# United States Patent

**Heiss et al.**

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## [54] METHOD AND APPARATUS FOR TINTING PAINT


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[51] **Int. Cl.** ..... **B65b 1/04,** B65b 3/04

[58] **Field of Search** ..... 141/89–93, 48, 141/63, 65, 66, 1, 9, 3, 99–107, 128, 20



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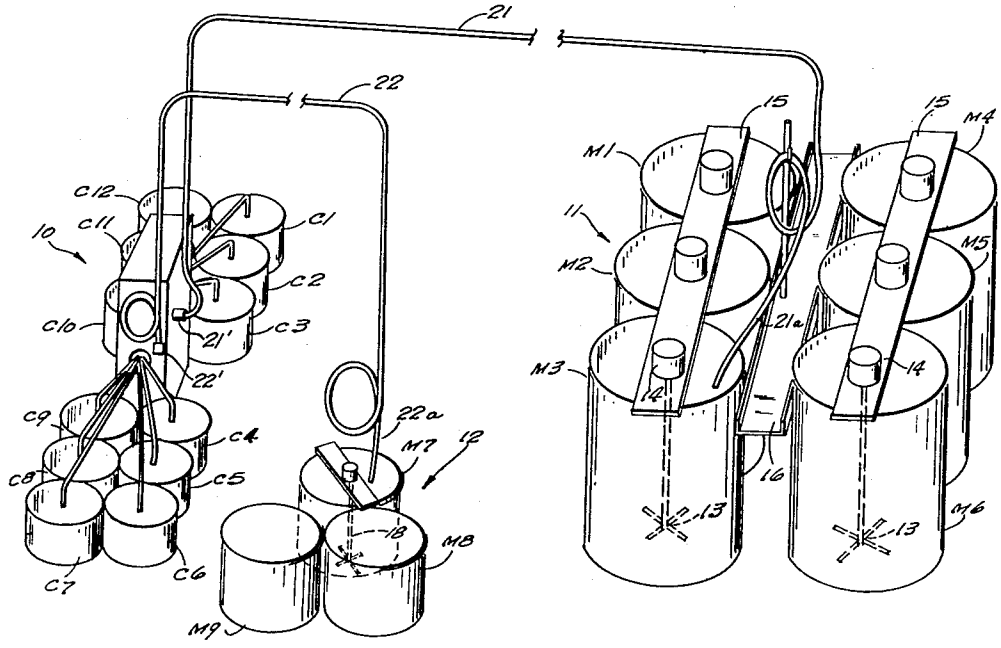
[57] **ABSTRACT**

A method and apparatus for batch tinting paint by adding preselected amounts of selected paint colorants to a batch of base paint in a paint vessel at a mixing station. The different paint colorants are stored at a colorant storage station, and a charge of paint colorant consisting of preselected amounts of one or more selected paint colorants to be used in tinting a batch of base paint are delivered to the inlet end of a single tube delivery line extending from the storage station to the mixing station. The charge of paint colorant is thereafter purged from the line and delivered to the mixing vessel by passing a purging fluid including a purging liquid compatible with the colorant into the line while delivering the purging liquid and colorant to the mixing vessel.


