nip of sheet-transporting rollers 12 which propel the sheet forwardly into the open cassette. Such dispensing apparatus avoids injurious rubbing contact of one film sheet against another during the dispensing operation.

Once the cassette 32 has been loaded, that is to say, after the sheet of radiographic film has completely passed through the nip of the feed rollers 12 and has been introduced fully into the cassette, the latter is removed from the apparatus again. The cassette is automatically closed as it is withdrawn, so that light does not enter the cassette. Before retracting the carriage 36 a dual grip 54 is operated to cause a lever 55 to be urged downwardly against the cassette lid 34. At the same time lever 55 prevents shifting of the cassette on the carriage 36. As the carriage 36 is drawn back rabbet 51 releases the cassette lid and rabbet 50 subsequently reverses the latch levers 35 into their normal positions, so light-tightly closing the cassette. If desired, a cam 56 may be provided which presses on the lid 34 and on the levers 35 as the cassette is withdrawn, this as a safety measure in case the lid should not have been properly closed

by the rabbet 50. When the cassette is out of the apparatus, it is locked by pushing the levers 35 into their locking position.

During the steps of introducing and withdrawing a cassette, ambient light must be prevented from entering the open magazine 37. This is achieved by a light-screening device comprising an opaque flexible curtain 40 made e.g. of rubber or synthetic polymeric material. This curtain, when in closed position, extends between the magazine and cassette holding sections of the housing 31 and over the top of the front end portion of the magazine. The curtain is automatically progressively opened during movement of the carriage 36 into closed position. In that closed position a vertical closure wall 36a on the carriage-closes the housing at its cassette loading end so that no light can reach the interior of the magazine 37 from that end of the housing.

An isometric view of the light-screening device is shown in Figure 2. The curtain is shown in its closed position, in which the vertically disposed portion of the curtain is sufficiently long to keep light from entering the magazine from the cassette holding section of the main housing 31. The curtain 40 is tensioned between two pairs of strings 41 and 60 connected to opposed edges of the curtain by clips 46. The strings pass around four rotatable shafts 44. The extremities of the strings 60 attached to the lower edge of the curtain are joined to springs 57 which are connected to parts of the main housing 31.

The strings 41 attached to the top edge of the curtain follow paths which reach to near the opposite end of the housing 31, as appears from Figure 1. There, they are guided over guide sheaves 42. The ends of those strings are likewise connected to parts of the housing 31. It will be seen from Figure 2 that the strings 41 lie in close parallel relationship where they pass transversely across the apparatus, between the sheaves 42.

The automatic opening of the curtain 40 is achieved by providing the carriage 36 with rotatable sheaves 43 which are rotatably mounted in a support 58 on the carriage and which before the carriage has been pushed fully into the housing 31 make contact with the said parallel transverse portions of the strings 41 and push them back between the sheaves 42. In consequence, during a last part of the closing movement of the carriage the curtain becomes pulled back by the strings 41 against the action of the tensioning springs 57. The placing of the sheaves 42 and the sheaves 43 is such that the curtain is not raised from between the magazine and cassette holding sections of the main housing

31 until the cassette carriage 36 has reached a position in which it prevents access of light to the magazine holding section but such that when the carriage reaches its fully inserted position the curtain has moved sufficiently to allow unimpeded transfer of a film sheet from the magazine into the open cassette. When the cassette is subsequently withdrawn the curtain becomes automatically lowered again by the action of the springs 57.

Among numerous modifications which can be made to the illustrated apparatus above described, the sheaves 43 could be substituted by some other form of device, e.g. by a pair of hooks.

Another device for opening a locked cassette 32 when introducing the latter into the day-light loading apparatus is represented in Figure 3.

Such device comprises a pivoted lever 80 which is capable of performing a partial rotation over an angle determined by the length of slot 84 provided in the main housing 31. At the upper end of said lever 80 an arm 81 is provided which can pivot about a bush 82. A spring 83, mounted inside the bush 82 and bearing against the arm 81, urges the latter towards contact with a pawl 85. When the lever 80 is at rest, the whole lever system (levers 80 and 81) lies horizontally.

Lever 81 is provided with a slot for receiving the free end of a cassette latch lever 35 as the cassette is pushed into position within the main housing 31. As the cassette advances following capture of its latch levers by the levers 81 (one to each latch lever) the lever 80 swings upwardly through the position illustrated, while the levers 35 remain in the slots of levers 81. At a given moment during the advance, the latch levers 35 collapse toggle fashion and unlock the cassette lid 34. When this step occurs, a suction device comprising one or more suction cups such as 88 or 89 and a vacuum conduit 86 (see also Figure 4) is moved towards the lid 34. When the suction cup 88 or 89 contacts the lid 34, vacuum is applied through openings such as 87 and the suction cup is now capable of lifting the lid 34 sufficiently to enable a film sheet to be fed into the cassette container portion 33.

