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Huss

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[54] **DEVICE FOR DEVELOPING PHOTOGRAPHIC FILM OR PAPER**

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Related U.S. Application Data

[63] Continuation of Ser. No. 239,180, March 29, 1972, abandoned.

[30] **Foreign Application Priority Data**

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Mar. 31, 1971 Germany 7112239

[52] **U.S. Cl.** **354/299;** 354/323
[51] **Int. Cl.** **G03d 13/00**
[58] **Field of Search** ..... 95/89 R, 93, 96, 97, 98; 354/297, 299, 323, 324, 331

[56] **References Cited**

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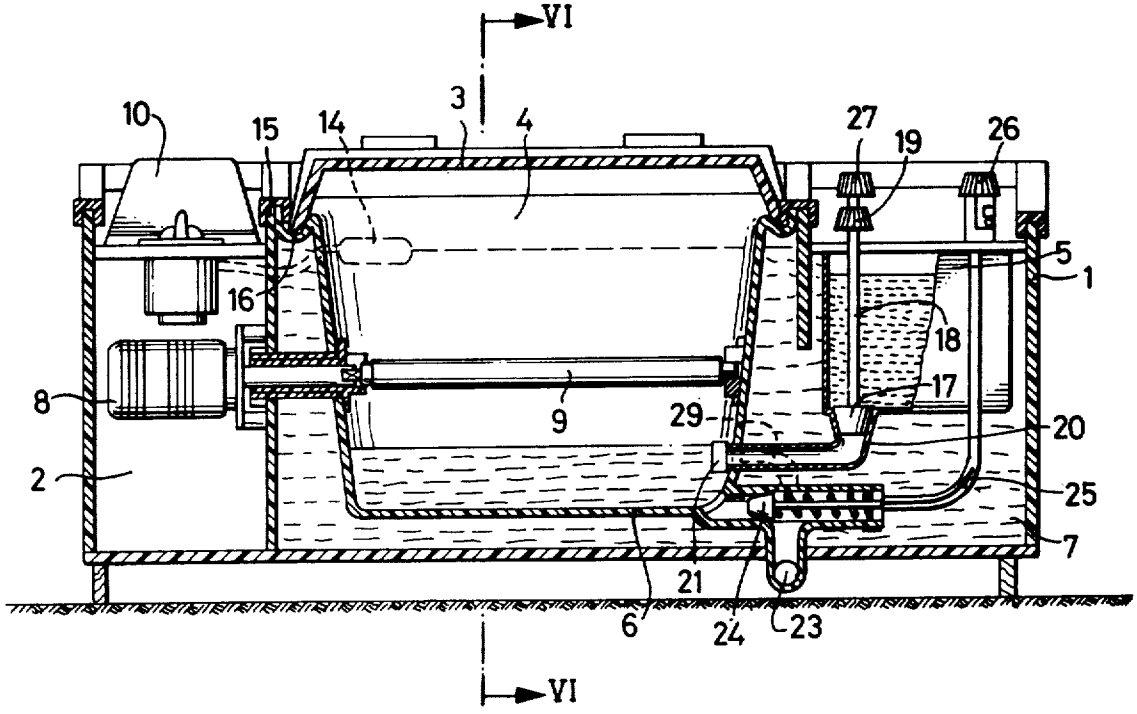
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Primary Examiner—Fred L. Braun
Attorney, Agent, or Firm—Karl F. Ross

[57] **ABSTRACT**

In a device for developing photographic material, such as photographic film or paper, a tank containing a drum arranged for immersing the said material in developing chemicals in the tank, and a plurality of reservoirs for the said chemicals are all immersed in a thermostatically controlled water jacket. Transverse barrier walls can be erected to divide the tank up into predetermined lengths depending on the length of the photographic material to be developed. The supply to, and discharge from, the tank of the liquid developing chemicals are controlled by suitable valves.

