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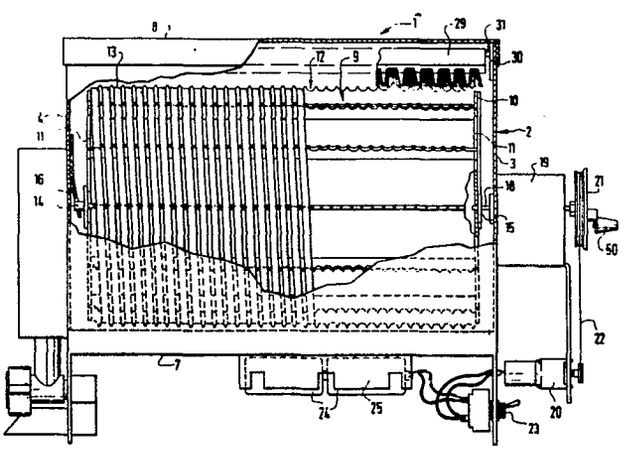
(54) **Method of and apparatus for developing film.**

(57) Apparatus for developing cine film has a light-tight tank (2) enclosing a carrier (9) around which a length of film (13) is helically wound and supported by its edges in successive staggered identations (12) on adjacent ribs (10). As the carrier is rotated by drive means (19) both sides of the film are immersed in the requisite processing solutions or rinse liquids fed at (26) and removed at (27). Manual drive means (50) allows careful loading. Brush (29) is pivoted to engage gently with the film to remove any opaque backing.



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METHOD OF AND APPARATUS FOR DEVELOPING FILM

This invention relates to a method of and apparatus for developing photographic film, and in particular to a method of and apparatus for developing 8 mm cine film.

Usually, motion picture film is processed in automatically operating equipment. However, many people would find it more convenient to process their own film at home rather than sending the film away to be processed.

A typical colour reversal film process suitable for home use involves passing an exposed film through a first development bath which yields a negative image. This is then reversed, either by means of a chemical reversal process or by re-exposure to a bright light source. The film is then passed through a second development bath and is subsequently thoroughly washed, bleached and fixed to provide a permanent image. The film is next passed through a stabilising solution which extends the life of the colour dyes. Finally the film is dried. The result obtained is a finished positive.

One of the problems of home developing of a motion picture film is that colour film usually has a black backing. This black backing gives good antistatic and anti-halation properties, and comprises carbon particles applied to the base side of the motion picture

film. It appears quite opaque, and is advantageous for films which are used on a camera spool without a leader and a trailer.

The backing is very difficult to remove in a home-developing process.

One known method of removing the backing involves a three-stage operation. Firstly, the backing is wetted with an alkaline solution to soften the binder. Secondly, the base side of the film is buffed or rubbed in order to remove the softened backing. Thirdly, the film is rinsed with water to remove any remaining particles of backing from both the emulsion and base sides of the film. This rinsing operation is carried out before the film is placed in an acid stop bath or acid fixer, since either of these would otherwise tend to harden the softened backing.

Another known method of removing the backing, used in commercial processing facilities, involves either an alkaline prebath before the developer or a developer which is itself alkaline. This method of processing is adapted to the length of film being processed. A known alkaline prebath has a pH value of 9.3, and can be prepared by dissolving the requisite amount of borax in a solution of sodium sulphate. This level of alkalinity is sufficient to soften the backing but not to initiate development in the emulsion side of the film. The base side of the film is buffed or rubbed with a gauze or cotton swab, whilst the film is in the prebath, to remove the backing. The film is then rinsed under water for a short period before transfer to the developer solution.

If a prebath is not used, the base side of the film can be buffed or rubbed with a gauze or cotton swab, whilst the film is in the developer. The base and emulsion sides of the film in this case are rinsed with water before transferring the film to the acid stop bath solution, in order to remove any loose backing particles. Any remaining spots of backing can be removed before the film is dried using a soft swab moistened with, for example, ethyl alcohol. Care is however needed because the emulsion layer is still soft

and can easily be damaged.

The present invention sets out to provide an apparatus and method, usable by the home enthusiast, for developing film which can, moreover, be used to remove carbon backing as necessary.

