Jan. 4, 1938. R. A. WEBSTER 2,104,283

AGITATING OR MIXING APPARATUS

Filed Oct. 18, 1934 2 Sheets-Sheet 1

Fig. 1.

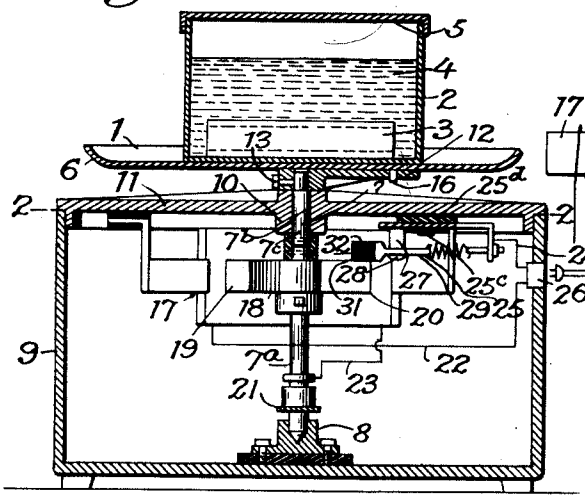


Fig. 12.

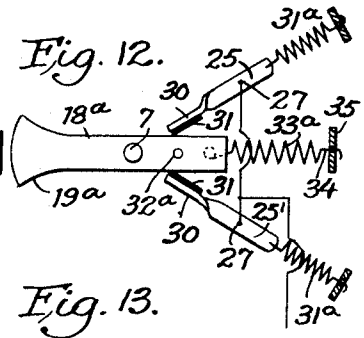


Fig. 13.

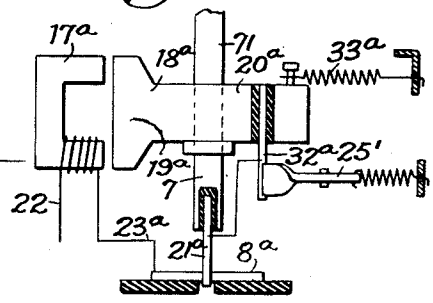


Fig. 2.

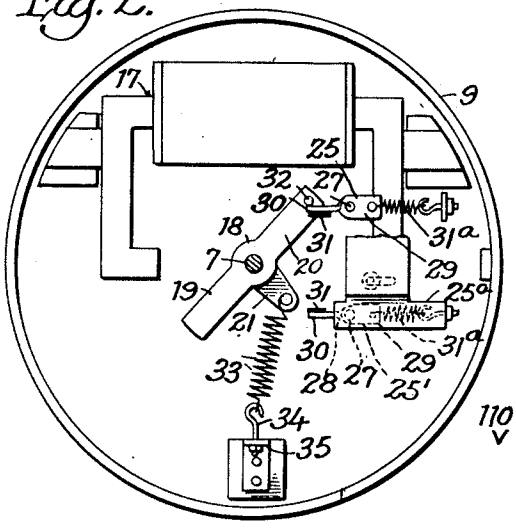


Fig. 14.

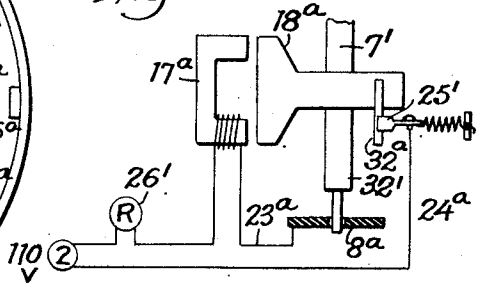
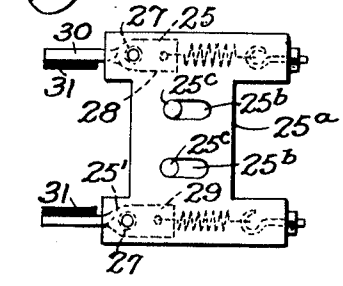


Fig. 2a.



Inventor:
Robert A. Webster,
By C. C. Hines,
Attorney.

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Fig. 3.

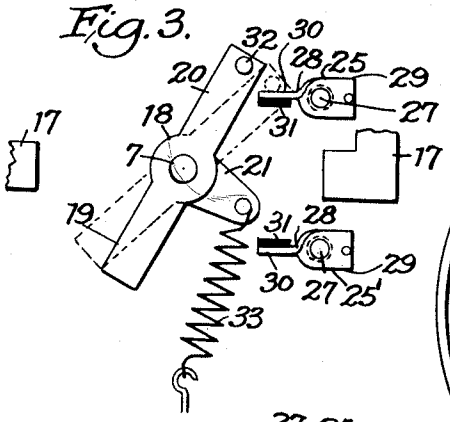


Fig. 8.