**14 Claims, 6 Drawing Figures**



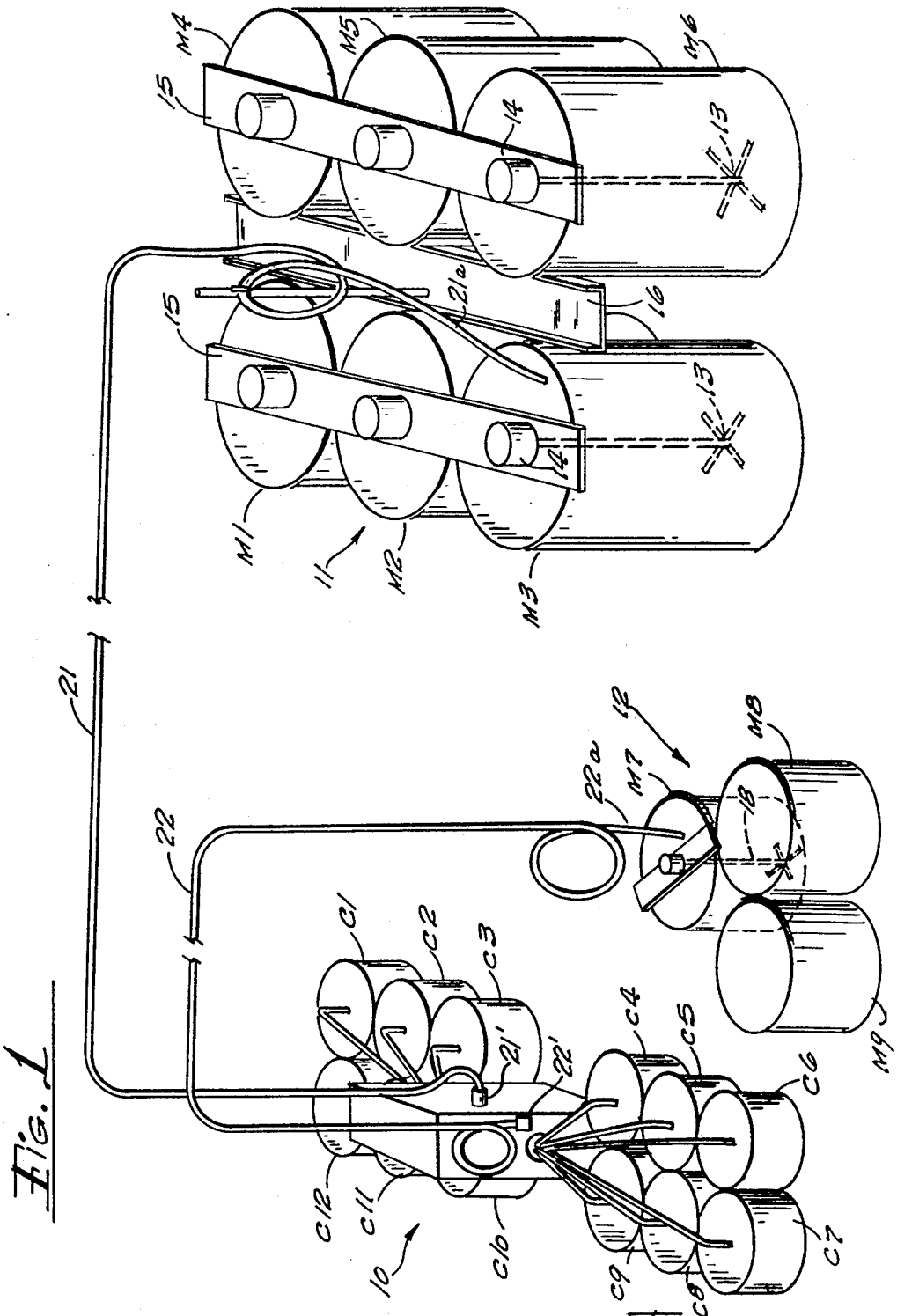



Fig. 1

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Fig. 2

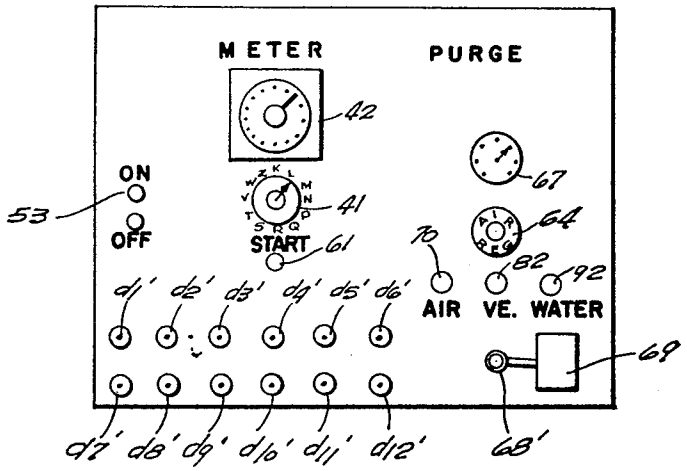


Fig. 3

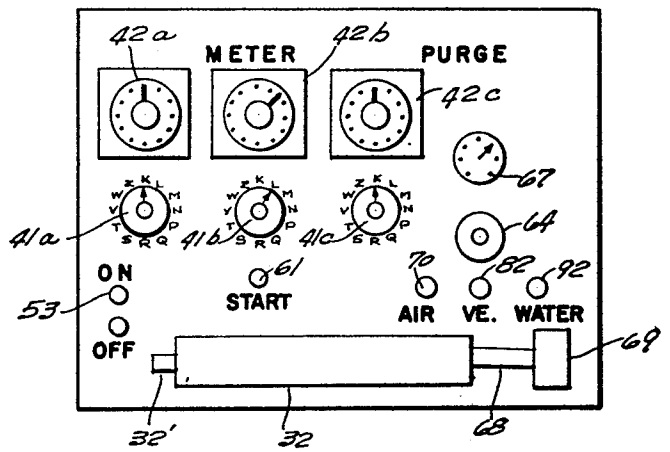


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FIG. 4

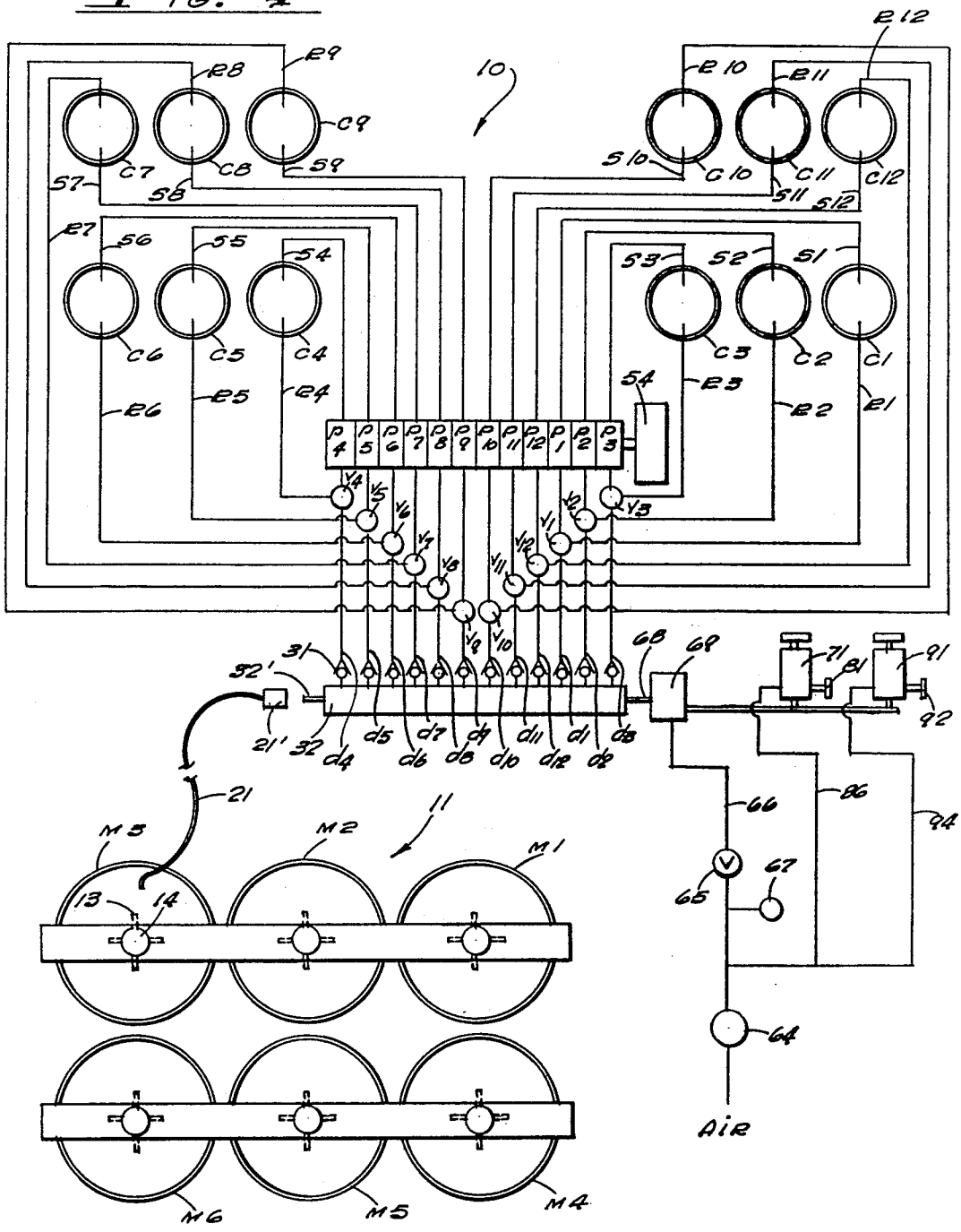


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Fig. 6

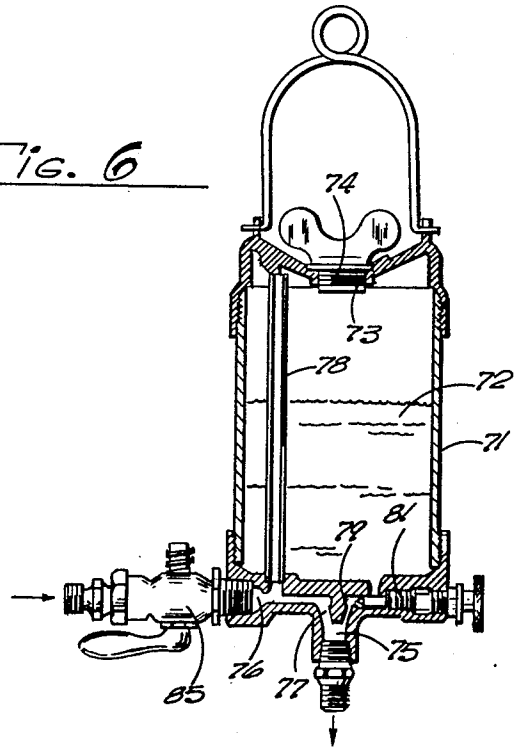
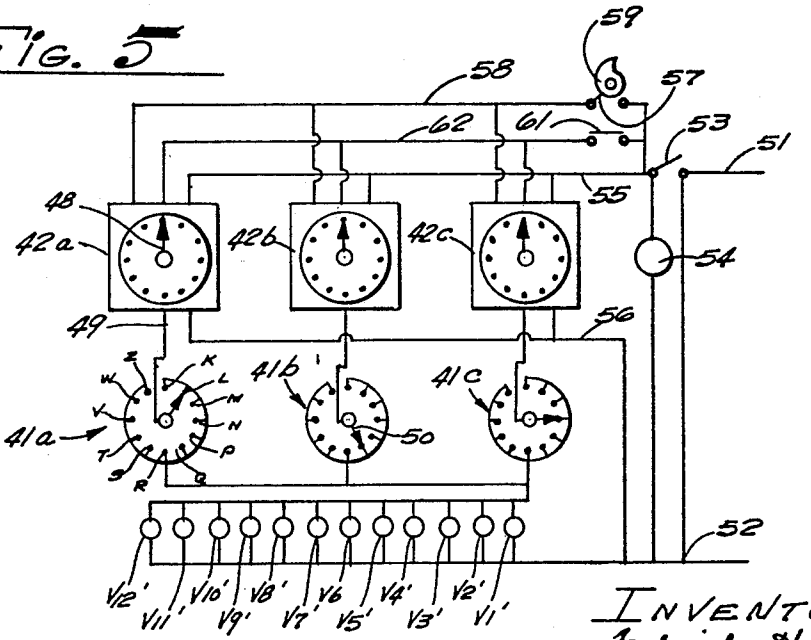



Fig. 5

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# METHOD AND APPARATUS FOR TINTING PAINT

## BACKGROUND

The present invention relates to a method and apparatus for batch tinting or shading of paint in a paint manufacturing facility. In the manufacture of paints, it is usual to tint or shade a batch of paint in mixing tanks at a tinting or shading work center in the paint manufacturing facility by the addition of colorants to modify one or more of the color characteristics of the base paint, that is the hue, saturation and value of the base paint, to produce a paint mixture of the desired color. In order to simplify the terminology in the present application, the words "tint" and "tinting" are used to denote the adding of a colorant to a base paint, whether it be for the purpose of modifying the hue, saturation or value of the base paint and, as such, the words tint and tinting are intended to include shading.