In one aspect the invention provides apparatus for developing a length of exposed but undeveloped photographic film, comprising a carrier around which the length of film can be helically wound, supported, for rotation by suitable drive means, within a light-tight tank having inlet and outlet means for processing solutions and/or rinse liquids; the carrier possessing a plurality of like ribs parallel to and equally spaced from the axis of rotation to define a cylindrical array, the ribs being uniformly spaced around the cylindrical array, each rib having on an outer straight edge a succession of indentations each of a size to hold a standard film width by the edges only.

Usually the indentations on adjacent ribs are staggered so that a notional helical winding path is defined around the cylindrical array of ribs.

The indentations themselves are usually arcs of a circle, e.g. semi-circular and for the 8 mm film developing apparatus will of course be of such a diameter as to hold such 8 mm film by its edges.

Preferably, there are 12 ribs on the carrier, although more or less can also be used. They can be constituted as flat bars secured at each end to an end plate so as to define a cylindrical array.

The drive means can be coaxial with the axis of rotation. In such a case, it lends itself to provision of both a motor drive and a manual drive, the latter for careful initial loading and the motor for operating the process.

Alternatively, as described more fully below, the drive means can

be a friction drive acting on the outer surface of a cylindrical member supporting the ribs.

Other optional features may also be present. Thus, the tank walls may define a heating jacket. In particular there may be provided an elongate brush to contact the notional surface of the cylindrical array, whereby it can engage a film wound over the ribs to remove a backing layer during processing.

A preferred embodiment of the invention provides apparatus for developing a length of exposed but undeveloped photographic film, comprising: a base formed to provide a semi-cylindrical tank surrounded by a waterjacket, both the tank and the jacket having liquid inlet and outlet means; a generally cylindrical carrier journalled for rotation at a suitable clearance in the semi-cylindrical tank; and a light-tight lid fitting over the base and carrier, including drive means engageable with the carrier surface; the carrier possessing a plurality of like equispaced parallel ribs along its surface, each having on an outer straight edge a succession of indentations each of a size to hold a standard film width by the edges only.

In such a case, conveniently the liquid inlets are depressions formed in an upper portion of the base uncovered by the lid, one depression feeding by gravity the water bath and the other communicating via a light-trap and suitable duct to the base of the semi-cylindrical tank.

The drive means may be an electric motor housed in an upward extension of the lid, presenting the surface of a drive wheel through a slot in the base of such upward extension to engage with the carrier surface.

A particularly useful feature of this embodiment resides in the drive to the carrier cylinder. Preferably the drive means and the contacting portion of the cylindrical carrier are provided

with a layer of a friction drive material, such as a nylon hook pile strip e.g. that known under the Registered Trade Mark of VELCRO.

The invention also extends to a method of developing exposed but undeveloped photographic film on apparatus as described above comprising the steps of: winding the film in dark-room conditions around the ribs so as to lodge in the indentations and be held by the edges only; closing the light-tight tank; introducing a processing solution into the tank; rotating the carrier, so that the solution comes into contact with both sides of the film, for a time sufficient for the processing stage; draining off the processing solution; introducing and draining successive rinse liquid and/or further processing solutions as necessary, while continuing to rotate the carrier, until development is complete; and removing the lid.

With such a method the carrier may be rotated to dry the film after the lid is removed.

The invention will be further described with reference to the accompanying drawings, in which:

Figure 1 shows a part cut-away side view of one embodiment;

Figure 2 shows a part cut-away plan view of the embodiment of Figure 1 with the lid removed;

Figure 3 shows a perspective view of another embodiment with the lid raised;

Figure 4 is a section on IV-IV of Figure 3.

Equipment 1 for developing cine film comprises a tank 2 with end walls 3 and 4 side walls 5 and 6, base 7 and lid 8 which forms a light-proof closure around the top of the walls 3, 4, 5 and 6.

Carrier 9 possesses generally circular end plates 11 connected by parallel ribs 10 and is journalled for rotation at the end walls 3 and 4 of the tank as described more fully below. There are preferably 12 ribs, but more or less are possible.

Each rib 10 is a flat bar having indentations 12 punched or moulded along its outer edge, and is received at each end to a crenellation of one of the plates 11. In transverse section the ribs can be seen to be substantially equispaced around the circumference of a notional circle.

In the embodiment shown, each indentation is part-circular, to give the rib a 'scalloped' appearance. By way of example, for developing equipment usable with 8 mm film, the indentations can be semi-circular and of 8.73 mm diameter; a minimum size for use with such film might be 7.94 mm.

