July 30, 1968 A. S. TAYLOR ETAL 3,394,677

APPARATUS FOR SURFACE DYEING OF CAPSULES

Filed June 14, 1963 3 Sheets-Sheet 1

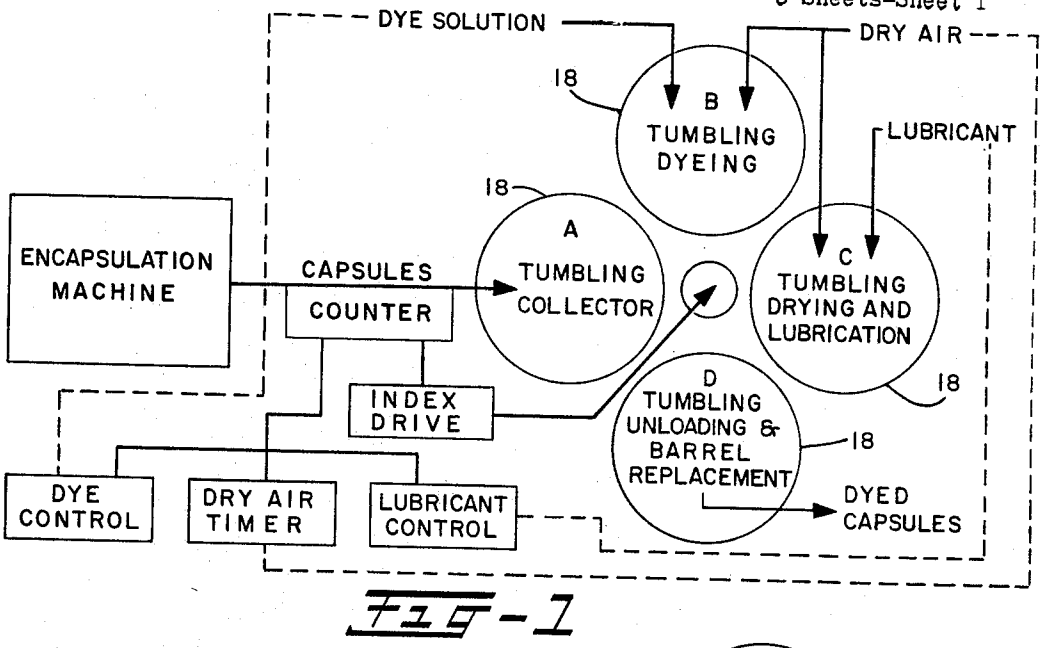


Fig-1

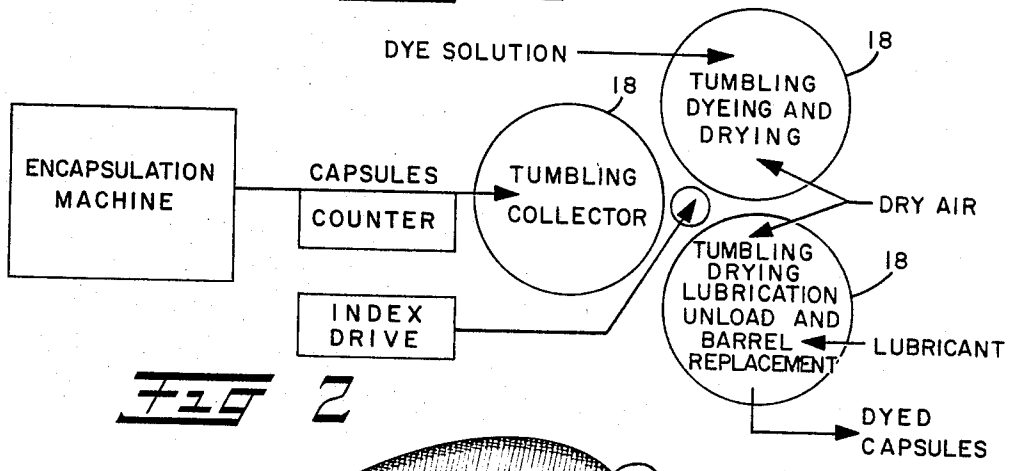


Fig 2

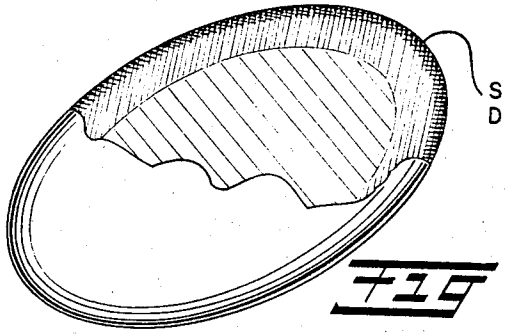


Fig 5

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APPARATUS FOR SURFACE DYEING OF CAPSULES

