

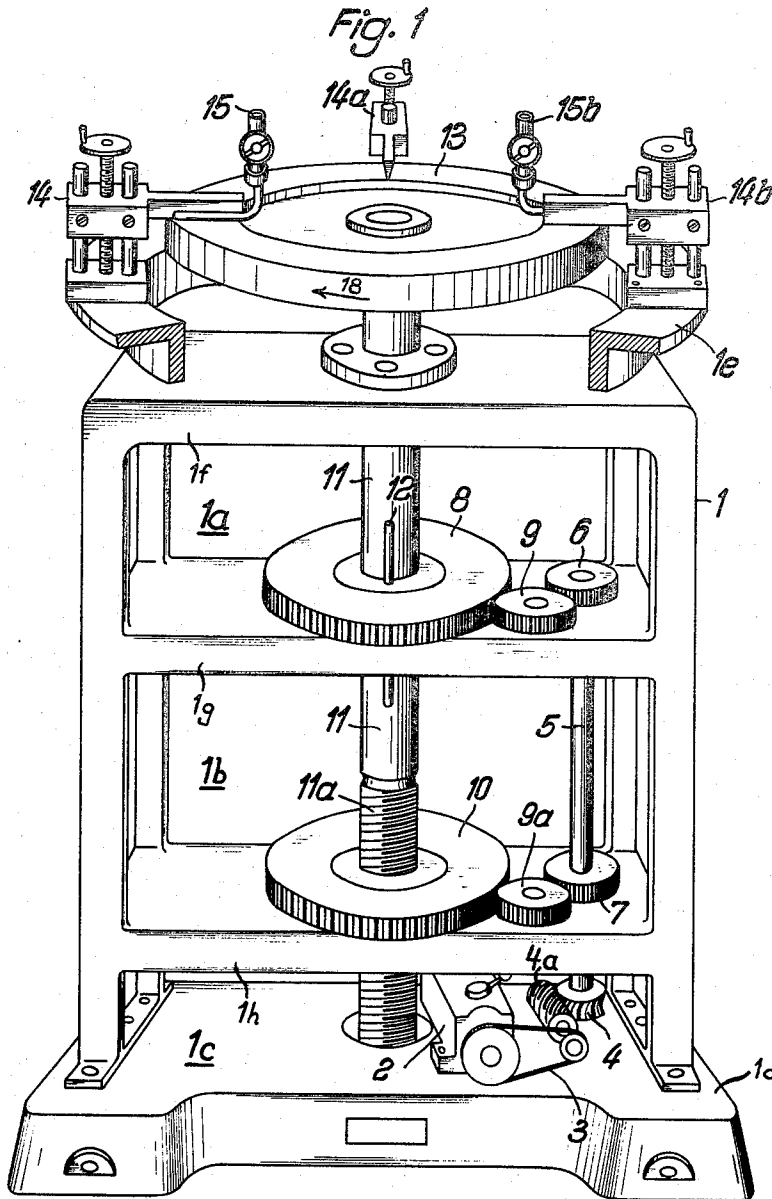
June 28, 1960

K. WAHL
APPARATUS FOR MANUFACTURING COLOR SCREENS FOR
USE IN CONNECTION WITH COLOR PHOTOGRAPHY

2,942,293

Filed May 21, 1956

3 Sheets-Sheet 1



Inventor:
KARL WAHL
BY *Leon M. Kraus*

June 28, 1960

K. WAHL

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Fig. 2

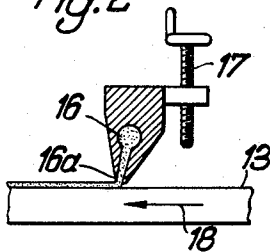


Fig. 3