The indentations on adjacent ribs are uniformly staggered in the same sense, so as to define a notional helical path around and along the carrier 9. A typical length for the carrier is 305 mm, which combined with the size of indentations given above, spaced along the ribs 10 by an amount less than the width, and combined with a suitable diameter of the notional circle (around which the ribs are spaced) can provide a helical path of total length approximately 15 metres, i.e. fully adequate to accommodate a standard reel of 8 mm film.

The carrier 9 has a stub axle 14 at one end plate and a slot 15 at the other end plate. Axle 14 is held for rotation at support member 16. Slot 15 engages with a protruding shaft 18 of drive means 19, connected in turn via pulley 21 and drive belt 22 to motor 20. Control of motor 20 is given by switch 23 connected to batteries 24 held in battery holder 25. Pulley 21 also has a manual handle 50 so that the carrier can be turned by hand if desired for loading, as described below.

A liquid inlet 26 for processing solutions is provided with a light-trap (not shown). A liquid outlet 27, controlled by rotary valve 28, is provided to drain liquid from the tank between processing stages and at the end of the process.

Brush 29 is pivotally mounted in end supports 30, around axis 31. The bristles of this brush engage the carrier as this rotates.

To use the equipment, a length of undeveloped cine film 13 is wound in dark room conditions on to carrier 9 with the base carbon layer outwards, using handle 50 so as to control the winding carefully. The lid 8 is placed securely over the tank 2.

The first processing solution is poured into tank 2 through the inlet 26, and past the light-trap, so as to extend approximately halfway up a rib lying at its lowest position, or otherwise as necessary if more or less than 12 ribs are present. The processing solution should cover a stretch of film over each turn; since the film is held at its edges only if there is good film/liquid contact.

The carrier is then rotated by motor 20 operating drive means 19 typically at 6 to 20 r.p.m. until the processing solution has contacted the film 13 for a length of time as known in the photographic art to be suitable for the requisite stage of cine film development. It will be appreciated that this step in itself is not part of the invention, and is therefore not discussed in detail.

The processing solution is drained, a rinse solution is poured in through inlet 26, and the carrier further rotated. This is then drained, and further processing solutions, and/or rinse solutions are successively added and drained.

During these operations passage of the ribs through the solutions ensure that it is suitably stirred. Also, the carbon backing becomes softened and removed by the gentle but continued action of pivoted

brush 29; whichever direction of rotation is chosen.

Typically, the process is completed in under two hours. At the end of this time the lid can be removed and, if desired, the carrier rotated for such length of time as may be necessary to dry the film (possibly at a higher speed of rotation). Drying takes place uniformly without formation of drying marks.

It is of considerable advantage to ensure that all internal parts, at least, of the equipment are made of synthetic polymeric material, to ensure that trace amounts of contaminant metal ions do not build up in the processing solutions and thus affect the developing process. Typical such materials are polyethylene, polypropylene or polyvinyl-chloride. For cheapness the tank may be pressed or vacuum-formed but for rigidity it is preferable to inject the ribs 10 and end plates 11.

Another embodiment of the equipment is shown in Figures 3 and 4.

Figure 3 shows in perspective view developing equipment 31 with the lid 32 lifted from the base 33.

Lid 32 is a light vacuum-formed tray-like member with slightly sloping downwardly extending walls 34 and a raised housing 35 for batteries and a motor, as described more fully below.

Base 33 is again a light vacuum formed member, of somewhat similar shape, with surrounding and downwardly extending sloping walls 36. In the top is formed a tank 37 of semi-circular cross-section for receiving a carrier member 38, shown only in dotted outline for clarity of illustration. The remainder of the tops is formed as a flat portion 39 with two spaced square recesses 40 and 41 for processing solutions and for inlet of temperature-control water respectively, as described below. Between these lies a thermometer 42 shaped so as to dip into one end of the tank 37 and pass upwards

and outwards along a recess in flat portion 39.

Figure 4 shows a cross-sectional view along line IV-IV of Figure 3.

Raised housing 35 of lid 32 has a depression 43 formed in the top, with removable cover 44 fixable thereover. This covered recess thus provides an accessible holder for batteries 45 connectable by switch 46 also operating warning light 46a. (see Figure 3). Within the housing 35, at a level lower than depression 43 is a motor 47 (shown only diagrammatically) and supported on base plate 48. This plate is securable around its edges by means not shown for ease of illustration in a surrounding recess 49 around the lower edge of housing 35.

Housing base plate 48 has a slot 51 through which protrudes a drive wheel 52 of motor 47, having frictional drive surface 52a.