Filed June 14, 1963 3 Sheets-Sheet 2

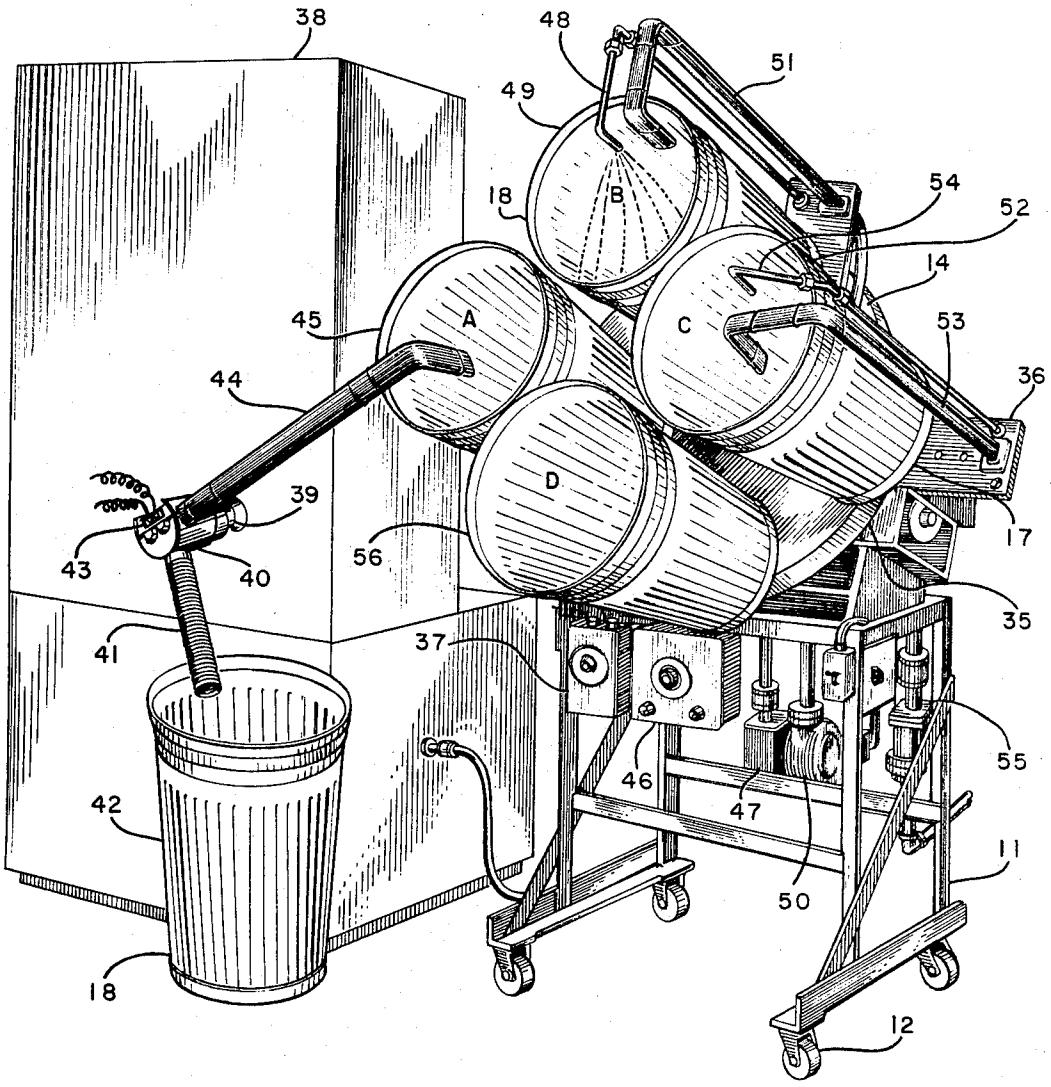


FIG-3

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APPARATUS FOR SURFACE DYEING OF CAPSULES