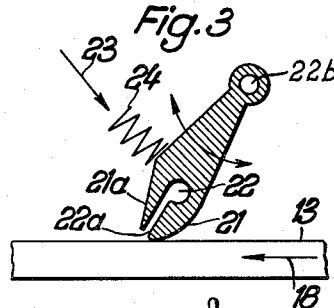


Fig. 4

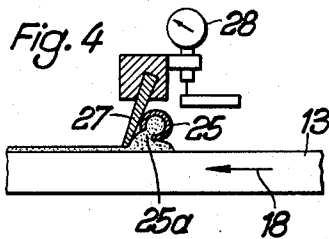


Fig. 5

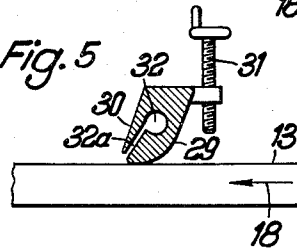


Fig. 6

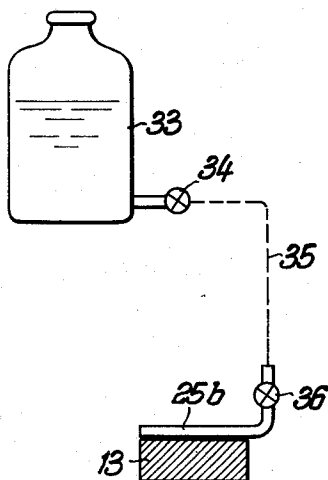
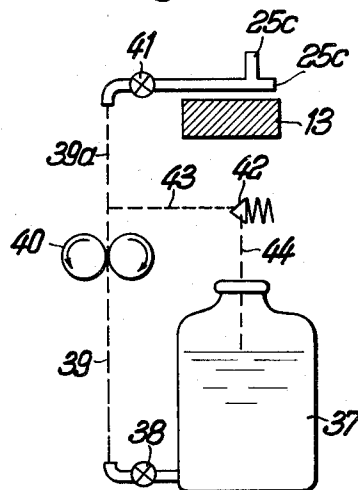


Fig. 7



Inventor:

KARL WAHL

By *Henry M. Strauss*
Att.

June 28, 1960

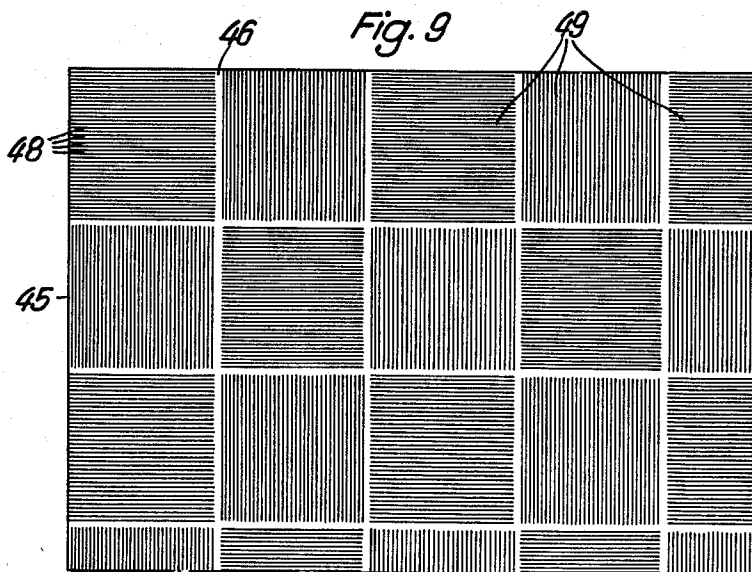
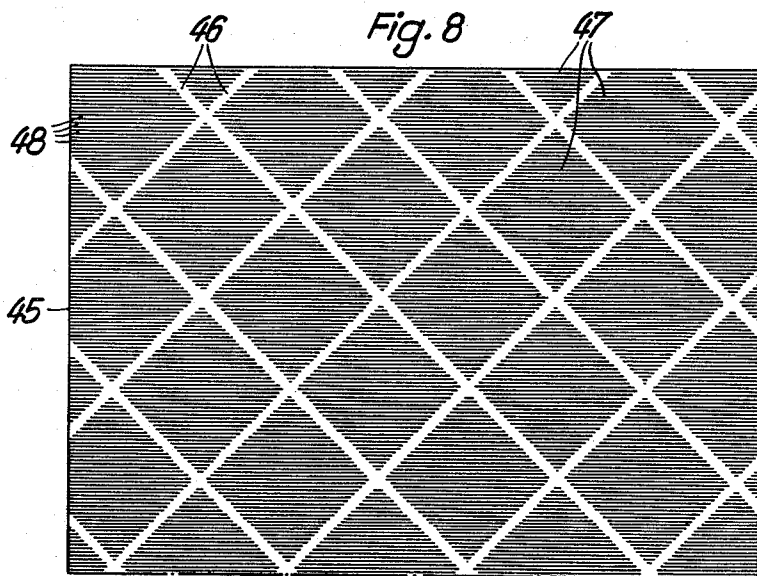
K. WAHL