The lower edge of lid 32 rests on the shaped surround 53 of base 33. Raised rim 54 ensures a light-tight seal.

Base 33 itself has a permanent base plate 55 fitted in a water tight fashion all around in shaped recess 56. It therefore constitutes a water bath 57, with a warm water inlet at 41 (as described above but not shown in the section of Figure 4) and a simple overflow outlet at 58, remote from the inlet 41 and fed from near the base plate at 59 to ensure good mixing and hence a uniform bath temperature.

Tank portion 37 is provided with inlet/outlet duct 60 passing through but not communicating with water bath 57 to drain tap 61. This duct 60 also communicates with vertical duct 62 fed from the inlet 40 via light trap construction 63 consisting essentially of a tray 64, an opaque plate 65 spaced from the base by rods 66 and almost but not quite reaching the walls of tray 64 so as to provide a tortuous liquid path and keeps out stray light.

Carrier 38 in this embodiment is a rigid polymer cylinder with integral projecting ribs 67 resembling the free ribs 10 in Figure 1 and possessing suitable indentations 68, staggered as before to provide a notional helical path. End caps 69 are each provided with a simple stub axle 70 each fitting into an upwardly open slot, not shown, in rotation supports 71. Around one end of the cylindrical carrier 38 there is provided a drive region 72 which when the lid 32 is in place frictionally engages with the surface 52a of protruding drive wheel 52 of the motor.

Surfaces 72 and 52a in the embodiment shown are each composed of a strip of hook pile material e.g. as known under the Registered Trade Mark of VELCRO. This ensures good frictional contact and accommodates slight differences in dimension or placement of the lid 32 in relation to base 33. It also gives good transmission of motion in either direction, without vibration or back-lash, suitable for low power drives of this nature. Moreover, it is a synthetic polymer not introducing contaminant ions.

The equipment of Figures 3 and 4 is used in essentially the same way as the equipment of Figures 1 and 2. The main additional operating feature is the water bath, fed by gravity through inlet 41 and imparting to the processing solution 73 the required temperature as measured by easily visible thermometer 42

Claims

1. Apparatus for developing a length of exposed but undeveloped photograhic film, characterised in that it comprises a carrier around which the length of film can be helically wound, supported, for rotation by suitable drive means, within a light-tight tank having inlet and outlet means for processing solutions and/or rinse liquids; the carrier possessing a plurality of like ribs parallel to and equally spaced from the axis of rotation to define a cylindrical array, the ribs being uniformly spaced around the cylindrical array, each rib having on an outer straight edge a succession of indentations each of a size to hold a standard film width by the edges only.

2. Apparatus as claimed in claim 1 characterised in that the indentations on adjacent ribs are staggered so that a notional helical winding path is defined around the cylindrical array of ribs.

3. Apparatus as claimed in claim 1 or 2 characterised in that the indentations are arcs of a circle.

4. Apparatus as claimed in any one preceding claim characterised in that the drive means is coaxial with the axis of rotation.

5. Apparatus as claimed in any one preceding claim characterised in that the tank walls define a heating jacket.

6. Apparatus as claimed in any one preceding claim characterised in that an elongate brush is provided to contact the notional surface of the cylindrical array, whereby it can engage a film wound over the ribs to remove a backing layer during processing.

7. Apparatus for developing a length of exposed but undeveloped photographic film, characterised in that it comprises a base formed to provide a semi-cylindrical tank surrounded by a water jacket,

both the tank and the jacket having liquid inlet and outlet means; a generally cylindrical carrier journalled for rotation at a suitable clearance in the semi-cylindrical tank; and a light-tight lid fitting over the base and carrier, including drive means engageable with the carrier surface, the carrier possessing a plurality of like equispaced parallel ribs along its surface, each having on an outer staight edgea succession of indentations each of a size to hold a standard film width by the edges only.

8. Apparatus as claimed in claim 12 characterised in that the indentations are arcs of a circle of such dimension as to hold 8 mm cine film by its edges, and the indentations on adjacent ribs are staggered so that a notional helical winding path is defined around the ribs.

9. Apparatus as claimed in claim 7 or 8 characterised in that the liquid inlets are depressions formed in an upper portion of the base uncovered by the lid, one depression feeding by gravity the water bath and the other communicating via a light-trap and suitable duct to the base of the semi-cylindrical tank.