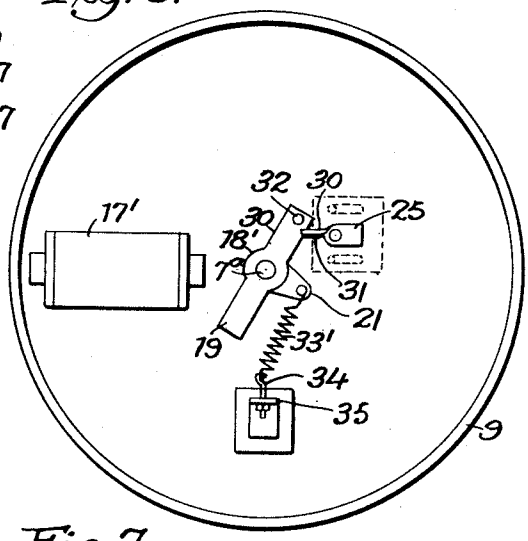


Fig. 4.

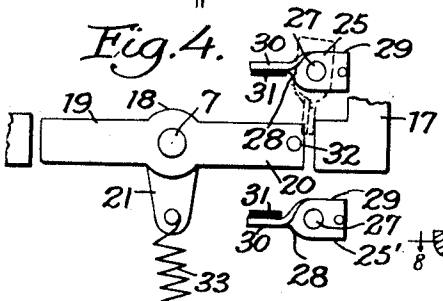


Fig. 7.

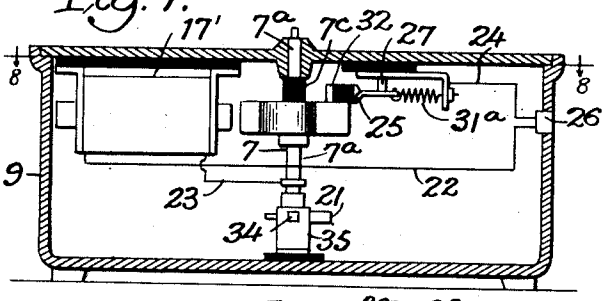


Fig. 5.

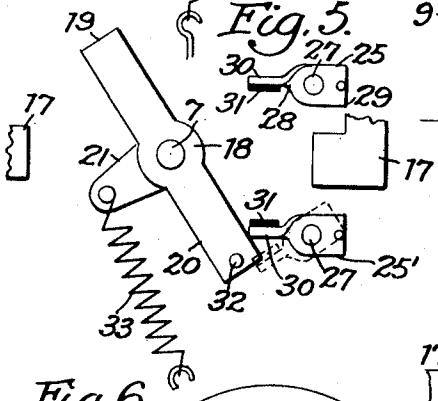


Fig. 9.

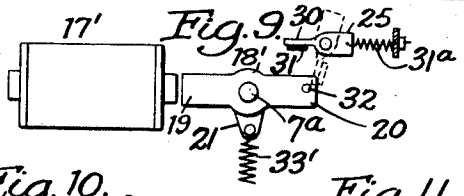


Fig. 6.

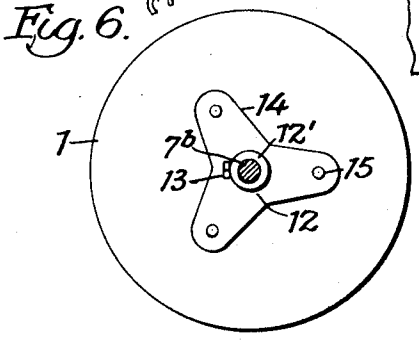


Fig. 10.

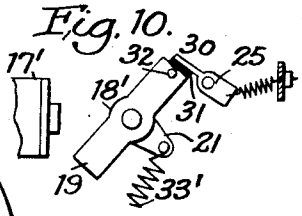
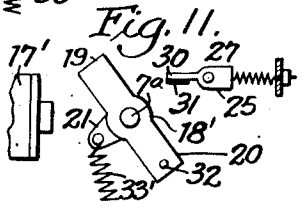


Fig. 11.



Inventor:

Robert A. Webster,

By C. C. Hines,

Attorney.

Patented Jan. 4, 1938

2,104,283

UNITED STATES PATENT OFFICE

2,104,283

AGITATING OR MIXING APPARATUS

Robert A. Webster, Santa Monica, Calif.

Application October 18, 1934, Serial No. 748,940

10 Claims. (Cl. 172—126)

This application is a continuation in part of my prior application filed December 21, 1933, Serial No. 703,463.

The invention relates to an apparatus for agitating liquids or agitating and mixing liquids and solids and, while designed particularly for use in developing or fixing photographic films or plates for the purpose of giving a proper motion to the solution for the developing or fixing action and to keep the fluid in perfect solution, is also adapted for general use in agitating or mixing chemical or other solutions and for other analogous agitating and mixing actions. While, therefore, in the following specification, I have, for purpose of exemplification, described my invention as adapted particularly for processing photographic films or plates, I desire it understood that it is not limited to such use, but may, in the form shown, or in suitably modified forms, be employed for various agitating and mixing purposes.

It has become quite a common practice to employ small cameras using either motion picture film or narrow widths of kodak type film, and, owing to the fact that the pictures as made with these cameras are quite small, it is necessary to make enlargements from such negatives in order to produce photographs of satisfactory size.