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APPARATUS FOR MANUFACTURING COLOR SCREENS FOR
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Filed May 21, 1956

3 Sheets-Sheet 3



Inventor:
KARL WAHL
By *Wm. M. Kraus*
Att.

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2,942,293

APPARATUS FOR MANUFACTURING COLOR SCREENS FOR USE IN CONNECTION WITH COLOR PHOTOGRAPHY

Karl Wahl, Schaan, near Vaduz, Liechtenstein, assignor to Firma Emimeta Fabrikations-Anstalt, Schaan, near Vaduz, Liechtenstein

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12 Claims. (Cl. 18—5)

This invention relates to apparatus for manufacturing line screens for use in connection with color photography.

It is known, in the production of multi-colored line screens of the type employed in connection with additive color photography, to form such screens by slicing or peeling thin films from a block of thin layers of alternately different colors.

Heretofore, however, production of these multi-colored, multi-layer blocks has presented a number of difficulties, since it is always essential first to assemble the individual colored layers, made of acetyl cellulose or like materials, for example, in superposed relation with the greatest possible precision, then to bond the layer together into a unitary block while retaining them exactly plane and parallel to one another, and finally to peel or slice the desired films from the block.

For some purposes it is, moreover, required that the colored lines of the screens and thus the individual colored layers of a multi-layer block as described above have an exactly predetermined and uniform thickness which is sufficiently small so as to enable the screens to include approximately 100 to 200 lines per mm. It has generally been very difficult to attain this degree of fineness. Apart from this, it has also not been possible heretofore to effect continuous production of such blocks.

An important object of the present invention is, therefore, to provide means facilitating the preparation of multi-layer blocks from which colored-line screens are to be peeled or sliced.

Another object of the present invention is to provide means facilitating continuous production or formation of the requisite multi-layer blocks with the highest possible degree of precision.

It is also an object of the present invention to provide means affording highly efficacious apparatus for preparing blocks of a plurality of differently colored layers of plastic material arranged in alternating sequence one next to the other, whereby colored-line screens may be produced by slicing very thin films from such blocks along planes substantially at right angles to the planes of the block layers.

Yet another object of the present invention is to provide means contributing to apparatus of the aforesaid type capable of assembling the various colored layers into a block of the desired size and in adhering relationship with respect to one another in one continuous operation.

A further object of the present invention is the provision of means rendering the manufacture of line screens for photography purposes greatly simplified in nature as well as substantially less expensive and time-consuming than has heretofore been the case.

To this end, the invention provides a novel means capable of highly advantageous use in a process for preparing multi-layer blocks from which colored-line screens are manufactured by peeling thin films in a prescribed manner, which process is characterized by the depositing, onto a continuously moving base or receiver, of a plural-

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ity of layers of colored material in one continuous operation, a number of layers, corresponding to the number of different colors employed, being started simultaneously by a number of layer-forming devices located at different stages of the path of movement of said base except at the very beginning of the operation, as more fully explained hereinafter. The desired block is thus formed, as it were, by winding the colored material in the form of a multiple thread of a screw. The colors are, for example, red, green and blue as is customary for purposes of color photography.

The continuously moving base or receiver is constituted, by way of example, by a rotating plate or disc which may be in the form of an annular, flat surfaced ring. It is also possible to employ an endless belt as the rotating receiver or base on which the layers of colored material may be deposited.