6 Claims, 8 Drawing Figures



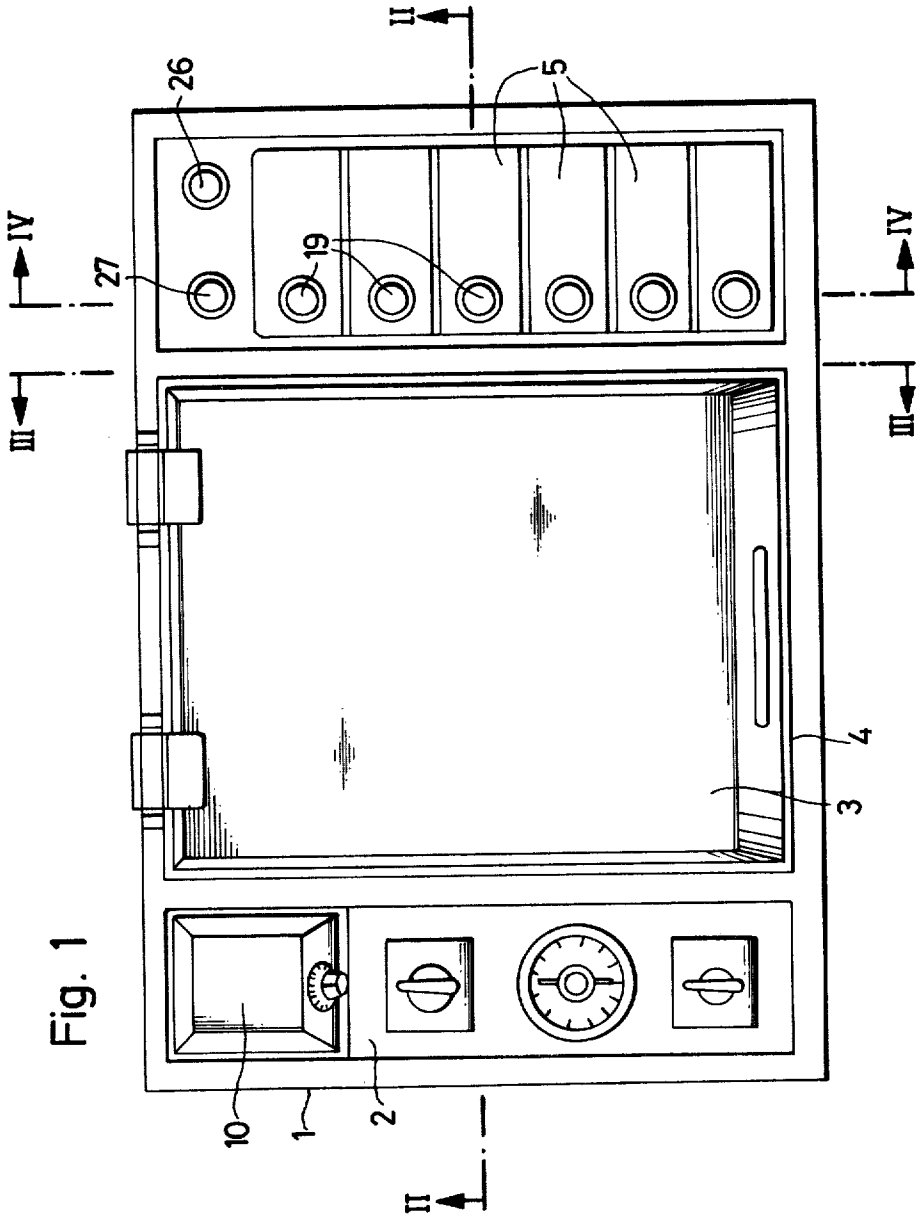


Fig. 1

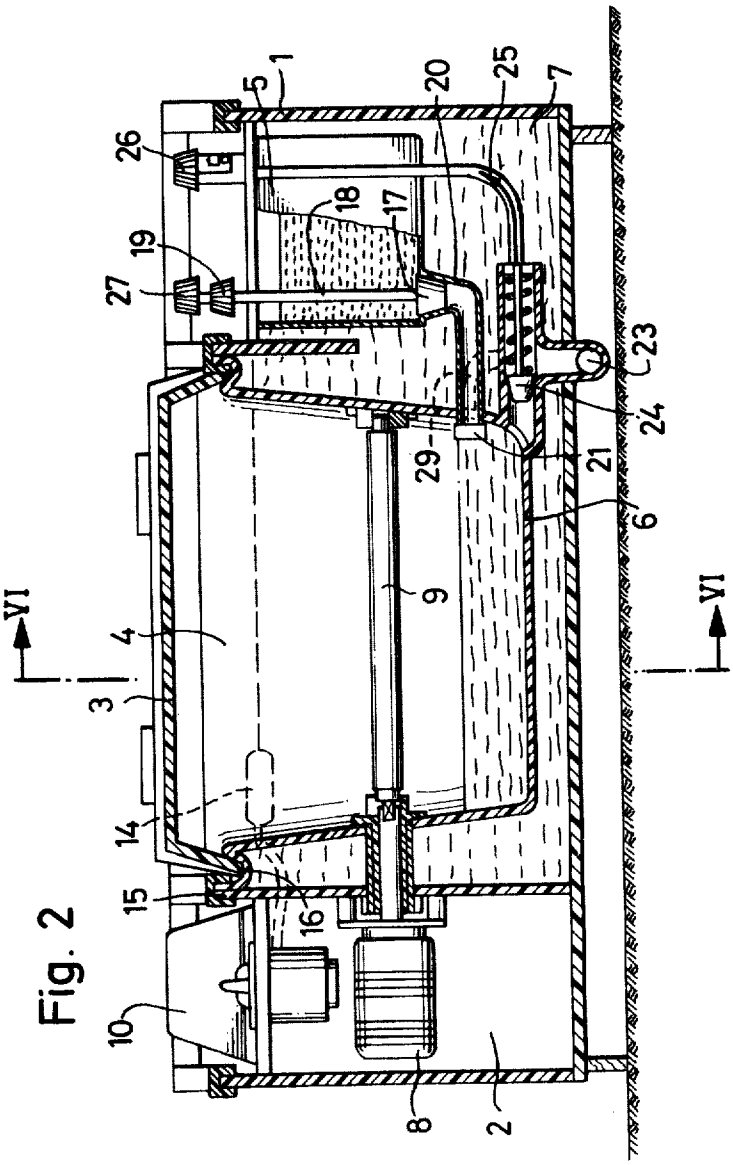


Fig. 2

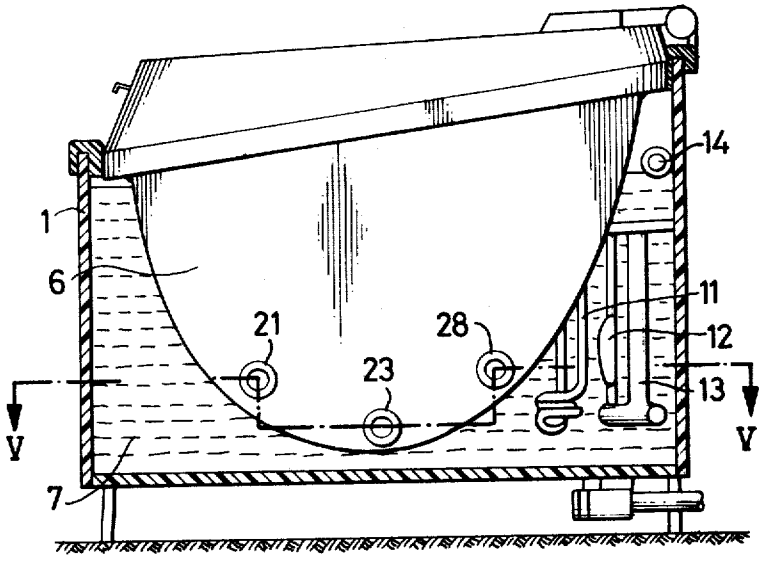


Fig. 3