In the enlarging of small photographic images, it is necessary to develop the film in such a way as to produce the finest grain possible. A photographic image on a film is made up of minute grains or particles and the method of processing the film determines, to a large extent, the size of these particles or coarseness of such particles, which may show up as coarse, granular objects on the resulting enlarged photographic image.

There are several factors that are involved in making up a fine grain photographic image; among other things the type of developing agent used, length of development, temperature of solutions, rapidity of drying, etc. In order to produce the finest grain, all of these variables must be controlled. There are now very satisfactory developing formulae obtainable which, when properly used, will produce very good results.

I have discovered that by the use of certain developing solutions, and by agitation of the bath in a certain way, that the speed or time period of development may not only be materially hastened and rendered fixed or predetermined with a standard amount of agitation, under proper conditions such as temperature, composition of development, etc., but that films developed by my novel process of agitation are finer grained and more uniform in quality, are less apt to be streaked, and very rarely show such defects as air bubbles or spots due to settling or insufficient mixing of the developing bath. This is due apparently to the fact that components of the baths are kept uniformly in solution and prevented from settling, while at the same time during the development of the image minute amounts of gas are given off due to the chemical reaction and, as these gas bubbles are constantly removed by the agitating action from the surface of the film or emulsion, development proceeds with a better grain producing motion and at a faster speed and with a greater degree of uniformity in excellence of quality.

I have also discovered by agitating chemical or other solutions or mixtures in a certain way a better maintenance of the ingredients of a solution or mixing of liquids or solids and liquids, and particularly solids which are difficultly soluble, may be effected.

One object of my invention, therefore, is to provide an agitating or mixing apparatus whereby a novel and peculiar agitating or mixing action may be obtained for the purpose of flowing a liquid or solution, maintaining ingredients in solution or facilitating their combination in a chemical or other reaction, or mixing fluid or solid and fluid ingredients together to secure more reliable and efficient results and greater rapidity of action.

Another object of my invention is to provide an apparatus having a novel and improved agitating action whereby the ingredients of a solution may be kept in properly mixed condition while freely releasing any generated gases therefrom.

The invention consists of the features of construction, combination and arrangement of parts, hereinafter fully described and claimed, reference being had to the accompanying drawings, in which:—

Fig. 1 is a vertical section through one type of agitating apparatus for carrying my invention into practical effect.

Fig. 2 is a horizontal section taken substantially on line 2—2 of Fig. 1.

Fig. 2a is an enlarged detail view of the movable switch contacts and their adjustable carrier bracket plate.

Figs. 3, 4 and 5 are views showing the movements of the armature and its coaction with the contacts to effect oscillation of the receptacle by the apparatus.

Fig. 6 is a bottom plan view of the receptacle supporting pan or tray.

Fig. 7 is a view similar to Fig. 1 showing a modified form of the apparatus.

Fig. 8 is a horizontal section on line 8—8 of Fig. 7.

Figs. 9, 10 and 11 are views similar to Figs. 3, 4 and 5, showing the action of the armature and single contact employed in the structure disclosed in Figs. 7 and 8 for oscillating the receptacle supporting pan or tray.

Figs. 12, 13 and 14 are views showing still another form of my invention.

In the practical forms of my invention herein disclosed for purposes of exemplification, I have shown a structure particularly adapted for use in developing, toning and fixing photographic films, plates, etc., but it is to be understood that in the forms disclosed, or other suitably modified forms, the apparatus may be used for general agitating and mixing purposes. This apparatus, as shown, comprises a pan or tray 1 of circular or other suitable form to receive and support a receptacle 2 designed to receive the film 3 which is to be developed, and which is immersed in the developing solution 4 therein. This receptacle may be provided with a suitable cover 5 and may be made of any suitable form and of any appropriate material not adversely affected by the developing solution or ingredients to be mixed or agitated. The film 3 may be disposed in this receptacle either in any suitable manner to expose the emulsion side of the film to the solution while preventing such side of any portion of the film from coming in contact with the walls of the container or any other portion of the film. The film, for example, when in strip condition may be spirally or otherwise wound upon a developing rack with its emulsion side outermost and its turns properly spaced or arranged to prevent contact of the emulsion sides of the film with each other. Preferably the pan or tray 1 is provided with an upturned guard flange 6 and is of suitably larger dimensions than the receptacle to catch and retain any amount of the developing solution which may unavoidably escape therefrom.