According to the invention, the distances between the various layer-forming devices or means above the continuously moving receiver are so chosen that each of the simultaneously applied colored layers has dried on or adhered to the receiver surface by the time it arrives at the next layer-forming device sufficiently to enable the next colored layer to be deposited on top of the already formed layer without danger of distorting the latter or of mingling the two layers or of the colors thereof. Preferably, these distances are so chosen that the individual layers thoroughly adhere to the receiver but are still slightly tacky or adhesive.

As indicated hereinabove, the invention contemplates the application of the colored layers onto a rotating disc or annular plate in spirally superposed relation with respect to one another, substantially in the manner of screw threads. In conjunction with this arrangement, it is possible to position between the various means for forming the colored layers additional devices for forming and depositing an intermediate adhesive or protective layer, for example, onto each colored layer prior to the application thereto of the next colored layer.

Understandably, as the thickness of the block increases on the continuously moving receiver, the distance between the receiver and the layer-forming means must be increased correspondingly to ensure that all colored layers formed are of uniform thickness. Drying of the colored layers, as by specially arranged drying means disposed between the various layer-forming means, can also be effected in accordance with the present invention, the type of drying action or drying means employed depending, of course, on the characteristics of the materials from which the colored layers are formed.

To carry out the process of the present invention, a number of different arrangements have been found to be suitable. An especially efficacious apparatus for this purpose consists of a rotating disc or plate which is automatically lowered with respect to the layer-forming devices located thereabove in direct correspondence with the thickness of the layers to be formed by said devices, as more fully explained hereinafter.

This renders it advisable to construct the apparatus in such a manner that the speed of rotation of the receiver plate may be adjusted independently of the speed of sinking or downward movement thereof. Consequently, adaptation of the apparatus to different types of materials which might be used, such as acetyl cellulose, nitrocellulose, suitable thermo-plastic synthetic materials and the like, as well as to the desired thicknesses of the individual colored layers of the multi-layer block to be formed is readily realized.

To the extent that thermoplastic synthetic materials are employed, it is also advisable to provide for controlled heating of the layer-forming means or of the receiver plate. In order to form layers of different thick-

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nesses in one and the same block, the spacing between the layer-forming devices along the continuously moving and sinking receiver can be suitably predetermined by constructing the devices for desired adjustment toward and away from one another.

The advantages accruing from the present invention may be seen from the fact that it is possible to manufacture in an extremely simplified manner blocks of a plurality of colored layers, as are employed in the production of colored-line screens for use in connection with additive color photography, continuously and with complete uniformity of thickness of the individual colored layers. It is, consequently, also possible to slice or peel thin films from such blocks to constitute high precision and extremely fine line screens which are much less expensive than any heretofore known.

These and other objects of the invention will become further apparent from the following detailed description, reference being made to the accompanying drawings showing preferred embodiments of the invention.

In the drawings:

Fig. 1 is a schematic front view of an apparatus for implementing the principles and procedures of the present invention;

Figs. 2 to 5 are, respectively, partly sectional schematic views of four different types of layer-forming devices usable with the apparatus of Fig. 1;

Figs. 6 and 7 are schematic illustrations of two types of arrangements for supplying layer-forming material to the layer-forming devices employed with the apparatus; and

Figs. 8 and 9 are two diagrammatic illustrations of different types of line screens produced in accordance with the present invention.

Referring now more particularly to Fig. 1, the apparatus of the present invention consists of a frame 1 mounted on a suitable base 1d and defining by means of its top 1f and shelves or platforms 1g and 1h a plurality of vertically spaced compartments 1a, 1b and 1c. Mounted on the base 1d and in the compartment 1c is a drive motor 2 which is connected by means of a belt 3 to a worm 4a meshing with a worm gear 4 connected to a rotatable vertical shaft 5 extending upwardly from the base.

Arranged on the shaft 5 in the compartment 1a is a gear 6, while a gear 7 is also arranged on the shaft 5 but in the compartment 1b. A gear 9 in the compartment 1a meshes with the gear 6 while a gear 9a meshes with the gear 7 in the compartment 1b.