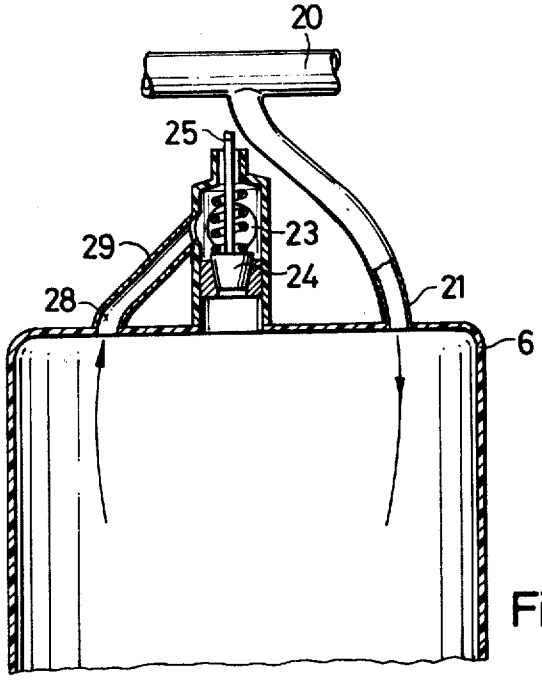


Fig. 5

Fig. 4

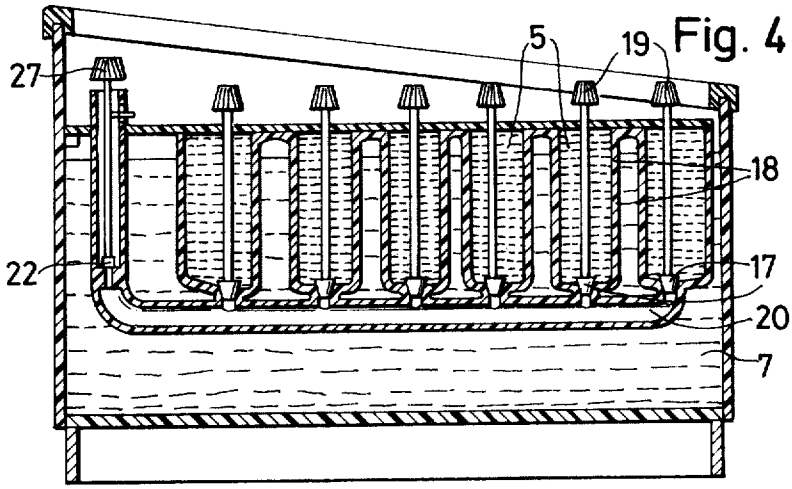


Fig. 6

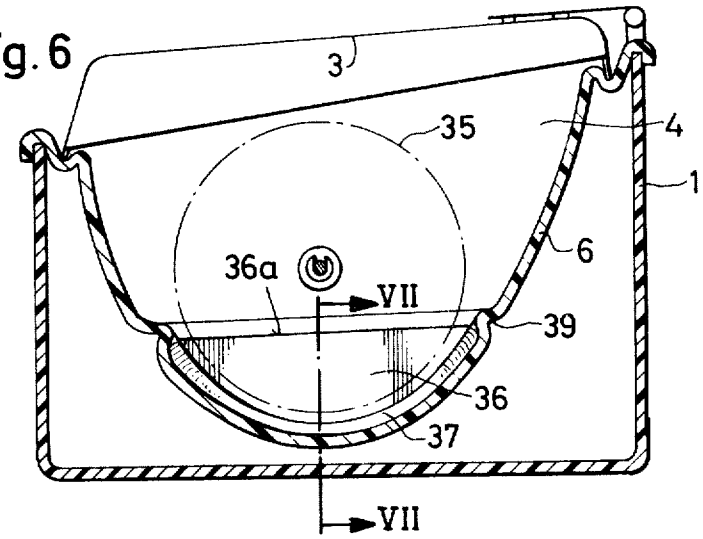


Fig. 7

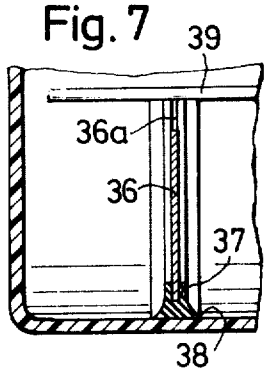
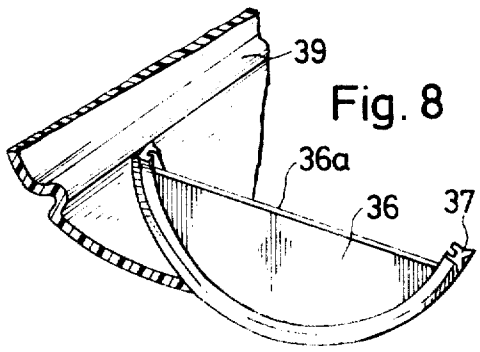


Fig. 8



DEVICE FOR DEVELOPING PHOTOGRAPHIC FILM OR PAPER

This is a continuation of application Ser. No. 239,180, filed 29 Mar. 1972, now abandoned.