The pan or receptacle 1 is suitably supported upon the upper end of a supporting and operating shaft 7 which is journaled at its lower end in a bearing 8 in a casing 9 and extends at its upper end through and is journaled in a bearing 10 in a detachable lid or cover 11 designed to normally close said casing 9. Any suitable means for mounting the pan or tray upon the shaft may be employed. In the present instance the shaft is shown as comprising a lower section 7a and an upper section 7b, and the upper end of the upper shaft section is shown as provided with a supporting spider 12 having a central collar 12' embracing the shaft section 7b and secured thereto by a set screw 13 and a plurality of equidistantly arranged radial arms 14, preferably three in number, having sockets or receiving openings 15 therein to detachably receive positioning and coupling studs 16 depending from the base of the pan or tray. With this construction, the pan or tray may be readily detached at any time desired from the upper section of the shaft and the lid or cover 11 then opened to allow access to be conveniently secured to the interior of the casing 9 for installing, removing, cleaning or repairing any of the working parts contained therein. In practice, the casing and its cover may be made of either conducting or non-conducting material, and in either case the shaft 7 may be made of upper and lower sections as above described, which sections may be connected by a coupling collar or sleeve 7c of rubber or other non-conducting material pinned or otherwise fastened to the shaft sections and electrically insulating the same from each other so as to electrically insulate internal current conducting elements from exposed parts and thus prevent the transmission of shocks to persons handling the film and solution containing and supporting means. Preferably the receptacle 2 is independent of the pan or tray 1, that is, is not physically attached thereto but simply rests thereon, so that the receptacle and its contents may be applied and removed without the necessity of employing any fastenings. It will, of course, be understood that instead of a single receptacle a plurality of independently detachable receptacles may be employed, all mounted in superposed relation within the pan or tray or upon the supporting spider, and the construction and arrangement of the receptacles may vary as desired as long as the principles of construction and operation of the apparatus are preserved. I may also employ pans or receptacles of other suitable forms and mounted in any other suitable way on the agitator shaft to suit the character of the work to be performed. The best results are obtained by disposing the receptacle or each receptacle so that its center or axis is coincident with its center of oscillation, i. e., the shaft 7.

It will be understood that the solution 4 is intended in accordance with my invention to be agitated so as to secure the beneficial actions stated on the film during the developing process. I therefore provide means for agitating the solution by imparting motion to the shaft 7 such as will agitate the developing fluid in a prescribed way.

I have found that maximum efficiency of operation is obtained by periodically and alternately rotating the shaft in opposite directions, that is to say, oscillating the shaft on its own axis, and thereby imparting back and forth motion in a curvilinear path or oscillation to the receptacle 2 and the developing fluid contained therein in a horizontal plane on a vertical axis. This motion may be fast or slow and its degree, i. e., arc of motion, may vary as occasion may require and will in practice be suitably governed to maintain all of the components of the solution in motion and in a state of solution and to cause the solution to flow back and forth through the film and against the surfaces thereof for a developing action therein. I preferably, however, use a reversible motor which has a quick or sudden reversing motion so as to give a sharp jerk at the end of each power stroke, and also means for producing a cushioning and braking action on the armature at the end of each power stroke, whereby the agitation of the developing fluid is increased and the developing effect on the film increased to a material degree. As a result of agitating the solution in such a manner while it is chemically acting upon the sensitive coating of the film, a physical washing action of the solution on the film is obtained whereby the developing action is facilitated and promoted, and at the same time all gases generated by reaction in the solution and tending to cling to the surfaces of the film are forced off and caused to pass to the surface of the solution and to be dissipated, and all the components of the solution are kept in a state of solution and prevented from separating out and causing streaking, spotting or uneven development of the film. The beneficial effect in these directions obtained by oscillation of the solution in a horizontal path about a vertical axis is much greater and much more effective,

as my experiments and practical working operations have shown, than any other mode of agitation which might be employed since the washing action of the solution on the film produced by the oscillations of the fluid is in a horizontal plane and at an angle to the plane of any bubbles of gases which may be generated and arise, and in a proper direction to ensure maintenance of all particles of the developer in solution, so that rapid freeing of gases and developing action of the solution on the film is obtained without spotting, streaking or otherwise injuring the film.

The means for oscillating the shaft in the manner described disclosed in the structure shown in Figs. 1 to 6, inclusive, is in the form of an electric motor designed to impart two power strokes to the shaft on each cycle of operation. This motor comprises a horseshoe-shaped electromagnet 17 suitably supported within the casing, and within the gap and between the poles of which moves an armature 18 centrally secured to the shaft 7 and embodying oppositely extending longitudinally alined arms 19 and 20 and an arm 21 extending therefrom at right angles to said arms 19 and 20. The armature, magnet and shaft are included in an electric circuit comprising a conductor 22 connected to one of the terminals of the magnet coil, a conductor 23 connecting the other terminal of said coil with the shaft 7 and the armature 18, and a conductor 24 connected with a pair of switch contacts 25 and 25' respectively, which conductors 22 and 24 lead to a suitable socket or other connector 26 with which a switch or attachment plug or the like may be coupled for connecting the same with a source of electric supply.

Each switch member or switch contacts 25 and 25' comprises a contact plate or the like centrally pivoted upon an axis 27 for swinging movement and to provide oppositely extending contact and operating arms 28 and 29, respectively, the contact arm 28 having a contact face 30 and an insulated face 31 for cooperation with a contact pin or stud 32 on the armature arm 20. These contact members or switches, which are retained in normal position by springs 31*a*, are designed to be successively and alternately engaged by the pin 32 in the swinging movements of the armature 18 for the purpose of periodically and alternately cutting the electromagnet into and out of the circuit for the purpose of swinging the armature in opposite directions to produce two power strokes of the motor on each cycle of action, whereby oscillating motion is imparted to the shaft 7 and the receptacle 2 and the solution contained therein.