Filed June 14, 1963 3 Sheets-Sheet 3

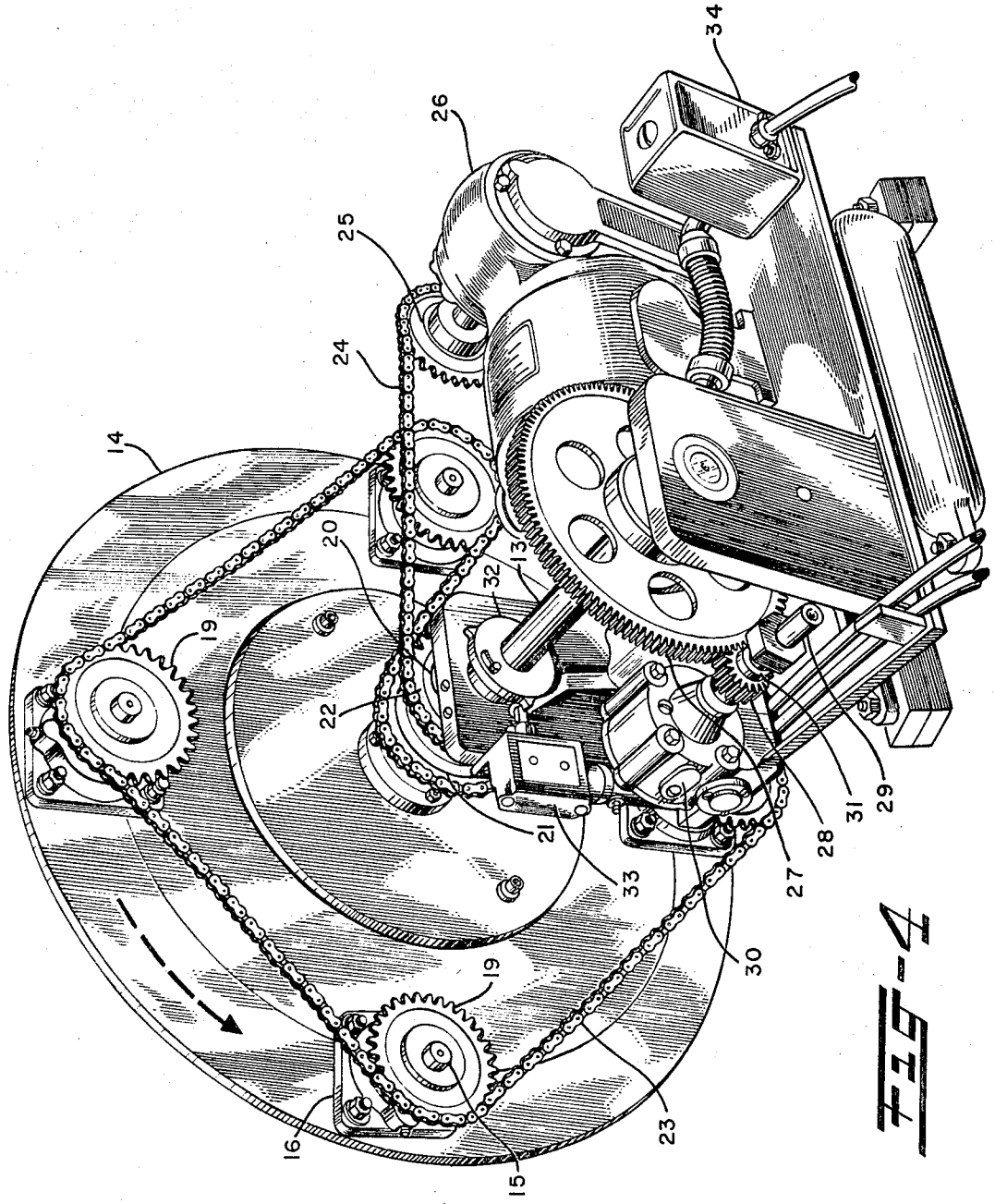


FIG. 4

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3,394,677

APPARATUS FOR SURFACE DYEING OF CAPSULES

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6 Claims. (Cl. 118—16)

ABSTRACT OF THE DISCLOSURE

A machine for coloring soft plastic capsules has a turntable shaft, a turntable thereon, three or four barrel shafts fixed on the turntable, and a barrel support holding a barrel cantilevered on each of these shafts. The barrels are indexed to 3 or 4 work positions. The barrels are rotated continuously, with capsules being fed as manufactured to the barrel in one position. Dye in a volatile solvent is fed into the barrel in another position, drying air passed into the barrel, and a lubricant introduced if desired, optionally at different work positions. The open-ended barrel can be removed from the barrel support to discharge dyed, at least partially dried capsules. The tumbling, dyeing, and drying cycles may be automated.

This invention relates to improvements in an apparatus for coloring plastic capsules, particularly soft gelatin capsules, in which the capsules are formed from a corresponding film which is either transparent or pigmented and which capsules are surface colored by tumbling with a solution containing dyes and dried, and the capsules so formed. Preferably the dyeing is accomplished on the wet capsules immediately after formation and the causules are coated with a lubricant as part of the process. Also, the invention includes a multiple-barrel tumbling apparatus for readily accomplishing the surface coloration. The capsules may have indicia on the surface when dyed.

Ingestible one-piece capsules, usually referred to as soft gelatin capsules, can be formed on machines such as disclosed in United States Patent 2,697,317, Stirn and Taylor, "Capsule Forming Die Roll," Dec. 21, 1954, from which the formed capsules are discharged in a current of air by an air conveyor. The film is conveniently formed from a mixture of primarily gelatin, glycerin and water, together with minor quantities of pigments, flavors and odors as desired, by methods such as disclosed in United States Patents 2,799,591, Michel and Knight, "Rapid Preparation of Encapsulation Formula," July 16, 1957; or 2,799,592, Hansen and Weidenheimer, "Rapid Preparation of Encapsulation Mixture," July 16, 1957; or 2,720,463, Stirn and Taylor, "Gelatin Capsule Casting Composition Preparation," Oct. 11, 1955. The gelatin composition may have other components, such as disclosed in United States Patent 2,770,553, Weidenheimer and Callahan, "Soft Gelatin Encapsulation," Nov. 13, 1956, showing certain amides, such as formamide or acetamide present; and United States Patent 2,776,220, Reed, Ritter, Valentine and Yen, "Gelatin Films and Capsules Made Therefrom," Jan. 1, 1957.

Gelatin substituents may be used and hence the film in its broader sense is a pressure sealable plastic, referred to as plastic strip. Present commercial practice uses gelatin films exclusively—hence the invention is described with particular reference to gelatin films.

After the manufacture of the capsules, such capsules have been dried in drum dryers, such as disclosed in United States Patent 2,638,686, Stirn and Taylor, "Drying Gelatin Capsules," May 19, 1953. Such capsules can be marked with an ink during manufacture, such as disclosed in United States Patent 2,624,163, Stirn, "Method of Making Colored Gelatin Capsules," Jan. 6, 1953; or 2,821,821, Yen, "Marking Gelatin Capsules," Feb. 4, 1958; or 2,929,320, Hansen and Glorig, "Machine for Marking Capsules," Mar. 22, 1960.

Many dyes are known to be toxic. Others have a comparatively low toxicity so that their use is approved for food, drug and cosmetic use, but even of those which are approved, additional evidence indicates that under at least some conditions it may be desirable to minimize the content of dyes which may be ingested.