10. Apparatus as claimed in any of claims 7, 8 or 9 characterised in that the drive means is an electric motor housed in an upward extension of the lid, presenting the surface of a drive wheel through a slot in the base of such upward extension to engage with the carrier surface.

11. Apparatus as claimed in any of claims 7, 8, 9 or 10 characterised in that the drive means and the contacting portion of the cylindrical carrier are provided with a layer of a friction drive material.

12. Apparatus as claimed in claim 11 characterised in that the friction drive material is a nylon hook pile strip.

13. A method of developing exposed but undeveloped photographic film on apparatus as claimed in any one preceding claim, characterised

in that it comprises the steps of: winding the film in dark-room conditions around the ribs so as to lodge in the indentations and be held by the edges only; closing the light-tight tank; introducing a processing solution into the tank; rotating the carrier, so that the solution comes into contact with both sides of the film, for a time sufficient for the processing stage, draining off the processing solution; introducing and draining successive rinse liquid and/or further processing solutions as necessary, while continuing to rotate the carrier, until development is complete; and removing the lid.

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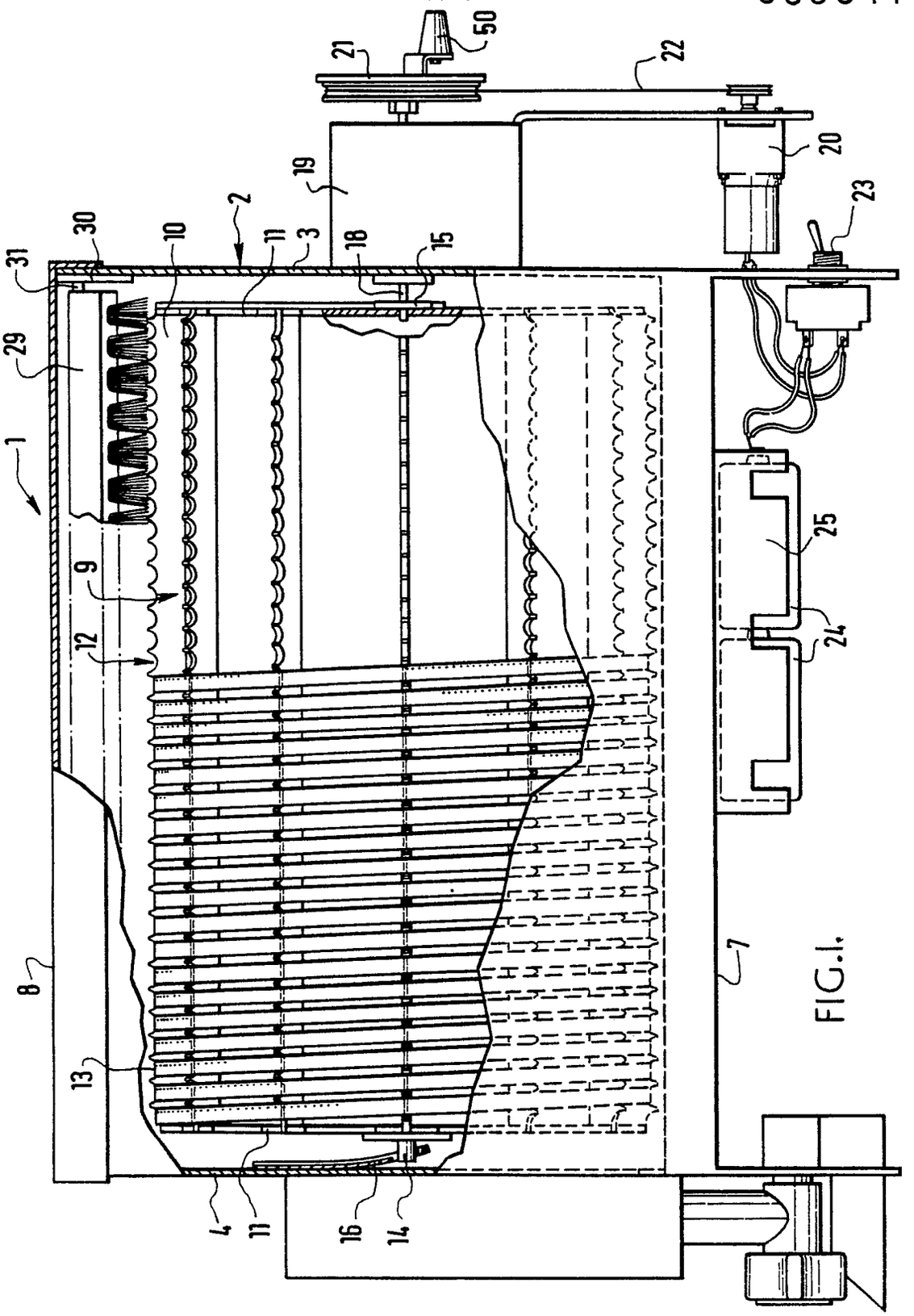

FIG.1.