The arm 21 of the armature has attached thereto one end of a coil controlling spring 33 the opposite end of which is attached to a swiveled anchoring and adjusting screw or bolt 34 carried by a supporting bracket 35, said spring operating to yieldingly oppose the swinging movements of the armature in opposite directions and to limit the throw of the armature in each of such directions and to bring it at the end of each power stroke to a predetermined position, ready for the starting of the next power stroke.

The operation of the motor will be readily understood by reference to Figs. 2 to 5, inclusive. Figs. 2 and 3 show the armature in one of its positions at the end of one power stroke, in which it lies at an angle across the field of the magnet with the contact face of switch 25 engaging pin 32, at which time the circuit is closed for the supply of current to the magnet. On the energization of the magnet the armature is moved from the position shown in Figs. 2 and 3 successively to the positions shown in Figs. 4 and 5. When the armature reaches the position shown in Fig. 4, in which it lies longitudinally in the magnetic field between the magnet poles, the pin 32 in its arc of swing with the contact face of the switch 25 passes beyond said contact face and on the same side of the switch on which its insulated face 31 is located, and in the further movement of the armature to the position shown in Fig. 5 it completes one power stroke. During the final movement of the armature the controlling spring 33 is brought from the angular position shown in Fig. 3, in which it lies at one side of the center of the arm 21 and normally maintains the armature in the position shown in Figs. 2 and 3, to the reverse position shown in Fig. 5 at the opposite side of the center of the arm 21 in which it checks the swing of the armature at the end of such power stroke and brings it into position to begin the succeeding opposite power stroke. In such movement of the armature on the said power stroke, the pin 32 on its arm 20 wipes past the insulated face of the switch 25' and comes into engagement with the contact face of said switch, as shown in Fig. 5. The electric circuit, which was broken when the pin 32 passed out of contact with the contact face of switch 25, is now again closed, with the result of again energizing the magnet to attract the armature which has moved on its opposite power stroke or back to the position shown in Figs. 2 and 3, during which movements the contact pin 32 on its arm 20 wipes past the contact face of such member 25' and passes beyond the insulated face 30 of said switch member and is brought again into engagement with the contact face of switch member 25. The spring 33 checks the movements of the armature on this second or reverse power stroke and brings the pin 32 into engagement with the contact face of switch member 25, ready for a repetition of the two power strokes on the next cycle of operation, as will be readily understood. The motor above described is one of reversible type which, due to the use of the reaction spring 33 and the contact action between the stud 32 and the switch contacts, causes a quick or sudden reversing motion of the armature with an abrupt countermotion jerk at the end of each armature stroke. This is increased by the cushioned bumping or braking action produced by engagement of the armature with each contact, the contact yielding in the wiping engagement against the resistance of the spring 31*a* to give the cushioning and braking action, such resistance checking or damping the movement of the armature at the extremity of the stroke to produce a cushioned bump stop action immediately prior to the abrupt change of stroke motion by the armature through the reactive force of spring 33 and the action of the magnet. As a result the mixture or solution 4 in the receptacle 2 which is being moved in one direction on a working stroke of the armature is subjected to a sudden checking or braking action and a sudden movement in the reverse direction at the end of the stroke, whereby two forces acting in opposite directions are exerted on the mixture or solution so as to produce in the solution a back lash and a resultant vertical wave motion as a concomitant of these forces. The surface of the film being treated is thus subjected to opposite washing actions in the direction of its length on each complete oscillation of the recep-

tacle and a vertical washing action in a transverse direction from edge to edge thereof at the ends of the oscillation strokes. This ensures even development of the film and the positive washing from the film surface, by longitudinal and transverse washing actions, of any portions of the solution which have become chemically exhausted and the constant subjection of the film to chemically active portions of the solution, thereby reducing the time period of treatment and enabling a finer and more uniform grain surface to be obtained. It has been found that where a constant relative movement between the film and a processing solution occurs, that portions of the solution which have been active on one part of the film surface and have become exhausted chemically in flowing from such portion of the film to another cause a dragging of the grain crystals in the film emulsion, that is to say, a dragging of the grain, which of course is very objectionable. This objection is overcome through the novel action of my apparatus, since the motion of the solution over the film, first in one direction longitudinally and then in the other direction longitudinally, and also edgewise of the film, causes an even distribution of chemically active portions of the solution, which are maintained in an intimately mixed state by the peculiar agitating action set up.

As shown, the contacts 25, 25' are preferably mounted on a bracket plate 25*a* having slots 25*b* for passage of clamping screws 25*c* entering an insulated plate 25*d* carried by the cover 11, whereby the contacts are rendered adjustable as a unit to vary the point of contact of the contact faces 30 with the contact pins 32. By this means the period of engagement of the contacts and power and duration of the power strokes may be varied and regulated to the degree required in any service action.