A gear 8 located in the compartment 1a is connected by means of a key 12 to a central and rotatable shaft 11 and meshes with the gear 9, the key 12 permitting longitudinal or axial displacement of the shaft 11 relative to the frame 1 and the gear 8 while inhibiting relative rotation between the shaft 11 and the gear 8. Suitable means (not shown) may be provided in the compartment 1a to prevent vertical axial displacement of the gear 8 without interfering with the rotation thereof.

The lower part of the shaft 11 located in the compartments 1b and 1c is provided with external threads 11a meshing with internal threads of a gear 10, the outer teeth of which mesh with the gear 9a in the compartment 1b. The gear 10, which thus constitutes a nut for the shaft 11, may rotate relative to the shaft 11 so as to displace the same axially, suitable means (not shown) being, however, provided to prevent any axial displacement of the gear 10.

Fixedly connected to the upper end of the shaft 11 is a ring-shaped or annular plate or disc 13 which constitutes the receiver or base on which the desired block of colored layers is to be built up. The receiver 13 thus rotates together with the shaft 11.

Mounted on the upper end of the frame 1 and concentrically with the receiver 13 is an annular supporting structure or ring 1e on which a plurality of layer-form-

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ing devices 14, 14a and 14b are adjustably arranged at spaced locations with respect to one another and the path of rotary movement of the receiver. It will, of course, be understood that a different number of such devices could be employed, depending on the desired characteristics of the block to be produced.

Leading to the devices 14 and 14b are feed or supply conduits 15 and 15b, respectively, through which the layer-forming material is fed to said devices. A similar conduit is provided for each device, the conduit for the device 14a not being shown, however, for purposes of clarity.

Turning now to Figs. 2 to 5, it will be seen that the layer-forming devices may be constructed in a number of different ways for the purpose of pouring and/or spreading the relatively fluid material onto the receiver 13.

In Fig. 2, for example, the material is introduced from the feed conduit, such as 15 in Fig. 1, into an elongated hollow chamber or cavity 16 formed in the dispensing portion of the device. A narrow passageway communicates with the lower portion of said cavity to form a substantially slot-like nozzle 16a. The distance between the rear edge of the nozzle 16a and the upper surface of the receiver 13 may be adjusted by means of a threaded spindle 17.

Upon rotation of the receiver 13 in the direction of the arrow 18, the colored material flows from the nozzle 16a onto the receiver to the extent determined by the aforesaid spacing between said nozzle and said receiver, whereby the thickness of the layer is predetermined accordingly.

According to Fig. 3, the layer-forming device includes an elongated chamber 22 which communicates with a narrow passageway defining a slot-like nozzle 22a, the entire nozzle member being pivotally supported at 22b and biased against the surface of the receiver 13 by means of a spring 24 acting in the direction of the arrow 23. The biasing action of the spring ensures that the lower or rear portion 21 of the nozzle 22a rests on the surface of the receiver 13. The opposite and front portion 21a of the nozzle is spaced from the receiver 13.

Thus, the material flows from the hollow space or chamber 22, to which it was introduced by the feed conduit 15, for example, and through the nozzle 22a so as to be deposited on the surface of the receiver 13 in the form of a layer, the thickness of which depends on the distance between the nozzle portion 21a and the receiver surface.

Referring now to Fig. 4, the colored material, according to this embodiment of the invention, is fed into the chamber-like interior of a slotted tube 25, the slot-like and nozzle-constituting opening 25a thereof having a length substantially equal to the width of the receiving surface of the plate or annulus 13. The layer-forming material thus flows through the slot 25a onto the surface of the receiver 13 and builds up thereon into a small supply pile.

Upon rotation of the receiver in the direction of the arrow 18, the pile of material comes up against a spatula or spreader 27, the lower edge of which is spaced from the surface of the receiver, whereby a layer of material is formed on the latter with a thickness corresponding to the spacing between the edge of the spreader and the receiver surface. This space may be adjusted by means of a threaded spindle, not shown in Fig. 4 but resembling the spindle 17 shown in Fig. 2, the adjustment being measured and regulated by means of a dial gauge micrometer 28 or like indicating device.