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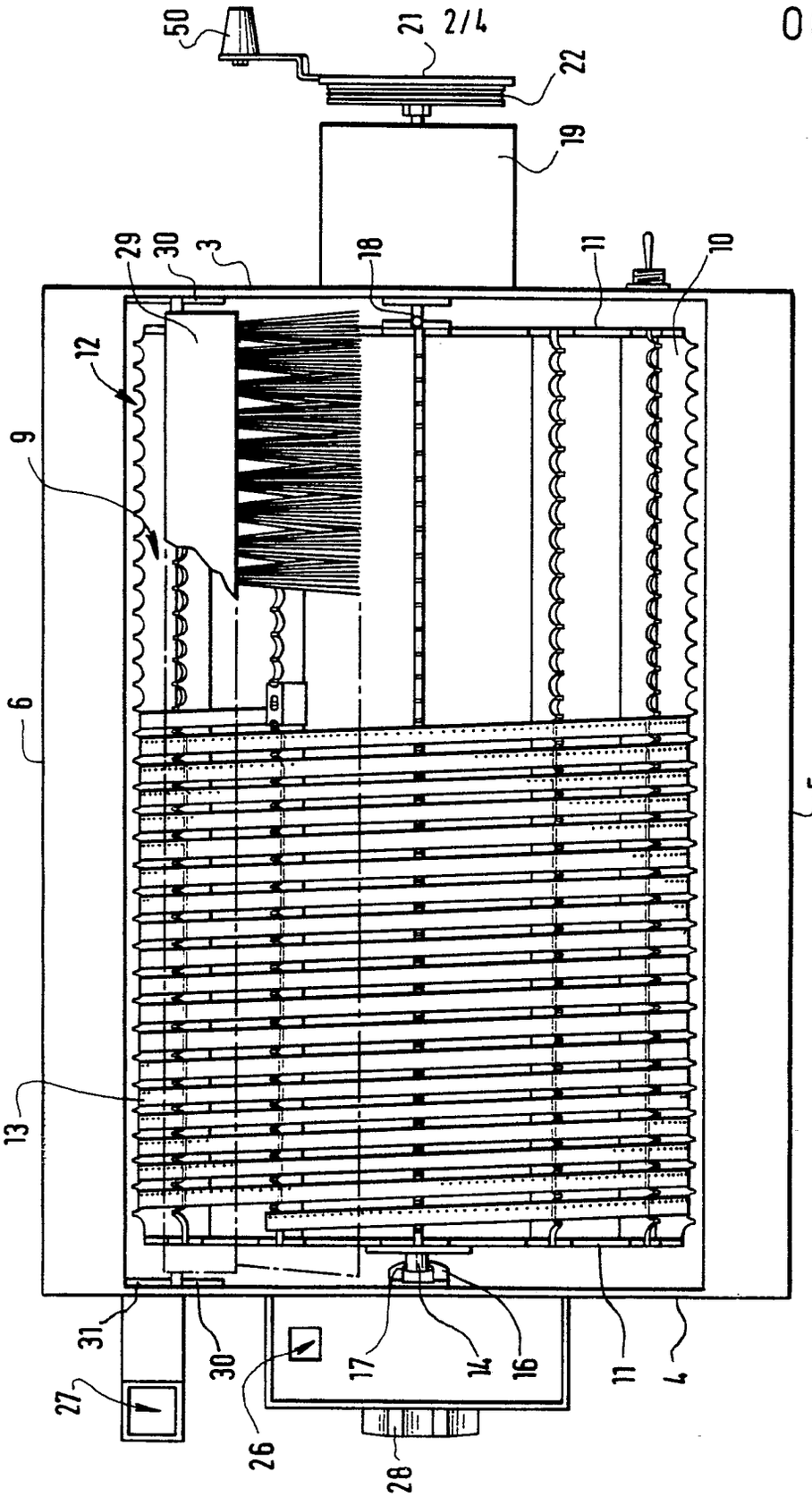

FIG.2.