The coloring of capsules is very useful for identification during manufacture, distribution and sale. It is additionally important in the hands of the final user as the patient when using capsules could easily confuse identity. It is not uncommon for a patient to be taking several different kinds of medication. Even though not approved by the medical profession, the patient may put an entire day's supply of tablets and capsules in a single container, with a mental reservation that he takes a pink one at one hour, a green one at another hour, and a blue one, etc. Unique colors are also useful to prevent "passing off," that is the sale of substitutes in the retail channels of trade, and serve as a reminder to the physician and druggist in identifying capsules. Hence there is a conflict between a desire to reduce the dye content, and a requirement for color for identification. If the surface of the gelatin strip from which a capsule is formed is colored, during the cutting out procedures a narrow uncolored strip is formed at the line of the seal which accentuates any irregularities in the seal line. Such capsules are, of course, clearly identifiable and are desirable at times as an additional identifying ornamentation.

We have now found that plastic capsules can be formed from an undyed plastic strip, particularly a gelatin composition, which strip may contain pigments such as titanium dioxide, calcium carbonate, barium sulfate, alumina, iron oxides or charcoal, to give either a white, gray or other color capsule and the outside surface only of the film forming the shell of the capsule is then colored by dyeing—giving capsules having a markedly lower quantity of dye than would be the case if the entire film were dyed. The appearance is elegant.

The capsules can be marked as by a printing process with identifying indicia either before or after dyeing by the choice of a marking fluid which gives a contrasting shade or color to the marking indicia.

Although the surface dyeing may be accomplished as a separate step, it is advantageous to accomplish the dyeing as part of a continuous operation. If the dyeing is accomplished as a line operation sequential to the formation, labor and handling is minimized, the entire coloring can be part of a single manufacturing operation under the control of a minimum crew, and the possibility of confusion of identity before dyeing is eliminated. While the possibility of a workman dyeing a batch of capsules the wrong color is remote, it is nonetheless desirable to take any steps which can minimize the possibility. If the capsules are dyed after formation, the residual web is of course undyed and may be more easily used as a component of subsequent gelatin formulations.

Any dye which is soluble in a solvent compatible with the film composition can be used. Water-soluble dyes can be added in water but usually dyes are preferred which are soluble in mixtures of lower alcohols and water as such dyes penetrate into the capsule surface more readily and the solvent system can be evaporated from the capsules.

Methanol is toxic, so usually its use is undesirable because care is required to remove all of it. Ethanol is technically very satisfactory, but in the United States at present taxation problems arise. Propanol or isopropanol are technically excellent, and available and economical. Tertiary-butanol is good, but slower in drying. Polyhydric alcohols, acetone, other ketones and other volatile water-miscible solvents may be used. From 25% to 75% alcohol in water is preferred (volume/volume basis).

For non-medicinal purposes any dyestuff may be used which has a satisfactory solubility and color. For most purposes non-toxic dyes are preferred. Among the dyes which are presently acceptable for food and drug use are those described in the article entitled "Colors for Food, Drugs and Cosmetics," published in the Encyclopedia of Technology, the Interscience Encyclopedia, Inc., 1949, vol. 4, pages 287–313. This encyclopedia describes the production and use of various colors, giving the name and formula for the Food, Drug and Cosmetic dyes which are soluble colors. The FD & C alcohol-soluble dyes there listed are excellent for present purposes. Whereas dyes not presently known to be non-toxic can be used, and are acceptable on proof of non-toxicity, the time for and cost of proof of non-toxicity is such that for commercial purposes the dyes known to be acceptable are very much a matter of choice.

The quantity of dye to be used can vary over very wide limits. The strength of the dye and the depth of color required, for a preferred value and chroma, are controlling factors. For capsules in general, a wide variation in color can be used. For any specific batch of capsules, a rather precise quantity of dye is required so that the finished capsules match arbitrary standards within acceptable limits, usually very narrow limits. A drug manufacturer sets a standard for a particular product and wants all batches to appear the same to the ultimate consumer.

The reduction in dye content of surface-dyed capsules over film-dyed capsules in which the entire film is colored, is at least about 70% and usually more. The actual dye content for any one capsule can vary over fairly wide limits, depending upon the dye strength and the intensity desired. Reproducibility of color is excellent. A water-soluble flavor or perfume can be added to the dye solution to introduce a flavor or odor at this point. Flavors such as cherry, lemon, lime, orange, raspberry, vanilla, and Ethavan® synthetic vanilla are suitable.

While the present invention is particularly meritorious with wet capsules, as these are formed, dried capsules can be dyed. The dry capsules usually require somewhat longer tumbling action with the dye solution to get even penetration. The surface of dried capsules must be free from uneven coating or uneven oily components to get even penetration.

The scope of the present invention is as set forth in the appended claims. The examples show certain embodiments in detail. One embodiment of our novel machine for the surface dyeing of capsules is shown in the accompanying drawings in which:

FIGURE 1 is a diagrammatic view showing the process steps of a four-barrel modification of the machine.

FIGURE 2 is a similar drawing of a three-barrel modification of the machine.

FIGURE 3 shows a pictorial view of the assembled machine.

FIGURE 4 is a partial view showing the drive mechanisms with safety guards removed.

FIGURE 5 is a representation of the final surface colored capsule.

Although one particular modification is shown in these drawings, it is to be understood that a mechanic skilled in the art may readily substitute mechanical equivalents for particular features.