The amount of colorant which need be added to a batch of base paint to bring it to the desired color can be closely approximated by formulas or by a laboratory determination of the amount of different colorant additives necessary to bring a quart sample of the base paint through specifications, and then working out the proportions necessary for the batch of base paint. However, there are many variables such as inevitable variations in raw materials of the base paint and in effectiveness of dispersion of the pigment in the base paint, as well as variations in the colorant tinting strength of the colorants, which variables effect the amounts of the different colorants which must be added to bring the base paint to the desired color. It is accordingly the usual practice to add a first charge of colorant consisting of the major portion of the different colorants deemed necessary to bring the base paint to the desired color, and then mix and color test the result and mixture to ascertain the additional amounts of the different colorants which must be added to bring the base paint to the desired shade. Thus, successive charges of colorant are added to the base paint during the tinting operation, with the amounts of colorant in the successive charges diminishing as the paint mixture approaches the desired shade.

A paint manufacturing facility will often have several tinting work centers at different locations in the plant with a number of mixing tanks at each work center. Different size mixing tanks are used for tinting different size batches and some tanks are relatively small, of the order of 100 gallon capacity while others are larger for example 500 and 1,000 gallon capacity. The amounts of the different colorants in each charge of colorant utilized in tinting the batch of base paint varies widely depending upon the volume of the batch and the amount of color change to be effected by the charge. Thus, the amounts of each colorant in the charge may be relatively low, for example of the order of one-eighth gallon or relatively high, for example of the order of 6 to 8 gallons. Accurate delivery of such widely different amounts of the different colorants to the mixing tanks at the different tinting work centers has presented a long standing problem in the paint industry. This problem can be considered twofold, that of physically transporting the colorant from the colorant storage station to the tinting station, and the problem of accurately measuring the amounts of each colorant delivered to the paint mixing tank. Some paint manufacturing facilities utilize a single paint colorant storage station and are accordingly confronted with both problems, that of physically transporting the colorant to the mixing station and of accurately measuring the amounts of colorants delivered. Some paint manufacturing facilities utilize auxiliary colorant storage stations adjacent each mixing station, to provide more convenient access. While this alleviates the problem of transportation of colorants by the paint tinter to the mixing tank, it does not entirely overcome that problem and obviously requires a duplication or even multiplication of the number of colorant storage areas which must be provided with a corresponding duplication or multiplication of the number of measuring systems which must be provided, if such measuring systems are utilized. In an attempt to solve the problems, it has heretofore been proposed as disclosed in U.S. Pat. No. 3,398,858, assigned to the assignee of the present invention, to provide a mobile tinting apparatus in which containers of the different colorants are mounted on a mobile vehicle with individual measuring apparatus provided for each of the colorants. While such mobile tinting apparatus has been useful, it has not entirely solved the problem, particularly in the tinting of large batches which may require utilization of relatively large volumes of some colorants. In the mobile tinting apparatus, relatively small colorant reservoirs of the order of 5 gallons have been utilized in order to minimize the overall mass which must be transported from the main colorant storage station to the individual tinting station. Such volumes of colorant may not be adequate for tinting large batches and, in any event, would require relatively frequent return trips for refilling of the colorant containers on the mobile unit.