This invention relates to a device (hereinafter referred to as "a device of the kind specified") for developing photographic film or paper having a light-impermeable developing chamber in a housing, an elongate tank wherein a drum for supporting photographic material to be developed, such as film or paper, is supported for rotation about a horizontal axis and for immersion in the tank, and a plurality of reservoirs for chemicals for use in a photographic developing process, the said reservoirs being in communication with the tank via conduits.

The object of the invention is the economical utilisation and correct handling of the said chemicals in a device of this kind.

In so-called "daylight developing devices" it is known to provide inside the housing a hot air circulating device which is intended to keep the tank, the drum, the chemical reservoirs, and the pipes at a constant temperature, because the quality of development work depends to a great extent on the maintenance of the operating temperature within close tolerances. In order also to maintain the correct temperature in the said chemicals which are to be supplied to the tank or in the water used for washing and rinsing, it is necessary that before being introduced into the tank these liquids should be kept for a long period of time inside the housing which is at the required temperature. The quantities of liquid needed for a number of developing operations must therefore be kept stored in the housing of the developing unit. Air however is a poor conductor of heat, and the circulation of hot air in the intricate interior of the housing can never ensure a uniform temperature of all parts.

The problem underlying the invention therefore consists in providing a daylight developing device of the kind specified, in which rapid and uniform temperature control of the developing chamber, of the tank and of the liquids to be introduced into the latter is possible.

According to the invention, in a device of the kind specified, the tank defines the floor and the walls of the developing chamber and is, jointly with the reservoirs, immersed in a water jacket, and a temperature control device is provided for keeping the temperature of the water jacket constant.

The tank and the reservoirs are effectively kept at constant temperature by the water jacket surrounding them. Since the heat transfer and the heat storage capacity of the jacket are very good, any chemicals which are added and which may be at different temperatures are rapidly brought to the desired temperature and kept at that temperature with great accuracy, so that it is not necessary for large amounts of chemicals to be kept ready in the housing of the apparatus. The jacket does not require any additional space in the housing since it simply fills gaps which in any case exist between the tank and the housing wall. The temperature control device may simply comprise a heater, temperature sensor, and circulating pump.

In order to save developing liquid when only smaller amounts of material or material of smaller dimensions are to be developed and therefore a shorter drum would be sufficient, it is known to subdivide a developing tank into smaller compartments by means of an insertable partition or barrier wall. For this purpose it must be possible for the partition to be inserted in any desired position along the tank. For fastening purposes it is usual to provide a retaining bar which extends on the top edge of the partition and the ends of which clip over the bent-over edges of the tank. The partition is thereby firmly pressed against the bottom of the vessel, so that it bears sealingly against the inner surface of the latter and prevents developing liquid from flowing out into the unused portion of the tank.

This type of fastening of the partition cannot be employed in the case of a tank which forms the bottom and the walls of the developing chamber. The edges of the tank are here extended upwards to the lid of the housing. A retaining bar engaging over the edge of the tank would have to be made very long and would interfere with the fitting of the lid.

Another problem underlying the invention accordingly consists in providing for the tank a construction which permits simple, effective fastening of the partition or barrier wall without it engaging over the edges of the tank.

According to a preferred feature of the invention this problem is solved by providing, on each of the two oppositely situated longitudinal walls of the curved or arcuate tank, a longitudinal bead, and a barrier wall disposed in and transversely of the tank with opposite corners of the barrier wall clampingly tucked under the said beads. The partition or barrier wall is thus supported by its corners against the respective beads on the wall of the tank and its elastic edge facing the bottom of the tank is pressed sealingly against the latter. For the purpose of extracting the partition, at least one of its two corners is moved sideways out of engagement with the bead. If the tank is a deep drawn part, it is advantageous for the two beads to be formed in the wall of the tank by a beading operation during the deep drawing of the tank. The production of the beads is thus considerably simplified and can be effected without an additional operation.