For convenience and mobility the apparatus is built on a support frame **11**, mounted on casters **12**. In the support frame is journaled a turntable shaft **13**, which is at an angle, conveniently from 10° to 45° with the horizontal; 15° gives preferred results. On the turntable shaft is a turntable **14**. Journaled in the turntable shaft are four barrel shafts **15**. Conventional pillow block bearings **16** are used. On the upper end of the barrel shafts are located barrel supports **17**. The barrel supports each hold a plastic barrel **18**. Conveniently the plastic barrels are corrugated polyethylene or polypropylene barrels formed by molding as one-piece plastic barrels. A twenty-gallon size is convenient as such a barrel is big enough to hold a worthwhile number of capsules and is small enough for one man to handle a barrel containing capsules without difficulty. Such barrels are readily commercially available, being sold for such diverse uses as shipping containers for exotic chemicals, storage barrels for fruits and vegetables, and waste paper and garbage baskets. The barrel support **17** is of a size adapted to hold the particular plastic barrels being used at a given time. Because most barrels are tapered so that they stack, for convenience and molding the barrel support may be a barrel clamped to the upper end of the barrel shaft; or may be a stainless steel frame of rods. It should be of non-corrodible composition and readily cleaned. At the other end of the barrel shaft is a barrel shaft sprocket **19**.

Mounted on the turntable shaft is a coaxial sprocket hub **20** having a shaft drive sprocket **21** and a drive sprocket **22**. A barrel drive chain **23** is mounted around each of the barrel shaft sprockets **19**, and between two of them extends around the shaft drive sprocket **21**. A main drive chain **24** extends over the drive sprocket **22** and a motor sprocket **25** mounted on a reduction drive motor **26**.

The reduction drive motor **26** drives its motor sprocket **25** and through the main drive chain **24** causes the coaxial sprocket hub with shaft drive sprocket **21** to rotate. The drive shaft sprocket **21** through the barrel drive chain **23** in turn causes each of the barrel shafts **15** and the associated barrels **18** to rotate. The barrels should rotate fast enough to give a tumbling action to the capsules contained therein, and well below the critical speed at which capsules would be held against the sides of the barrel by centrifugal force. A speed of 30 to 60 revolutions per minute gives good results. For the appended examples, a speed of 40 revolutions per minute was selected.

The barrel drive system is thus independent of the angular position of the turntable and the barrels can be kept turning continuously independent of the rotation of the turntable. A short interruption of barrel rotation does no harm, but is not necessary as the barrels can be removed from and inserted in the barrel holders while the barrel holder is rotating and a means to interrupt the rotation is an unnecessary embellishment.

On the turntable shaft **13** is a turntable shaft gear **27** which in turn is driven by a turntable pinion gear **28**. The turntable pinion gear is mounted on an indexing motor shaft **29**. The indexing motor assembly **30** is an electric motor with an associated reduction drive to turn the indexing motor shaft. Between the indexing motor shaft and the turntable pinion gear is a slip clutch **31**. This is a conventional slip clutch; conveniently a driven member between spring loaded driving members; so that the starting and stopping of the rotation of the turntable is cushioned and if any of the equipment is jammed accidentally, slippage occurs without damage to the mechanism or operator.

An indexing cam **32** is adjustably mounted on the turntable shaft **13** and in turn has cam points operating the indexing switch **33**, the functioning of which is described later.

The reduction drive motor **26** is controlled by a tumbling switch **34**, which controls the barrel rotating action.

As shown in FIGURE 3, a drive safety shield **35** is placed over the barrel drive chain system to protect the operator from getting caught in the sprocket drive and to act as a grease catcher. Similarly, the turntable shaft and its associated mechanism is protected by a safety cover **36** which serves to enclose the drive system and also serves as a support for certain nozzles, as later described.

Also mounted on the support frame is a capsule counter **37**. The encapsulation machine **38** is shown diagrammatically. From the encapsulation machine the capsules are conveyed in an air stream by an air conveyor **39**. In the air conveyor is a conveyor valve **40** which in one position diverts capsules through a waste chute **41** to a waste container **42**. During start up and adjustment, capsules not known to be perfect are diverted through the waste chute to the waste container. On the conveyor valve **40** is a mercury switch **43** which closes only when the conveyor valve **40** is in position to feed capsules through the capsule transfer duct **44** which discharges capsules into the barrel at a first barrel position **45**, lettered as position A. The mercury switch **43** controls the capsule counter **37**. The capsule counter is synchronized with the speed of the encapsulation machine and counts capsules only while capsules are being fed through the capsule transfer duct **44**. The counter is preset to a capsule batch number and when a desired number of capsules have been introduced into the barrel in position A starts the rotation of the indexing motor assembly. From 1,000 to 16,000 capsules is a convenient batch size, depending in part on capsule size.

When the turntable shaft is rotated one-quarter turn the indexing cam **32** through the indexing switch **33** stops the rotation of the turntable. The counter also then actuates a sequence controller **46** which includes a dye control that actuates a dye solution pump **47** which injects a dye solution through a dye nozzle **48** into the rotating barrel containing capsules at the dyeing barrel position **49**, designated as position B. For best results, a multiple jet nozzle is preferred. A spray may produce a mist that causes loss of dye. Too coarse a nozzle, impinging at a single point, may cause uneven dyeing. A nozzle having fine streams that impinge diagonally across the face of the tumbling capsule mass gives excellent results over a wide range of coloring conditions.

The sequence controller also includes a dry air timer that controls a dry air blower **50** which blows dry air through a dry air pipe **51** into the barrel in position B. The sequence controller operates the dry air control valves and regulates the interval between dye addition and air drying, and also turns off the air before the capsules are overdried if for some reason the encapsulation machine does not keep up with the drying cycle.