These problems of the prior art are overcome by the present invention which provides a method and apparatus for practicing the method wherein the different paint colorants are stored at a colorant storage station and individually preselected amounts of selected ones of the paint colorants are accurately delivered from the colorant storage station into the mixing tank at one or more tinting work centers. Accordingly, the present invention provides a method of batch tinting of paint by adding preselected amounts of paint colorant to a batch of base paint in a paint mixing vessel at a tinting station to produce a paint of selected color, wherein the different paint colorants are stored in colorant reservoirs at a storage station remote from the mixing station, a charge of paint colorant consisting of preselected amounts of one or more selected paint colorants are delivered to the inlet end of a single tube delivery line extending from the storage station to the mixing station, and the charge of colorant then purged from the line by passing a gaseous fluid under pressure into the inlet end of the single tube delivery line while introducing a purging liquid compatible with the colorant in the gaseous fluid for passage therewith through the line, and discharging the purging liquid and colorant from the line into the paint mixing vessel until substantially all of the charge of paint colorant has been delivered from the line to the mixing vessel. The present invention also provides an apparatus for practicing the method wherein measuring means are provided at the colorant storage station for delivering accurately measured preselected amounts of selected ones of the different paint colorants to be used in tinting a batch to a single tube delivery line extending from the storage station to the mixing station and an apparatus for forcing a purging fluid including a relatively small quantity of purging liquid compatible with the colorant into the inlet end of the single tube delivery line to purge substantially all of the colorant from the line into the mixing vessel.

It is accordingly an important object of this invention to provide an improved method and apparatus for accurately delivering preselected quantities of selected ones of a plurality of different paint colorant from a colorant storage station to one or more remote tinting work centers for use in tinting a batch of paint.

Another object of this invention is to provide a method and apparatus for batch tinting a paint wherein the colorant storage and measuring apparatus can be located at a single station and deliver measured quantities of colorants to the mixing tanks at one or more tinting work centers.

Another object of this invention is to provide a method and apparatus for batch tinting of paint wherein contamination of colorants utilized in tinting different batches is avoided.

Still another object of this invention is to provide a method and apparatus for batch tinting of paint wherein the paint colorants are delivered from the storage station to the mixing station in a single tube delivery line and the line then purged to effect delivery of substantially all of the colorant to the mixing tank without introducing significant quantities of other materials into the paint which might adversely effect the paint.

These, together with other objects and advantages of the present invention will become apparent as the same becomes better understood from the following detailed description when taken in connection with the accompanying drawings wherein:

FIG. 1 is a partial diagrammatic perspective view illustrating a colorant storage station and several tinting work centers having mixing tanks for mixing the base paint and colorant;

FIG. 2 is a side elevational view of one form of colorant dispensing console which can be utilized in practicing the invention;

FIG. 3 is a front elevational view of another form of colorant dispensing console;

FIG. 4 is a diagrammatic view illustrating a colorant storing, measuring, dispensing and delivering apparatus suitable for use in practicing the invention;

FIG. 5 is a schematic diagram of an electrical control system for use in controlling the apparatus of FIG. 4; and

FIG. 6 is a vertical sectional view through an apparatus utilized for passing purging fluid and liquid through the single tube delivery line.

Referring now more specifically to FIG. 1, there is diagrammatically illustrated a colorant storage station **10** containing reservoirs for a plurality of different colorants, herein shown **12** in number and designated C1–C12 inclusive. The method and apparatus of the present invention are arranged to deliver accurately measured quantities of selected ones of the different colorants to one or more tinting work centers. As diagrammatically illustrated, two tinting work centers designated **11** and **12** are provided, it being understood that the measuring and dispensing apparatus can be utilized with a single tinting work center or with a greater number than that illustrated. Each tinting work center has one or more mixing tanks and, as shown, the tinting work center **11** has six mixing tanks designated M–M6, each adapted to receive a different batch of base paint to be tinted. The diagrammatic illustration of tinting work center **11** is representative of relatively large volume mixing tanks, for example of the order of 500, 1,000 gallons or more. Such mixing tanks commonly have agitators or mixers permanently mounted thereon and, as diagrammatically shown, each tank has a rotary mixer **13** driven as by a motor **14** mounted on a support structure **15** adjacent the top of the tank. As is customary, a walkway or platform **16** is provided adjacent the top of the tank for use by the tinter when introducing colorant into the tank or removing a sample therefrom. Tinting work center **12** is representative of a work center used for tinting relatively smaller batches of paint, for example 100 gallons and, as shown, includes a plurality of mixing tanks, herein shown three in number and designated M7–M9 inclusive. Mixing apparatus is also provided for the tanks M7–M9 and, as shown, a portable mixing unit **18** is shown mounted on one of the tanks M7.