In a preferred development of the invention the jacket water is also used for rinsing and washing. Thus it is not necessary to provide a separate temperature controlled storage vessel for the water to be passed into the tank, while in addition it is impossible for differences in temperature to occur between the tank and the material being developed through the introduction of water from the mains supply.

In order to be able to feed the chemicals to the tank in a simple manner even when the chemical reservoirs are disposed in the common water jacket together with the tank, the bottoms of the chemical reservoirs may lie at a higher level than the bottom of the tank, and the chemical reservoirs are adapted to be connected through selectively controllable outlet or discharge valves to a common manifold leading into the tank. In this arrangement all the pipes leading from the chemical reservoirs to the tank are also situated inside the water jacket and their temperature is therefore likewise controlled, so that there can be no change of temperature in the liquid flowing into the tank.

It is advantageous for the inlet valve for the water jacket to be placed in the manifold of the chemical reservoir. It is thereby ensured that in addition to the tank the chemical manifold and, where applicable, the previously emptied chemical reservoir which has not yet been re-closed are rinsed with water the temperature of

which corresponds exactly to the required temperature for the chemicals, so that the chemicals subsequently flowing through the manifold will not undergo any change in temperature either while so doing, as would be the case if the manifold were rinsed by cold tap water.

A further development of the invention provides for the tank to have an overflow aperture which is situated some distance above the bottom of the tank and which opens into the tank outlet or discharge conduit by way of an overflow pipe downstream of the tank discharge valve. For the purpose of washing the material being developed it is thus possible for a predetermined level of water to be adjusted in the tank as long as the discharge valve at the tank outlet remains closed. By this means the flow of an unnecessarily large amount of jacket water through the tank for the purpose of washing the material being developed is prevented. It is advantageous for the jacket water to flow into the tank at least substantially tangentially to one edge of the tank. In addition, provision may also be made for the overflow opening to be situated at the other edge of the tank, so that a current circulating in an arc is formed in the tank, whereby uniform washing over the entire tank is achieved while the amount of jacket water consumed is reduced to a minimum.

One form of device embodying the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

FIG. **1** is a plan view of the device;

FIGS. **2** to **4** are sections along the lines II—II, III—III, and IV—IV in FIG. **1**, respectively;

FIG. **5** is a section along the line V—V in FIG. **3**;

FIG. **6** a section through the tank and housing along the line VI—VI in FIG. **2** with a partition or barrier wall inserted;

FIG. **7** is a section along the line VII—VII in FIG. **6**; and

FIG. **8** is a perspective view of the partition shown in FIGS. **6** and **7**, with part of the wall of the tank.

The housing **1** of the developing device comprises essentially three juxtaposed portions, namely a control housing **2**, a developing chamber **4** which can be closed by a lid **3**, and a group of juxtaposed chemical reservoirs **5**. The walls and the bottom of the developing chamber are formed by a tank **6**. The tank and the chemical reservoirs are immersed in a common water jacket **7**, which occupies most of the space between the tank and the housing. Only the control housing is kept free of the water jacket (FIG. **2**). Between the individual chemical reservoirs there is in each case provided a space which enables the water jacket to bathe each reservoir on all sides (FIG. **4**).

A drive motor **8** for a drum for supporting the material to be developed (films or papers) is also accommodated in the control housing. In FIG. **2** only the drum shaft **9** driven by the motor is shown, while the drum to be mounted on it is omitted. Together with its shaft, the drum can be lifted out of the developing chamber. At the side of the control housing **2** a temperature control device is provided which has a thermostat and from which a heater **11**, a heat sensor **12** and circulating pump **13** project into the water jacket. A level regulator with a float **14** operates an inlet valve for the water jacket.

The top edge **15** of the tank **6** engages over the edges of the housing wall. A channel **16**, which extends parallel to and around the edge and is open at the top, receives the edges of the housing lid **3** in such a manner as to provide a light seal (FIGS. **2** and **6**).