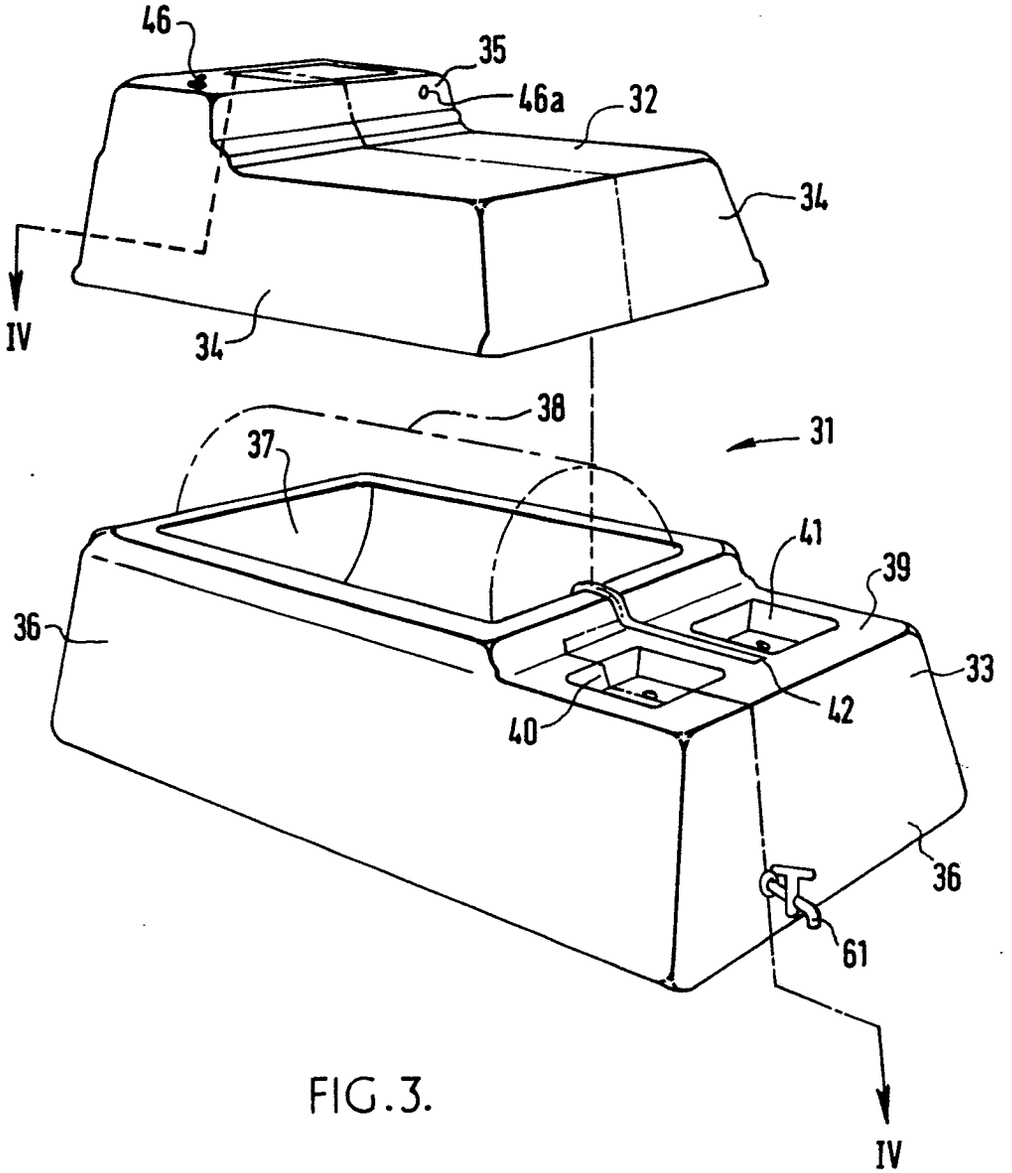

FIG.3.