In a drying and lubrication position **52**, designated as position C, a second dry air pipe **53** directs additional dry air on the capsules. Also in this position a lubricant nozzle **54**, fed by a lubricant pump **55**, in turn operated by a lubricant control, which is part of the sequence controller **46**, directs a lubricant on to the capsules as they are tumbling, which gives a slightly soft sheen to the surface and prevents the capsules from sticking to each other. The fourth position is a loading and unloading position **56**, designated as position D. At this point the machine operator removes the barrel containing the dyed and lubricated capsules and replaces the barrel with an empty barrel ready for the next cycle. More than four operating positions can be used; four is preferred as these are enough stations for flexibility, and the machine is of convenient size. An alternative operating procedure uses station B to dry the marking on printed capsules using the air blower. Station C is fitted with a dye nozzle, and dyeing, drying and lubrication are performed sequentially at this station.

As shown in FIGURE 2, all operations can be conducted in three positions, although the nozzles may complicate barrel loading and unloading; and the timing of unloading may be less flexible.

The dye is conveniently added promptly if dried capsules are being colored. With wet capsules, that is freshly formed capsules, preferably the capsules are tumbled for a time to shape and permit the capsules to partially dry before dyeing. Hence it is advantageous to use the second barrel position to hold and tumble the capsules, the third to dye, dry and either the third or fourth position to add the lubricant. Drying air can be introduced in all positions, although such introduction is normally mandatory only after the addition of the dye solution. Where large barrels are used, at lower production rates, ambient air currents may be enough to dry, depending on fan locations, and air movement in the encapsulation room. Other variations within the scope of the appended claims are obvious to those skilled in the art.

As common in pharmaceutical practice, percentages are based on volume of liquids and weights of solids. Where not otherwise specified, the abbreviation w./v. for weight solids/volume of liquid, based on unit density for water or v./v. is used in part for clarity.

Example 1

A gelatin mix was prepared as described in Example 5 of United States Patent 2,799,591, supra, except that the red dye and red pigment were omitted. The gelatin was cast as a continuous strip and capsules were formed therefrom, as described in United States Patent 2,697,317, supra. 4,000 capsules were manufactured in a flat oval size, the surface of which in finished form is approximately 493 square millimeters. (Capsules are about 21.8 mm. long and about 7.2 mm. in diameter.) 4,000 capsules were counted into a polyethylene tumbling barrel, the apparatus indexed and in the dye position 75 ml. of a dye solution containing 0.5% by weight of FD & C Blue No. 1 in a 50% by volume mixture of isopropanol and water was added automatically by the dye pump over a period of about 15 seconds, in 5 jets across the face of the tumbling capsule mass. The capsules were tumbled for two minutes to smoothly and uniformly coat all of the capsules with the dye solution and then a current of room air was blown on the capsules for two minutes, at the end of which time all of the dye solution was either absorbed in the capsules or evaporated. 8 grams of powdered stearyl alcohol was dusted on the surface of the tumbling capsules by hand, and during an additional two-minute tumbling period spread over the capsule surfaces. The entire operation was carried out at normal operating room conditions of 68° F. and 35% relative humidity.

The barrel containing the capsules was then removed from the machine and the capsules were transferred to trays and spread out in a single layer. The capsules were then put in a dry room and allowed to remain until dry. The capsules are uniformly and evenly dyed. The capsules can be coated with an air drying resin such as disclosed in United States Patent 2,727,833, Yen and Stirn, "Capsule Finishing Process," Dec. 20, 1955, if desired.

Example 2

The dye in Example 1 is present to the extent of about 94 micrograms per capsule. The procedure of Example 1 is repeated using a concentration of 1.0% of FD & C Blue No. 1 in the dye solution. The capsules have about 188 mcg. per capsule and are a deeper blue than obtained in Example 1.

The run is repeated using 0.5% solution of FD & C Red No. 2, and containing 0.1% Ethavan® as a flavor. A red capsule is obtained.

Example 3

Using the gelatin formula and encapsulation machine referred to in Example 1, capsules are produced having a surface area of about 657 square millimeters with a length of about 25.4 mm. and a diameter of 8.25 mm. 4,000 such capsules as they come from the encapsulation machine

are collected in a rotating barrel, rotating at 30 r.p.m., the barrel is indexed to the dyeing position, position B, rotated for 6 minutes, and thereto is then added 150 ml. of 50% isopropanol, in water, v./v., containing 0.058%, weight per unit of volume, of FD & C Violet No. 1, and 1.442% weight per unit of volume of FD & C Red No. 4.

After tumbling for about 4 minutes air is turned into the tumbling drum and the capsules are dried by air for an additional 6 minutes, after which 10 ml. of 5% weight/volume of stearyl alcohol in isopropanol is added by the automatic sequence controlled pump in position C, and the capsules are allowed to continue tumbling for another 4 minutes and drying air is introduced. Tumbling is continued for several minutes until in a 4-barrel machine the barrel is indexed to the loading and unloading position, position D, after which the barrel containing the capsules is removed. The capsules are spread in a single layer in drying trays and dried.

The length of time capsules are tumbled after the addition of a lubricant before they are unloaded is not important and hence for production purposes the capsules are permitted to continue tumbling with or without air being blown upon them until subsequent batches of capsules are ready for dyeing. If, for example, the encapsulation rate is 400 per minute, and 4,000 capsules are used in a batch, the holding time is ten minutes per station for continuous production. If difficulties in encapsulation delay the production rate, a longer tumbling has no harmful effect on the final capsules. As the barrel is at the unloading and barrel replacing station for ten minutes, the operator may remove the barrel containing capsules and replace it with an empty barrel at his convenience at any time during this ten-minute period.