The bottoms of the chemical reservoirs **5** lie at a higher level than the bottom of the tank **6**. At the bottom of each reservoir is provided an outlet or discharge valve, which is in the form of a plug valve **17** and has a rod **18** extending upwards and an operating knob **19** (FIGS. **1** and **2**). The outlet valves lead into a common manifold **20**, which has an inlet opening **21** leading into the tank.

An inlet valve **22** is also connected to the manifold, and through it jacket water can be passed into the manifold and consequently into the tank (FIG. **4**). The inlet valve **22** is in the form of a two-stage valve, with the aid of which two different cross-sectional areas for the passage of liquid therethrough can be provided. The admission of jacket water can thus be adjusted to the amount desired for rinsing or washing, and unnecessary consumption of water, which would also militate against the maintenance of a constant temperature, is thus avoided.

The tank **6** may for example be produced by deep drawing. At its lowest point there is provided an outlet **23** which can be closed by a plug valve **24** (FIGS. **2** and **3**). The plug valve **24** is opened and closed through a Bowden cable **25** by means of an operating knob **26**, which, like the operating knobs **19** for the reservoir closures and an operating knob **27** for the two-stage inlet valve **22**, is situated on the right-hand side at the top of the device (FIG. **1**).

Overflow orifice means in the form of an opening **28** is disposed some distance above the floor of the tank and via an overflow conduit defined by a pipe **29** leads into the tank outlet conduit **23** downstream of the plug valve **24** (FIGS. **2** and **5**).

As can be seen from FIGS. **3** and **6**, the bottom portion of the tank is curved substantially cylindrically and thus matches the cylindrical shape of a horizontally disposed drum **35** receiving and supporting the material to be developed, this drum being shown chain-dotted and having its bottom region immersed in the contents of the tank.

If the drum **35** is now substantially shorter than the tank **6**, in order to confine developing liquids only to that portion of the tank which is actually needed for the developing process, a partition or barrier wall **36** is inserted into the tank. At its bottom edge, which is curved in the form of an arc of a circle to correspond to the shape of the tank, the partition is provided with an elastomeric sealing section or element **37** (FIG. **7**), the back of which has a U-shaped cross-section and clips around the edge of the partition, while on its side facing the tank it forms two parallel sealing lips **38**, which lie sealingly against the wall of the vessel when the partition is inserted (FIGS. **7** and **8**).

A sealing section with two sealing lips provides a good sealing action with adequate resilient play of the partition in the direction of the wall of the tank, thus facilitating the insertion and clamping of the partition and increasing its stability in the tank.

In the region of the top edge **36***a* of the inserted partition **36** there are formed, on the two oppositely situated longitudinal walls of the curved tank **6**, two beads **39** which extend parallel to the bottom of the tank and which are formed by a beading operation during the deep drawing of the tank. The length of the sealing sec-

tion 37 is so chosen that each of its two ends clips under a bead (FIG. 8), and is thus prevented by the rigid partition 36 from buckling laterally and is pressed sealingly prestressed against the curved tank. It is however also possible to make the sealing section shorter and to arrange the corners of the partition themselves to engage or tuck under the beads.

In operation, the developing device is connected to the water mains and to the electricity mains. The housing 1 is filled with water, which is brought to the desired temperature by the temperature control device 10 and is circulated by the circulating pump 13. The reservoirs 5 are charged with the chemicals needed for the developing process. The drum receiving the material to be developed, for example photographic papers, is suspended in the tank 6 and rotated by the motor 8.

When the plug of the valve 17 of the first chemical reservoir 5 has been withdrawn, its contents flows through the manifold 20 and the orifice 21 into the tank 6 and there bathes or circulates around the material to be developed, which is moved by means of the drum. After the required processing time, the operating knob 26 is pulled to open the discharge valve 24 in the tank outlet conduit 23, and the developer liquid flows out of the tank. By opening the inlet valve 22, jacket water can now be passed through the manifold into the tank, in order to rinse the pipe and the tank and, if required, to wash the material being developed. At the same time water can flow into the discharged chemical reservoir, which is still open, and likewise flush out this reservoir. If it is intended only to rinse the reservoir and the tank, the discharge valve 24 will be kept open during the admission of jacket water; if however the material being developed is to be washed, the discharge valve will be closed. The water then rises in the tank to the level predetermined by the overflow orifice 28, and thence flows through the overflow pipe 29 into the tank outlet 23, the water in the tank being constantly circulated and renewed.