Still a further type of layer-forming device is illustrated in Fig. 5 where, in a manner similar to that shown in Fig. 3, the material flows into an elongated cavity or chamber 32 and from the latter through a narrow passageway defining a nozzle 32a onto the surface of the receiver 13. The device of Fig. 5, however, does not employ a pendularly or pivotally supported nozzle as

shown in Fig. 3, adjustment being effected instead by means of a threaded spindle 31.

The thickness of the deposited layer of material is determined, in this embodiment of the invention, by the difference between the front portion or lip 30 and the rear portion or lip 29 of the nozzle 32a. The adjustment spindle 31 effects the requisite raising and lowering of the nozzle, the portion 29 thereof being, however, always maintained out of engagement with the receiver surface.

Referring now to Figs. 6 and 7, the means for supplying or feeding the layer-forming material to the devices 14, 14a etc., may be constructed in a number of different ways. In the embodiment of Fig. 6, the material flows from a reservoir or supply container 33 under the action of gravity through a conduit 35 controlled by a stop valve 34 and a regulating valve 36 into a pipe 25b which corresponds, for example, to the tube 25 shown in Fig. 4. Nevertheless, the pipe 25b may be considered as the equivalent of the chamber-and-nozzle structures 16-16a, 22-22a and 32-32a illustrated in Figs. 2, 3 and 5, respectively.

In the embodiment of Fig. 7, the layer-forming material is taken from a reservoir or supply container 37 through a conduit 39 controlled by a stop valve 38, feeding of the material being effected by means of a force pump or pressure pump 40. The latter transfers the material into a conduit 39a controlled by a suitable regulating valve 41 and thence to suitable nozzle means 25c located above the receiver 13.

The nozzle means 25c, of course, may be thought of as representing any one of the nozzles illustrated in Figs. 2 to 5. Excess material, which cannot flow through the regulating valve 41 due to the particular setting or adjustment thereof, is bypassed into a conduit 43 controlled by a spring-biased check valve 42 and thence through a conduit 44 back to the reservoir or container 37. Other types of check or one-way valves may, of course, be employed.

The operation of the apparatus according to the present invention is as follows:

The material, of which the block of layers is to be manufactured, is fed in appropriately colored conditions through the conduits 15, 15b etc. to the layer-forming devices 14, 14a, 14b etc. which may, by way of example, have any of the constructional characteristics illustrated in Figs. 2 to 5. The receiver 13 is set into rotation in the direction of the arrow 18 by actuation of the drive means 2 acting through the intermediary of the transmission system 3, 4a, 4, 5, 6, 9 and 8.

The material dispensing element or nozzle member of the device 14 is initially adjusted relative to the surface of the receiver 13 to ensure that the first layer of material deposited on the latter has the requisite and desired thickness. Upon rotation of the receiver, the deposited layer reaches the device 14a. During its travel, this layer is, however, dried as by air or heat derived from any suitable means located between the devices 14 and 14a, so that the next layer of material may be superposed onto the first layer by the device 14a.

The elevation of the latter must be initially adjusted to such an extent that the desired thickness of the second layer is attained. The above described procedure is now repeated as the receiver 13 rotates further, so that the second layer has dried by the time it arrives at the nozzle member of the device 14b preparatory to depositing of the third colored layer onto the second layer. As will be readily understood, the elevation of the device 14b must also be initially adjusted to correspond to the desired thickness of the third layer to be formed.

Although only three layer-forming devices are illustrated in Fig. 1, more may, of course, be employed, so that the first device deposits a colored layer, the second device a colorless separating or adhesive layer, the third device again a colored layer, the fourth device another

colorless adhesive or separating layer, the fifth device a third colored layer, and the sixth device still another colorless separating or adhesive layer.

Thus, the number of layer-forming devices will depend on the number of colored and colorless layers to be formed and united into a block.