It will thus be seen that the invention provides simple, reliable and efficient means in the form of a reversible electric motor of simple type, the field of which is alternately energized to effect reverse power movements of an armature which converts opposite rotary motion to the solution or ingredients to be mixed or agitated to secure the novel and advantageous working action of the solution on the film hereinbefore set forth or mixing or agitation of the ingredients. It will also be understood that the construction is such that by means of the socket or connector 26 the apparatus may be plugged into any current supply circuit to start the apparatus into operation whenever required. It will, of course, be understood that the casing 9 and its cover and other proper parts may be suitably insulated from the electrical contacts and conducting connections, or that the casing and its cover may be made in whole or part of metal or conducting material, and insulated with other required parts of the apparatus from the coacting electrical conducting parts thereof. All parts of the apparatus which may possibly be injured by chemical action of the developing solution may, of course, be made of a material proof against such action.

In the modified form of my invention shown in Figs. 7 to 11, inclusive, an ordinary form of electromagnet 17' is shown, which cooperates with an armature 18' on the shaft 7', which armature is electrically operated in one direction only, that is, on one of its power strokes, and is operated by a spring 33' in the opposite direction or on its reverse power stroke. The armature 18' may be of the same structure as the armature 18, but only a single contact switch 25 is provided for cooperation with the pin 32, which imparts motion to the armature in one direction, the armature being impelled in the reverse direction by the action of a combined controlling and power or motor spring 33' having a controlling function similar to spring 33 but also operating as a motor spring. In the operation of this form of the apparatus it will be seen that when the parts are in the position shown in Fig. 8, the circuit will be closed to energize the magnet for movement of the armature on its electrically driven power stroke from the position shown in Fig. 8 to the position shown in Fig. 11. Between these positions the pin 32 on the armature arm 20 wipes past the contact face of the switch member 25 and swings by inertia to the position shown in Fig. 11, thus placing under tension the spring 33' which immediately swings the armature back on its opposite power stroke to the position shown in Fig. 8, ready for a repetition of the power stroke operations above described. This form of the apparatus may be used under some conditions, as for driving an apparatus of small type in which a limited quantity of film is developed at a time and which, accordingly, does not require much power to operate it, though the power of the magnet and the spring may be of any degree of power desired.

While the construction of the device may be such that upon letting on the supply of current, as by means of a switch, the device will start and continue its operation automatically, the construction in the present instance is such that it is necessary to turn the mechanism by hand through part of one turn in order to make the first contact, after which time it works automatically. When the device is not in operation the tension of spring 33 keeps the armature in line with the poles of the magnet, so that a preliminary movement thereof is necessary to make the first contact, as above set forth.

It will be observed that the method of making contact between the pin 32 and the switch members 25 and 25' is in the nature of a wiping action which tends to keep the contact surfaces bright and increases the certainty of contact action as well as the durability of the contact elements.

As stated, because of the type of motor used, as well as the type of switch mechanism used, a jerky action is produced at the end of each half oscillation which tends to set up a back lash or sloshing of the solution, with the result that portions of the solution flowing in one direction horizontally meet portions of the solution flowing in the other direction horizontally, so that a maelstronic action is set up, whereby vertical agitation as well as horizontal agitation is effected, whereby the agitation of the solution is greatly increased, with the resultant increase in the efficiency of the developing or mixing action. By this means any solid particles of the solution which tend to settle by gravity are washed up and dissolved, thus effecting a quicker solution and a more thorough mixing action.

In Figs. 12, 13 and 14 I have shown still another form of my invention which, while generally similar to those above described, differs in certain respects therefrom. As shown, an armature 18*a* having its arm 19*a* widened at its free end for coaction with the magnet 17*a* is carried by the oscillating shaft 7', a centralizing and power spring 33*a* having the same function as spring 33

being connected with the opposite arm 20*a* of the armature. The arm 20*a* carries a contact pin 32*a* which is electrically insulated therefrom and arranged for coaction with the circuit make and break contacts 25, 25'. The parts described are arranged in a circuit including a conductor 24*a* connected with the contacts 25, 25' and one pole of an electric supply line, and the pin 32*a* is connected by a conductor 32' to a bearing pin 21*a* fitted in and electrically insulated from the lower end of the shaft 7'. This pin 21*a* engages the metal bearing plate 8*a* which is connected by a conductor 23*a* to one terminal of the magnet coil, the other terminal of which is connected by a conductor to the other pole of the electric supply line. The circuit is provided with a suitable type of rheostat 26' for cutting the current on or off and regulating the current supply of the current to vary the power of the motor as desired and the time period of the oscillations. The operation with this construction will be readily understood from the description applying to the constructions previously described.