In the manufacture of light colored finishes, it is customary to start with a white base paint and then add preselected amounts of different selected colorants to the essentially white base to modify the same and produce a paint mixture of the desired hue, saturation and value. However, in the manufacture of deep color paint, a colored pigment is utilized from the outset and the colored pigment, together with other ingredients such as extenders, vehicles and so forth are blended in the grinding mill to produce an intermediate base paint of approximately the right color. This intermediate base paint is then placed in a mixing tank and preselected amounts of different ones of the colorants are added to this intermediate base paint to modify the hue, saturation and/or value of the paint to produce the desired final color. The amounts of the different colorants which must be added to the base paint, whether it be a white base paint or a colored base paint can be closely approximated by formulas empirically desired through experience, or by laboratory determination of the amounts of different colorants necessary to bring a small sample, such as a quart sample, of the base paint to the specified color and then working out the proportions necessary for the particular volume of the batch of base paint. However, because of the many variables in both the base paint and colorants, it is not possible in practice to determine the precise amounts of each of the different selected colorants which are necessary to produce the exact shade. Accordingly, it is the usual practice to introduce a first charge consisting of a major portion, such as 80 percent, of the amounts of each of the different colorants which are deemed necessary to modify the color of the batch to produce the desired color. The base paint with the first charge of colorant is then mixed and color tested. The additional amount of each of the different colorants necessary to bring the batch to the desired color specifications are then reevaluated and the proportions of the different colorants modified if necessary from the proportions utilized in the first charge. The second charge is then introduced into the mixing tank, mixed and again color tested and compared and a third, and sometimes even a fourth charge of colorant added as may be required to produce the final correction of the color of the base paint. The amounts introduced into the second, third or even fourth charges are very small as compared to those introduced in the first charge and very accurate measurement of the volumes utilized is necessary to reliably achieve the desired paint color. The amounts of each of the different colors utilized in each charge of colorant added to tint a batch of base paint thus varies widely and, for a 100 gallon batch for example, may vary from a relatively small quantity of the order of one-eighth gallon to a relatively large quantity of the order of 6 to 8 gallons. In accordance with the present invention, preselected amounts of selected different paint colorants to be used in tinting a batch of paint are delivered from the colorant storage station **10** to a selected mixing tank at one of the remote tinting stations **11** or **12** through a single tube delivery line that extends from the storage station to the tinting station. As shown, one single tube delivery line is provided for each tinting station, with a delivery line **21** extending from the colorant storage station **10** to the tinting station **11** and a second single tube delivery line **22** extending from the colorant storage station **10** to the tinting station **12**. The single tube delivery lines **21** and **22** can be of either rigid or flexible tubes and the outlet end of the single tube delivery line can either be arranged, as by a flexible end section *21a*, *22a* so that it can be selectively positioned to discharge in a selective one of the mixing tanks such as M1–M6 at tinting station **11** or, alternatively, the single tube delivery line can be branched at its outlet end and connected through a suitable valve arrangement (not shown) to branch conduits leading to the individual mixing tanks. Colorant is delivered to only a single mixing tank at one time from the colorant storage station and, if a branch conduit and valve arrangement is utilized, the valves are arranged so that the colorant is delivered through only a single one of the branch conduits leading to a selected mixing tank during delivery of any particularly charge of colorant. Thus, the branch conduit and valve arrangement, if used, in effect forms a single tube delivery line leading from the colorant storage station **10** to a particular mixing tank at the mixing station. Accurately preselected amounts of the different selected colorant to be utilized in tinting a particular batch of base paint are delivered from the respective colorant reservoirs C1–C12 to the inlet end of the single tube delivery line such as the line **21**. More than one colorant are commonly utilized in tinting a batch of base paint and the preselected amounts of the different colorants which make up the charge of colorant can be delivered either consecutively or concurrently into the inlet end of the single tube delivery line.