Closing the cassette 32 is effected by the reverse action. At the appropriate moment the vacuum is relieved so that the cover 34 is released. As the cassette is withdrawn from the day-light loading apparatus, the levers 80 and 81 are pulled down towards their horizontal positions, levers 81 being still engaged by the latch levers 35. As the levers 80, 81 are pulled into their horizontal positions the levers 35 become released and the loaded and locked cassette is at

the disposal of the operator.

By way of improvement or refinement of the illustrated apparatus as above described, the magazine 37 may be provided with the movable arm of a micro-switch which closes when the last sheet has been taken out of the magazine, causing the ignition or extinction of a small lamp on the front panel or the excitation of a buzzer. Means may be provided for controlling the opening of the magazine 37. Thus, as shown in Figure 1 there may be provided a micro-switch, with a movable arm 59 which is actuated by the magazine lid 38 and which operates a small lamp or a buzzer to indicate whether the magazine is in open or closed condition.

It is not essential for the magazine and cassette holding sections to be disposed in the same general plane as is the case in the illustrated apparatus. By providing e.g. a guide shell or a plurality of pairs of sheet-feeding rollers the sheets may be conveyed from a dispensing apparatus to a cassette loading station at a level above or beneath the level of the dispenser.

WHAT WE CLAIM IS:—

1. Apparatus for use in loading radiographic film cassettes, said apparatus comprising a casing within which there is a film sheet supply section in which a pile of radiographic film sheets can be placed and light-tightly enclosed, a cassette loading section in which a cassette can be placed and light-tightly enclosed and in which there is mechanism for opening a cassette introduced therein, a dispensing mechanism within said casing and operative for dispensing the top sheet of a said pile into a cassette while it is held open in said loading section, and a light-screen movable into an operative position between said supply section and said loading section to prevent access of light to a said pile of film sheets via said loading section when the latter is not light-tightly enclosed, said screen having operating mechanism which automatically causes movement of said screen into operative position as the said loading section is opened to insert or withdraw a cassette.

2. Apparatus according to claim 1, wherein said screen operating mechanism is automatically actuated to move said screen into inoperative position as the said loading section is light-tightly enclosed.

3. Apparatus according to claim 1 or 2, in which said loading section is provided with a cassette carriage movable between a retracted position for loading with a cassette and a forward position in which it light-tightly closes said loading section with the cassette enclosed.

4. Apparatus according to claim 3, wherein said carriage has means which ac-

31 until the cassette carriage 36 has reached a position in which it prevents access of light to the magazine holding section but such that when the carriage reaches its fully inserted position the curtain has moved sufficiently to allow unimpeded transfer of a film sheet from the magazine into the open cassette. When the cassette is subsequently withdrawn the curtain becomes automatically lowered again by the action of the springs 57.

Among numerous modifications which can be made to the illustrated apparatus above described, the sheaves 43 could be substituted by some other form of device, e.g. by a pair of hooks.

Another device for opening a locked cassette 32 when introducing the latter into the day-light loading apparatus is represented in Figure 3.

Such device comprises a pivoted lever 80 which is capable of performing a partial rotation over an angle determined by the length of slot 84 provided in the main housing 31. At the upper end of said lever 80 an arm 81 is provided which can pivot about a bush 82. A spring 83, mounted inside the bush 82 and bearing against the arm 81, urges the latter towards contact with a pawl 85. When the lever 80 is at rest, the whole lever system (levers 80 and 81) lies horizontally.

Lever 81 is provided with a slot for receiving the free end of a cassette latch lever 35 as the cassette is pushed into position within the main housing 31. As the cassette advances following capture of its latch levers by the levers 81 (one to each latch lever) the lever 80 swings upwards through the position illustrated, while the levers 35 remain in the slots of levers 81. At a given moment during the advance, the latch levers 35 collapse toggle fashion and unlock the cassette lid 34. When this step occurs, a suction device comprising one or more suction cups such as 88 or 89 and a vacuum conduit 86 (see also Figure 4) is moved towards the lid 34. When the suction cup 88 or 89 contacts the lid 34, vacuum is applied through openings such as 87 and the suction cup is now capable of lifting the lid 34 sufficiently to enable a film sheet to be fed into the cassette container portion 33.

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the disposal of the operator.