During rotation of the receiver 13 in the direction of the arrow 18, the shaft 11 is lowered due to the interaction between the threads 11a and the interior threads of the nut-like gear 10. Should this gear be stationary, this downward movement or sinking of the shaft 11 would be of a certain predetermined magnitude.

In order, however, to attain a sinking of the shaft 11 and receiver 13 the magnitude of which is less than the aforesaid predetermined magnitude, the gear 10 is set into rotation through the intermediary of the transmission shaft 5. The desired ratio of rotational movement of the gears 10 and 8 is attained through the difference in the numbers of teeth of the gears 6 and 7 and may be varied by replacing the gear 6 with a gear having a different number of teeth.

The same result is attained by substituting for the gears 6 and 7 a mechanically variable transmission. At the beginning of the operation it is, therefore, essential that the various layer-forming devices 14, 14a, 14b etc. are so adjusted relative to the receiver 13 that the nozzle member of the first device is spaced from the receiver by an amount corresponding to the thickness of one layer in wet or pasty condition. The second device is so adjusted as to be spaced from the receiver by an amount corresponding to the thickness of one dried and one wet layer, while the third device is spaced from the receiver by an amount corresponding to the thickness of two dried and one wet layer. Corresponding adjustments are made for any additional layer-forming devices employed.

The downward or sinking movement of the receiver 13 must, however, be so adjusted by proper selection of the gear 6 that this downward movement corresponds to the thickness of one layer.

During the above described continuous operation, there will be produced a multi-layer block consisting of a plurality of differently colored layers arranged in alternating sequence and separated, if desired, by suitable colorless isolating or intermediate layers, all arranged in a screw thread-like manner. In contradistinction to the heretofore known multi-layer blocks of this type which were discontinuously constructed of individual sheets having finite boundaries and areas, the thickness of a block produced according to the principles of the present invention increases continuously up to the desired extent.

A color screen manufactured with the aid of the process of the present invention from blocks produced by the apparatus disclosed hereabove is especially suited for use in connection with additive color photography, to which end it is applied in the form of a thin film onto a suitable carrier element. When, for example, in a color film, the color screen and the image receiver are separated from one another it is advisable to employ an arrangement as illustrated in Figs. 8 and 9.

In Fig. 8, the line screen 45, which, merely by way of example, may be considered as being coated onto a glass plate (not shown), is divided into a plurality of diamond-shaped or rhombic fields 47 by a plurality of separating grooves 46 formed or cut into the screen after application of the latter to the glass plate. The grooves 46 thus extend obliquely with respect to the lines 48 of the screen.

According to Fig. 9, the screen 45 is constituted by a plurality of fields 49 arranged in the manner of a checker board and separated by grooves 46, the screen lines 48 of each field extending transversely to the screen lines in any laterally adjacent fields.

In each of these types of screens, the separating grooves 46 permit expansion of the individual fields, so that the latter cannot overlap or interfere with one another. The

material of which the carrier element is made must, however, have a relatively low coefficient of thermal expansion.

By way of résumé, therefore, the apparatus according to the present invention is arranged to effect relative translatory movement between a receiver surface and a plurality of sources of layer-forming material disposed adjacent the path of movement of the surface. Suitable transmission means including a variable or differential mechanical or hydraulic transmission are provided to effect concurrent translation of the receiver past the sources and retraction of the receiver from the sources.

The process according to the invention thus could be carried out, by way of example, by rotating the carrier ring 1e with the sources 14 etc. and raising the same during its rotation, or by rotating the carrier 1e while lowering the receiver 13.

Various changes and modifications may be made without departing from the spirit and scope of the present invention and it is intended that such obvious changes and modifications be embraced by the annexed claims.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. Apparatus for continuously forming a block from a plurality of layers of differently colored layer-forming materials, comprising a plurality of sources of said materials arranged at spaced locations, a receiver movably disposed adjacent said sources and having a surface on which said materials are to be deposited in timed sequence during movement of said receiver, drive means for said receiver, and transmission means operatively interconnecting said drive means with said receiver for translating the same past said sources and for simultaneously retracting said receiver from said sources to an extent corresponding to the desired thickness of each layer formed on said surface, said transmission means including respective means for varying the speed of translational movement and the speed of retractive movement of said receiver independently of one another.