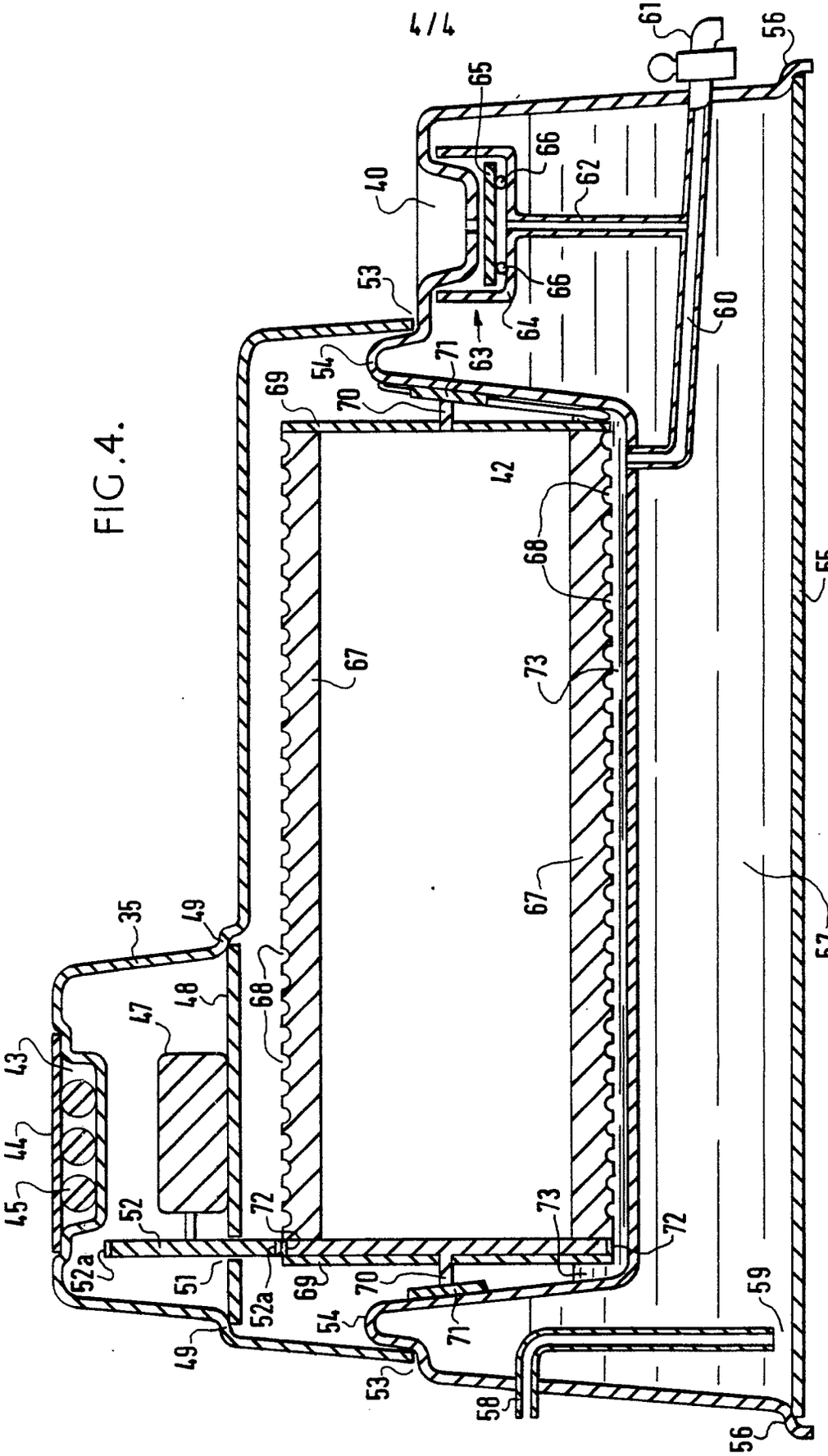
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FIG.4.

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EUROPEAN SEARCH REPORT

Application number
EP 81 30 5580

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
X,Y	US - A - 4 178 088 (H.D. HARDING) * Column 2, lines 43-50; column 4, lines 7-68; column 5, lines 1-41; figures 1-12 *	1,2,4, 5,7,13

	FR - A - 2 131 769 (H. HUSS)	
Y	* Page 5, lines 1-18; figures 1,2 *	4,5
A	* Page 5, lines 24-29; figures 2,4 *	9

A	DE - A - 2 734 688 (O. KOHLER)	
	* Page 3, lines 9-13; figures 1-5 *	6

CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)

G 03 D 13/04

TECHNICAL FIELDS SEARCHED (Int.Cl. ³)

G 03 D 13/04

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

X The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	15-02-1982	BOEYKENS