While the device as shown is designed especially for the treatment of film in strip form, it is also adapted for the development of so-called cut film, namely, film in sheet form and fairly flat. In the development of film in this form it is customary to place several pieces in a tray of developer at one time and without any attempt to separate them except by constantly moving them about in the tray. The present device may be used for the tray development of cut film by mounting the tray on the oscillating table and causing the individual pieces of cut film to constantly move around in the solution with respect to each other. The device as shown is also adapted for use in various agitating, mixing and coating operations and by varying the form and size of the receptacle as required may be employed for holding different quantities of material and different forms and sizes of articles to be treated. Because of its particular agitating motion it will be found of great value in compounding chemical substances or mixtures where a thorough mixture is desired together with a free release of generated vapors or gases or in dissolving chemicals and substances which are difficultly soluble and in all such operations ordinarily requiring slow and prolonged treatment, the device allowing the time period of treatment to be made fast or slow by varying the power and speed of the oscillations per minute of time, while in every case giving increased efficiency and reducing the time period of treatment over that ordinarily required.

If desired, each receptacle, in order to further increase the agitating effect, may be provided with riffles, disposed in its bottom or sides, or both, and which may be in the form of corrugations or solid ribs, as desired.

From the foregoing description, taken in connection with the accompanying drawings, the mode of operation and advantages of the apparatus will be readily understood by those versed in the art without a further and extended description. While the structural forms of apparatus disclosed are preferred it will, of course, be understood that changes in the form, proportions and details of construction of the working parts may be made within the scope of the appended claims without departing from the spirit or sacrificing any of the advantages of the invention.

By means of the adjustable anchor screws or bolts connecting the controlling springs to their connecting brackets or the like, the power action of the springs may be varied to regulate their working power and speed of operation within certain limits, as will be readily understood.

What I claim is:—

1. An electric motor for transmitting oscillatory driving motion to an agitating or mixing device comprising a vertical shaft, an electromagnet, a swinging armature carried by the shaft and adapted to be influenced by the magnet to oscillate the shaft, pivotally mounted contact devices arranged on opposite sides of the armature and each having a non-conducting face and a conducting face adapted to be successively engaged by the armature to impart a swinging motion thereto and to make and break connection therewith to control the supply of current to the magnet, said contact devices operating on said swinging motion to exert a braking action on the armature, springs yieldingly opposing movement of said contact devices and regulating their braking action on the armature, and reactive means acting on the armature at the end of a stroke for reversing its direction of motion and bringing the armature contact pin into engagement with the conducting face of the associated contact device.

2. An electric motor for transmitting oscillatory driving motion to an agitating or mixing device comprising a vertical motion transmitting shaft, an electromagnet, a swinging armature carried by the shaft and adapted to be influenced by the magnet to oscillate the shaft, a switch contact connected with the armature, a pivotally mounted contact device arranged in the path of movement of the armature and having a non-conducting face and a conducting face successively engaged by the armature contact for respectively checking the movement of the armature and to make connection to control a circuit supplying current to the magnet, in which action the armature wipes past the non-conducting face and swings the pivotally mounted contact in one direction beyond a normal position and the armature contact is brought into position to engage said conducting face on an initial part of the reverse stroke of the armature, a spring acting on said contact device to regulate its checking action on the armature and limit its swing under motion of the armature and to return it to normal position, means for adjusting the pivotally mounted contact device relative to the armature for varying the time period of contact of the contact device, and a resilient reaction device acting at the end of the armature stroke to impart a quick return movement of the armature as an initial part of its return stroke and by such movement to bring the armature contact into engagement with the conducting face of the pivotally mounted contact to close the magnet circuit.

3. An electric motor for transmitting oscillatory driving motion to an agitating or mixing device comprising a motion transmitting shaft, an electromagnet, a swinging armature connected to the shaft and oscillatable by the magnet, a contact member connected with the armature, resilient circuit make and break switches adapted to be respectively engaged by the armature at the ends of its opposite strokes for supplying current to the magnet, each of said switches having a non-conducting face adapted to be wiped past by the contact member near the end of the armature stroke to abruptly break or check the motion of the armature and a conducting face engaged by said contact member on a preliminary portion

of the reverse stroke of the armature to supply current to the magnet to impel the armature on such reverse stroke, and a resilient reaction device acting on the armature on its stroke movement past the non-conducting and conducting faces of each switch to stop the armature and impart an abrupt motion thereto as a preliminary portion of its reverse stroke to engage said contact member with said conducting face of the contact.

4. An electric motor for imparting oscillatory motion to an agitating or mixing device comprising a vertical motion transmitting shaft, a magnet coil, an oscillating armature connected to the shaft and influenced by the coil for oscillating the shaft, pivotally mounted circuit make and break devices arranged on opposite sides of the armature, each having a non-conducting face and a conducting face adapted to be successively engaged by the armature contact device near the end of a stroke movement of the armature, a resilient reaction device for stopping the armature at the end of a stroke and imparting a reverse movement thereto, and resilient means acting on said circuit make and break devices to yieldingly oppose the movement thereof under action of the armature contact, said faces arranged whereby the armature contact first engages the non-conducting face of each circuit make and break device to swing the same for a braking action controlled by the associated spring and then wipes past said non-conducting face for engagement with the conducting face of the contact on the reverse movement of the armature effected by the reaction device for a circuit make connection with said conducting face.