By way of improvement or refinement of the illustrated apparatus as above described, the magazine 37 may be provided with the movable arm of a micro-switch which closes when the last sheet has been taken out of the magazine, causing the ignition or extinction of a small lamp on the front panel or the excitation of a buzzer. Means may be provided for controlling the opening of the magazine 37. Thus, as shown in Figure 1 there may be provided a micro-switch, with a movable arm 59 which is actuated by the magazine lid 38 and which operates a small lamp or a buzzer to indicate whether the magazine is in open or closed condition.

It is not essential for the magazine and cassette holding sections to be disposed in the same general plane as is the case in the illustrated apparatus. By providing e.g. a guide shell or a plurality of pairs of sheet-feeding rollers the sheets may be conveyed from a dispensing apparatus to a cassette loading station at a level above or beneath the level of the dispenser.

WHAT WE CLAIM IS:—

1. Apparatus for use in loading radiographic film cassettes, said apparatus comprising a casing within which there is a film sheet supply section in which a pile of radiographic film sheets can be placed and light-tightly enclosed, a cassette loading section in which a cassette can be placed and light-tightly enclosed and in which there is mechanism for opening a cassette introduced therein, a dispensing mechanism within said casing and operative for dispensing the top sheet of a said pile into a cassette while it is held open in said loading section, and a light-screen movable into an operative position between said supply section and said loading section to prevent access of light to a said pile of film sheets via said loading section when the latter is not light-tightly enclosed, said screen having operating mechanism which automatically causes movement of said screen into operative position as the said loading section is opened to insert or withdraw a cassette.

2. Apparatus according to claim 1, wherein said screen operating mechanism is automatically actuated to move said screen into inoperative position as the said loading section is light-tightly enclosed.

3. Apparatus according to claim 1 or 2, in which said loading section is provided with a cassette carriage movable between a retracted position for loading with a cassette and a forward position in which it light-tightly closes said loading section with the cassette enclosed.

4. Apparatus according to claim 3, wherein said carriage has means which ac-



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tuates the screen operating mechanism to cause movement of said screen into operative position as the carriage is retracted.

5 2. Apparatus according to claims 1 and 2, wherein there is a cassette carriage which can be advanced and retracted for advancing and withdrawing a cassette into and from the cassette loading section of the casing via one end thereof; the said carriage has a closure wall which light-tightly closes that end of the casing once the carriage has reached a certain intermediate position during its advance; and said operating mechanism is constructed so that movement of the light screen from its operative to its inoperative position or vice versa takes place progressively in response to retraction or advance movement of the carriage from its fully advanced position towards said intermediate position or vice versa.

6. Apparatus according to any preceding claim, wherein said cassette opening mechanism is constructed so that it is operated automatically to open a cassette by the act of inserting a cassette into the loading section.

7. Apparatus according to any preceding claim, wherein said screen operating mechanism includes biasing means urging said screen into operative position and wherein loading and light-tight closing of said loading section causes displacement of the screen against the action of said biasing means.

8. Apparatus according to any preceding claim, wherein there is a magazine for holding a said pile of film sheets, said magazine being insertable into said supply section through an end opening thereof and having a wall which light-tightly closes such opening when the magazine is thus inserted.

9. Apparatus according to claim 8, wherein said magazine has a slidable lid portion and the supply section of the casing houses means which causes said lid portion to slide open as the magazine is inserted into operative position in such section.

10. Apparatus according to claim 9, wherein the supply section of the casing also houses means which causes said slidable lid portion of the magazine to

slide closed as the magazine is withdrawn from such section.

11. Apparatus according to claim 9 or 10, wherein said slidable lid portion has a projection which during insertion and withdrawal of the magazine abuts against a front stop and rear stop respectively, said rear stop being arranged to move automatically out of the path of said projection to allow it to pass once such rear stop has effected closure of said lid portion.

12. Apparatus according to any of claims 9 to 11, wherein said lid portion is slidable between the walls of an adjacent fixed double-walled lid portion.

13. Apparatus according to any of claims 9 to 12, wherein said screen when in operative position extends directly between said supply and loading sections and above an adjacent zone where a said pile of film sheets is exposed when said slidable lid portion is open.

14. Apparatus according to any preceding claim, wherein the dispensing mechanism comprises a sheet holder adapted to take hold of a sheet by one face thereof, mechanism for imparting to such holder a predetermined cycle of movements including a bodily descent movement for bringing it into contact with a margin of the exposed top surface of the top sheet of the pile, a tilting movement for causing that margin to hinge upwardly relative to the underlying sheet, ascent and advance movements causing further peeling of the top sheet away from the underlying sheet and bodily displacement of such sheet to advance said margin thereof to a sheet take-up position, and movement of return to its starting position; and take-up mechanism which is operative to take up a sheet by its said margin from said holder at said take-up position.

15. Apparatus for use in loading radiographic film cassettes, said apparatus being substantially as herein described with reference to the accompanying drawings.

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