Since the two orifices 21 and 28 are situated on the two longitudinal walls of the tank 6 (FIGS. 3 and 5), a circulating current is caused in the water. After the inlet valve 22 has been closed and the tank emptied by means of the plug valve 24, the next chemical can be introduced from one of the reservoirs into the tank. These operations are repeated until the developing process has been completed. Every time the level of the jacket water falls, the float 14 opens an inlet valve (not shown) so that the level of the water in the jacket is kept constant.

When short drums are used for smaller amounts or smaller sizes of material to be developed, the tank can be subdivided by the partition 36. The partition is inserted from above and engaged behind the beads 39. In order to remove it, it may, for example, be displaced along a bead until it slips out under the latter.

Through the adjustment of the temperature in the entire developing device by a common jacket, it is possible to make the unit so simple in construction and of such small dimensions that it is particularly suitable as a transportable unit or as a stand-by unit for small laboratories.

The invention may however be applied to larger units with the same advantages. In such larger units, however, solenoid valves controlled by a timer will be preferable to manual plug valves.

I claim:

1. A device for developing photographic material comprising:
- a housing forming an elongated tank providing a light-impermeable developing chamber therein;
- a drum in said tank rotatable about a horizontal axis for immersing photographic material therein;
- a plurality of reservoirs for chemicals for use in a photographic process disposed in said housing adjacent said tank;
- conduit means providing fluid communication between the tank and said reservoirs;
- a water jacket enclosing said tank, said conduit means and said reservoirs for heat exchange through said tank and said reservoirs between chemicals therein and water of said jacket;
- a temperature-control device for maintaining the temperature of said water jacket constant, the floor of said tank being arcuate and provided with a pair of spaced apart longitudinal beads; and
- a barrier wall disposed in and transversely of the tank with opposite corners of the barrier wall tucked clampingly under said beads.

2. A device for developing photographic material, comprising:
- a housing including an elongated tank providing a light-impermeable developing chamber;
- a drum in said tank rotatable about a horizontal axis for immersing photographic material therein;
- a plurality of reservoirs adjacent said tank for chemicals for use in a photographic developing process;
- a conduit means providing fluid communication between said tank and said reservoirs;
- a water jacket enclosing said tank, said conduit means and said reservoirs for heat exchange through walls of the tank and the reservoirs between chemicals therein and water of said jacket, said tank having a floor which is arcuate and conforms to the curvature of said drum along a lower portion thereof while reaching upwardly to a location above the top of said drum but within said water jacket;
- a temperature-control device for keeping the temperature of said water jacket constant, said conduit means including valves for said reservoirs enclosed in said water jacket;
- said conduit means including a manifold conduit, the floors of the reservoirs being disposed at a higher level than the bottom of said tank, the manifold conduit being arranged to open into the tank; and
- an inlet valve for the water of the water jacket, said inlet valve opening at one side into said water jacket and on another side into the manifold conduit for said reservoirs,
- said floor of said tank being formed with a pair of spaced apart longitudinal beads, said device further comprising a barrier wall disposed in and extending transversely of the tank with opposite corners of the barrier wall clampingly tucked under said beads.

3. The device defined in claim 2, wherein said inlet valve is a two-position further valve connecting the interior of said tank with said water jacket, said conduit means including a discharge valve and discharge conduit communicating with said tank.

4. The device defined in claim 2 further comprising overflow orifice means on said tank spaced from the floor thereof, an overflow conduit opening into said or-

ifice means, a discharge valve, and a tank-discharge conduit, said overflow orifice means opening into said tank-discharge conduit via said overflow conduit downstream of said discharge valve, said manifold conduit opening into said tank in such manner as to produce an arcuate current of liquid therein.

5. The device defined in claim **2,** further comprising an elastomeric sealing element adapted to receive a marginal region of said barrier wall facing said tank, said elastomeric element having a pair of sealing lips substantially contiguous with the tank.

6. The device defined in claim **5** wherein said corners of said barrier wall are divided by terminal regions of said sealing element.

* * * * *