Example 4

Using the encapsulation machine and the general formula of Example 1, two batches of capsules are produced in which for one strip the formula of Example 1 is used and for the other strip a similar formula, except that the titanium dioxide is omitted, is used. A printer is used to print on the surface of the titanium dioxide containing strip using the procedure described in United States Patent 2,821,821, supra.

A three-barrel machine, such as shown diagrammatically in FIGURE 2 is used. After 4,000 capsules are collected the machine indexes and tumbling is continued with drying air for only 8 minutes to permit the printing to dry. 100 ml. of a 50% v./v. isopropanol-water solution containing 0.05% w./v. FD & C Red No. 4 dye is then added. Tumbling is continued for three minutes, the machine then indexes and 10 ml. of a 5% w./v. solution of stearyl alcohol in isopropanol is added. Tumbling and drying air is continued for five minutes, after which the dyed capsules may be removed at the operator's convenience, at any time prior to the next indexing step.

The dye and lubricant may be added by hand, for small scale operations. The automatic addition is preferred in larger installations.

Example 5

The gelatin strips are cast from a gelatin formulation containing 0.45% red iron oxide pigment (Mapico Crimson 88) and 0.15% titanium dioxide. A printer is used to print on the surface of one strip using the procedure described in United States Patent 2,821,821, supra. In the case of printed capsules, it is advantageous to use the four-barrel machine, so that one stage, stage B, can be used to dry the print under a current of air, before dyeing takes place at stage C.

The capsules are spheroidal in shape, each having a surface area of 202 mm.^{2}, the major axis of the capsule measures 11.5 mm. and the minor axis measures 6.4 millimeters. After 13,000 are collected, the machine indexes and tumbling is continued under a current of drying air. After the machine again indexes, 100 milliliters of a solution of FD & C Red No. 2, 0.7% w./v., in 50% v./v. isopropanol-water is added in position C. After tumbling 2 minutes, air is introduced into the tumbler and continued until the machine again indexes. The capsules are lubricated by adding 8 grams of stearyl alcohol and removed.

Example 6

Using the red pigmented gelatin formulation described in Example 5, gelatin capsules having a surface area of 657 mm.^{2}, and pre-printed using a pigment printer and white pigment ink are produced. Six batches of 4,000 each of such capsules are collected in succession. The rate of collection is such that the machine indexes approximately every 8 minutes.

Each of the six batches is successively dyed using 100 ml. of six different dye solutions. The dye solutions are applied by hand over the area of the tumbling capsule mass, to get even spreading, but omitting operation of the dye solution pump. The procedure as described in Example 5 is otherwise followed. The compositions of the six dye solutions used are as follows:

(1) FD & C Red No. 2, 0.7% w./v. in 50% isopropanol-water
(2) FD & C Violet No. 1, 0.1% w./v. in 50% isopropanol-water
(3) FD & C Red No. 2, 0.7% w./v., FD & C Red No. 4, 0.35% w./v. in 50% v./v. isopropanol-water
(4) FD & C Blue No. 1, 1.0% w./v. in 50% v./v. isopropanol-water
(5) FD & C Yellow No. 5, 1.0% w./v. in 50% v./v. isopropanol-water
(6) FD & C Green No. 3, 1.0% w./v. in 50% v./v. isopropanol-water

In each case the applied dye modified the original red pigmented gelatin resulting in six new and different colors. The print also assumes slight coloration from the applied dye. Each batch of capsules is colored a distinctively different color, each with its own distinguishing imprint.

Example 7

Two gelatin formulations, one identical to that used in Example 1, and the other similar to it, except the titanium dioxide is replaced by 0.1% charcoal, are cast into strips simultaneously as in Example 4. The titanium-containing strip is printed as described in Example 4.

Using the 4 tumbler machine and procedure as in Example 5, 6160 capsules of 428 mm.^{2} surface area each are collected, dyed and lubricated. A particular capsule color sought was closely approximated by using 100 ml. of a dye solution of the following formula:

FD & C Red No. 2	percent w./v.	0.106
FD & C Red No. 4	do	0.276
FD & C Yellow No. 5	do	0.043
Isopropanol	percent	50

Water, v./v., enought to make 100%.

Orange and black printed capsules containing a total of 69 mcg. dye each were obtained.

From the above examples, it can be seen that a wide range of dye values can be used to color the capsules. In one instance with spheroidal capsules having a surface area of 657 square millimeters, it was found that 50 micrograms of dye gave the same surface color as on capsules containing 750 mcg. of dye where the dye is added to the gelatin formula to color the entire gelatin formula before it is cast into strips, from which the capsules are formed. This is a ratio of 1/15 of dye usage.

As typical of the ranges to be expected, the following is given as a table of certain commercial products showing the micrograms of dye used for gelatin dyeing where the entire gelatin formula is used, as compared with the quantity of dye per capsule with surface-dyed capsules.

TABLE I

Capsule	Gelatin Dyed Standard, mcg.	Surface Dyed mcg.
M	356	75
N	1,582	93.7
O	1,005	150
P	1,784	563
Q	880	250

Although the quantity of dye used may vary over wide limits, to obtain consistent color results for a given product, the quantity of dye should be held within 5%. The rate of application per unit of surface should be the same to get the same color for various size capsules of a given product, for example, in products which are manufactured in more than one dosage strength, where matching of color is desired. The uniformity of color obtained with surface dyeing is at least as great as when using dyes in the gelatin mix to color the entire gelatin mixture and is usually greater. Hence, for production purposes more even coloration can be obtained.