2. Apparatus for continuously forming a block from a plurality of layers of differently colored layer-forming materials, comprising a plurality of sources of said materials arranged at spaced locations, a receiver movably disposed adjacent said sources and having a surface on which said materials are to be deposited in timed sequence during movement of said receiver, drive means for said receiver, transmission means operatively interconnecting said drive means with said receiver for translating the same past said sources and for simultaneously retracting said receiver from said sources to an extent corresponding to the desired thickness of each layer formed on said surface, and a rotatable shaft, said receiver being disc-shaped and arranged on said shaft and substantially concentrically therewith for joint rotation, said sources being arranged in a circle along the path of rotation of said surface of said receiver.

3. Apparatus according to claim 2, said transmission means including respective means both operated by said drive means for effecting said rotation of said shaft together with said receiver and for concurrently retracting said receiver axially from said sources, whereby the speed of rotation of said shaft and receiver may be varied independently of the speed of retraction thereof.

4. Apparatus for continuously forming a block from a plurality of layers of differently colored layer-forming materials, comprising a plurality of sources of said materials arranged at spaced locations, a receiver movably disposed adjacent said sources and having a surface on which said materials are to be deposited in timed sequence during movement of said receiver, drive means for said receiver, transmission means operatively interconnecting said drive means with said receiver for translating the same past said sources and for simultaneously retracting said receiver from said sources to an extent corresponding to the desired thickness of each layer formed on said sur-

face, said transmission means including first means for effecting translation of said receiver past said sources, second means for effecting retraction of said receiver from said sources, and a differential transmission interconnected between said first means and said second means.

5. Apparatus according to claim 4, said differential transmission comprising gear wheels having respective predetermined numbers of teeth and arranged for selective replacement by gear wheels having different numbers of teeth.

6. Apparatus according to claim 4, said differential transmission comprising an infinitely variable hydraulic transmission.

7. Apparatus for continuously forming a block from a plurality of layers of differently colored layer-forming materials, comprising a plurality of sources of said materials, a disk shaped receiver rotatably disposed adjacent said sources and having a planar surface on which said materials are to be deposited in timed sequence during movement of said receiver, said sources being arranged in a circle along the path of rotation of said surface of said receiver above said receiver, drive means for said receiver, and transmission means operatively interconnecting said drive means with said receiver for translating the same past said sources and for simultaneously retracting said receiver from said sources to an extent corresponding to the desired thickness of each layer formed on said surface, each of said sources including a nozzle member provided with a slot-like outlet opening for the respective material, and means operatively connected to said nozzles for displacing the same relative to said surface of said receiver, to thereby control the thickness of each layer formed on said surface.

8. Apparatus according to claim 7, each nozzle member being arranged for pivotal movement relative to said surface provided with front and rear lips defining said opening, said displacing means comprising spring means biasing said nozzle member in a direction to cause engagement between said rear lip and said surface, said front lip being shorter than said rear lip by an extent corresponding to the thickness of the layer to be formed thereby.

9. Apparatus according to claim 7, each nozzle member comprising an elongated tube provided with a longitudinal slot defining said opening, and spreader means arranged adjacent said tube and spaced from the latter in the direction of translatory movement of said receiver, whereby layer-forming material dispensed onto said receiver surface from each tube through said slot thereof is spread into layer formation by its respective spreader means.

10. Apparatus according to claim 7, further comprising a plurality of reservoirs for containing said differently colored materials to be fed to said nozzle members, respectively, conduit means interconnecting each reservoir with its respective nozzle member, and valve means in each conduit means for regulating the flow of layer-forming material therethrough.

11. Apparatus according to claim 10, said reservoirs being located at a higher elevation than said nozzle members, whereby said flow of material from said reservoirs to said nozzle members occurs due to the force of gravity.

12. Apparatus according to claim 10, said reservoirs being located at a lower elevation than said nozzle members, and force pump means arranged in each of said conduit means for positively feeding said materials from said reservoirs to said nozzle members, respectively.

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