5. An electic motor for transmitting oscillatory motion to an agitating or mixing device comprising a vertical motion transmitting shaft, an electromagnet, an oscillating armature influenced by the magnet for oscillating the shaft, a resilient reaction element acting on the armature to arrest its motion at the end of a stroke and to impart to the armature a return motion as an initiatory part of its opposite or reverse stroke, and a switch device controlled by the armature and including contacts brought into engagement on such initiatory part of the return motion of the armature to supply current to the magnet for a power impulse in continuation of the return motion to impel the armature on the return stroke.

6. An electric motor for transmitting oscillatory motion to an agitating or mixing device comprising a vertical shaft, an electromagnet, an armature arranged to swing in a horizontal path and influenced by the magnet to oscillate the shaft, a switch device controlled in action by the horizontal swinging movements of the armature for controlling a supply of electric current to the magnet, and resilient reaction means acting on the armature for arresting the motion of the armature at the end of a stroke in one direction and imparting a quick return motion thereto as an initiatory part of the succeeding reverse stroke, said switch device including contacts operatively arranged so as to be engaged on such initiatory part of such quick return movement of the armature by the reaction means to supply current to the magnet to impel the armature on such reverse stroke as a continuation of the quick return movement whereby to impart to the material being mixed or agitated supplemental mixing or agitating movements on the oscillation strokes.

7. An electric motor for transmitting oscillatory motion to an agitating or mixing device comprising a vertical shaft, an electromagnet, an oscillating armature arranged to swing in a horizontal path and influenced by the magnet for oscillating the shaft, a resilient reaction element acting on the armature to arrest its motion at the end of a stroke and to impart to the armature a return motion as an initiatory part of its opposite or reverse stroke, and a switch device controlled by the armature and including a movable contact arranged at a point in the path of travel of a part of the armature and a contact connected to and movable by the armature into and out of engagement with the first-named contact, the second-named contact adapted to wipe past the first-named contact near the end of a stroke and to be brought into engagement with the first-named contact by the action of the reaction device on such initiatory part of the opposite or return stroke of the armature to supply current to the magnet to impel the armature on the return stroke as a continuation of the quick return movement.

8. An electric motor for transmitting oscillatory motion to an agitating or mixing device embodying means for incrementally increasing the agitating actions obtained by normal oscillating motions, said motor comprising a vertical shaft, an electromagnet, an armature, an electric supply circuit including the magnet, a switch contact arranged at a point in the path of travel of a part of the armature and a contact connected to and movable by the armature into and out of engagement with the first-named contact, said contacts being operatively arranged and adapted to be maintained out of circuit closing engagement during the final portion of a stroke of the armature in one direction and to be brought into circuit closing engagement by and upon initiation of a reverse stroke of the armature, and resilient means operatively cooperating with said armature and switch contacts to effect a sudden stop of the armature at the final portion of the stroke of the armature in the first-named direction and to impart to the armature a sudden return movement as an initial part of a reverse stroke without pause or dwell therebetween, in which initial part of the return movement the contacts are brought into engagement to close the circuit to the magnet to electromagnetically impel the armature during the remainder of its travel on such reverse stroke, whereby through such sudden stop and start actions vibratory actions on and supplementary to the stroke motions are set up modifying the direction and increasing the amplitude of the motions of the medium being agitated or mixed by the agitating or mixing device.

9. An electric motor for transmitting oscillatory driving motion to an agitator or mixing device comprising a vertical motion transmitting shaft, an electromagnet, a horizontally swinging armature coupled to the shaft and adapted to be influenced by the magnet to oscillate the shaft, a switch device comprising contacts brought into operative relation by the armature at or near the end of an armature stroke in one direction for engagement to close a circuit supplying current to the magnet on a preliminary part of the movement of the armature in the opposite stroke direction, and resilient reaction means acting at the end of an armature stroke to arrest its movement in such stroke direction and to suddenly reverse its direction of movement and in so doing to effect

such preliminary movement of the armature in the opposite direction and the engagement of the contacts to close the magnet circuit.

10. An electric motor for transmitting normal oscillatory and supplemental vibratory motions to an agitating or mixing device comprising a vertical shaft, an electromagnet, an armature arranged to swing in a horizontal path and influenced by the magnet to oscillate the shaft, switching means controlled in action by the swinging movements of the armature for controlling the supply of electric current to the magnet to impel the armature in each of its directions of movement, and resilient reaction means acting on the armature for arresting the motion of the armature at the end of each stroke and imparting a quick return motion thereto as an initiatory part of the succeeding reverse stroke, said switching means being operatively controlled by the armature prior to the completion of an armature stroke to cut off the supply of current to the magnet and being operative on such quick return movement of the armature on the initial part of the ensuing reverse stroke imparted thereto by the reaction means to supply current to the magnet to impel the armature on such reverse stroke as a continuation of the quick return movement, whereby to impart to the agitating or mixing device at the beginning and end of each armature stroke abrupt supplemental vibratory mixing or agitating motions.

ROBERT A. WEBSTER.