Surprisingly, the omission of dye from the casting formulation permits faster stripping of the cast gelatin formula from the casting wheel, and hence faster operation of the encapsulation machines. Also, the gelatin composition degrades more slowly in the absence of dye, so that the strip not used, and residual web may be used at higher concentrations in subsequent batches of gelatin formulations.

We claim:

1. A machine for continuously coloring soft plastic capsules comprising: a turntable shaft at an angle of about 10° to 45° with the horizontal, a turntable thereon, turntable shaft rotating means to intermittently rotate the turntable, shaft associated indexing means to control the angular position of the turntable, a plurality of short barrel shafts symmetrically mounted on said turntable concentric with said turntable shaft and adapted to be each located in a plurality of sequential operating positions as the turntable is indexed, means to substantially continuously rotate said barrel shafts, a barrel support on the upper end of each barrel shaft, a readily removable open-ended barrel in each barrel support, means to continuously supply filled soft plastic capsules to a first barrel position, means to add a volatile liquid dye composition at a following barrel position, and means to introduce drying air in at least one barrel position.

2. A machine for continuously coloring soft plastic capsules comprising: a turntable shaft at an angle of about 10° to 45° with the horizontal, a turntable thereon, turntable shaft rotating means to intermittently rotate the turntable, shaft associated indexing means to control the angular position of the turntable, a plurality of short barrel shafts symmetrically mounted on said turntable concentric with said turntable shaft and adapted to be each located in a plurality of sequential operating positions as the turntable is indexed, means to substantially continuously rotate said barrel shafts, a barrel support on the upper end of each barrel shaft, a readily removable open-ended barrel in each barrel support, means to continuously supply filled soft plastic capsules to a first barrel position, means to add and evenly distribute a volatile liquid dye composition at a second barrel position, and means to introduce drying air in at least one barrel position.

3. A machine for continuously coloring soft plastic capsules comprising: a turntable shaft at an angle of about 10° to 45° with the horizontal, a turntable thereon, turntable shaft rotating means to intermittently rotate the turntable, shaft associated indexing means to control the angular position of the turntable in one of four positions, four short barrel shafts symmetrically mounted on said turntable concentric with said turntable shaft and adapted to be each located in each of four sequential operating positions as the turntable is indexed, means to substantially continuously rotate said barrel shafts, a barrel support on the upper end of each barrel shaft, a readily removable open-ended barrel in each barrel support, means to continuously supply filled soft plastic capsules to a first barrel position, means to add a volatile liquid dye composition at a second barrel position, means to introduce a liquid lubricant at a third barrel position, and means to introduce drying air at selected times into the barrels in positions two and three.

4. A machine for continuously coloring soft plastic capsules comprising: a turntable shaft at an angle of about 10° to 45° with the horizontal, a turntable thereon, turntable shaft rotating means to intermittently rotate the turntable, shaft associated indexing means to control the angular position of the turntable in one of four positions, four short barrel shafts symmetrically mounted on said turntable concentric with said turntable shaft and adapted to be each located in each of four sequential operating positions as the turntable is indexed, means to substantially continuously rotate said barrel shafts, a barrel support on the upper end of each barrel shaft, a readily removable open-ended barrel in each barrel support, means to continuously supply filled soft plastic capsules to a first barrel position, means to add a volatile liquid dye composition at a second barrel position, means to introduce a liquid lubricant, and means to introduce drying air at selected times into the barrel in position three.

5. A machine for continuously coloring soft gelatin capsules comprising: a turntable shaft at an angle of about 10° to 45° with the horizontal, a turntable thereon, a turntable shaft rotating means to intermittently rotate the turntable, shaft associated indexing means to control the angular position of the turntable, a plurality of short barrel shafts symmetrically mounted on said turntable concentric with said turntable shaft and adapted to be each located in a plurality of sequential operating positions as the turntable is indexed, means to substantially continuously rotate said barrel shafts, a barrel support on the upper end of each barrel shaft, a readily removable open-ended barrel in each barrel support, means to continuously supply filled soft gelatin capsules to a first barrel position, means to count the number of capsules supplied, means to turn the turntable one position after a predetermined number if capsules have been introduced, means to add a predetermined quantity of volatile liquid dye composition at a selected time to the contents of the barrel in the second barrel position, means to add a selected quantity of a lubricant at a selected time to the contents of the third barrel position and means to introduce drying air at selected times to the barrels in positions two and three.

6. A machine for continuously coloring soft gelatin capsules comprising: a turntable shaft at an angle of about 10° to 45° with the horizontal, a turntable thereon, a turntable shaft rotating means to intermittently rotate the turntable, shaft associated indexing means to control the angular position of the turntable, a plurality of short barrel shafts symmetrically mounted on said turntable concentric with said turntable shaft and adapted to be each located in a plurality of sequential operating positions as the turntable is indexed, means to substantially continuously rotate said barrel shafts, a barrel support on the upper end of each barrel shaft, a readily removable open-ended barrel in each barrel support, means to continuously supply filled soft gelatin capsules to a first barrel position, means to count the number of capsules supplied, means to turn the turntable one position after a predetermined number of capsules have been introduced, means to add a predetermined quantity of volatile liquid dye composition at a selected time to the contents of the barrel in the second barrel position, means to add a selected quantity of a lubricant at a selected time to the contents of the barrel after the dye is introduced, and means to introduce drying air at selected times to the barrel.

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