As previously discussed, the amounts of the different colorants to be utilized varies widely with different batches of base paint and also dependent on whether it is the first, second or third charge of colorant utilized in tinting a particular batch. In many cases, the amount of each colorant utilized in a particular charge is small as compared to the volume of the single tube delivery line. However, provision is made for purging substantially all of the colorant from the line after a charge of colorant has been introduced thereinto to assure substan-

tially complete and accurate delivery of the measured charge of colorant to the mixing tank. Purging of the charge of colorant from the single tube delivery line is effected by forcing a purging fluid into the inlet end of the line. A gaseous purging fluid is preferably utilized to initially force a major portion of the charge of colorant from the delivery line while the end of the single tube delivery line is arranged to discharge into the selected mixing tank. However, the colorant is quite viscous and a substantial amount of colorant will remain adhered to the walls of the single tube delivery line after passage of a gaseous purging fluid therethrough. In order to remove substantially all of the colorant from the line and effect substantially complete delivery of the charge of colorant into the mixing tank, a purging liquid compatible with the paint colorant is thereafter passed through the single tube delivery line to purge substantially all of the colorant from the line and deliver the same into the mixing tank. The purging liquid utilized can be of various different compositions which do not adversely affect the paint colorant, that is it does not cause flocculation of the colorant. The purging liquid should be a thin liquid, that is one that has a low viscosity as compared to that of the colorant, so as to aid in carrying the viscous colorant out of the single tube delivery line, and the purging liquid should be clear so as to not alter the overall color of the paint mixture. Moreover, the volume of purging liquid used should be sufficiently small so as to not adversely affect the quality or viscosity of the paint and the purging liquid is advantageously dispersed in a gaseous fluid carrier for passage therewith through the line. The purging liquids may of course vary with different vehicle compositions in the colorant and may, for example, be the same liquid used as a vehicle in the colorant. Many colorants now in use in tinting of paint are adapted for use in both oil base and water emulsion paints and utilize, as vehicle, a mixture composed of ethyleneglycol, water and a wetting agent, with ethyleneglycol consisting a major portion of the vehicle, for example about 70 percent of the vehicle, water about 27 percent and the wetting agent about 3 percent. The wetting agent is used in the colorant vehicle to aid dispersion and may, for example, be a non-ionic surfactant of octyl or nonylphenol 1 mol condensed with 5 to 11 mols of ethylene oxide. The wetting agent, while useful in the purging liquid is not essential and the purging liquid for ethyleneglycol type colorants, may for example, be 50–90 percent ethyleneglycol, 10–45 percent water, and 0–40 percent wetting agent.

Measurement of the amounts of the different colors to be utilized in tinting a batch of base paint can be either by volume or by weight. In either type of measurement, it is necessary that the colorants in the reservoirs C1–C12 be homogeneous and provision should be made for agitating, stirring or otherwise remixing the colorants prior to dispensing so that each unit of a particular colorant dispensed has a uniform value. A volumetric type measuring apparatus is diagrammatically illustrated in FIG. 4 and includes a plurality of pumps designated P1–P12 having their inlets respectively connected through supply lines designated S1–S12 to the respective reservoirs C1–C12. The supply conduits S1–S12 communicate with the reservoirs adjacent the lower end so as to allow pumping of measured quantities of the respective colorants therefrom. While separate stirring apparatus can be utilized for each of the colorants, the pumps P1–P12 can advantageously be utilized to recirculate colorant through the respective reservoir to agitate and remix the same. Thus, as shown, the pumps P1–P12 have their discharge outlets connected through three-way valves V1–V12 and return lines R1–R12 to the respective reservoir, with the return lines preferably discharging adjacent the upper end of the reservoir. The values V1–V12 are conveniently of the three-way type normally positioned so as to bypass the colorant discharged from the pump back to the respective reservoir to recirculate and remix the same, and the valves V1–V12 are selectively operable to a second position to deliver the pump discharged to the respective delivery lines *d*1–*d*12, while shutting off flow to the respective bypass lines R1–R12.

Pumps P1–P12 are preferably of the positive displacement type so that the motion of the pump is correlative with the volume delivered thereby and may, for example, be rotary positive displacement pumps such as gear or vane type pumps wherein the output flow is proportional to the number of revolutions of the pump or, alternatively, can be of reciprocating piston type pumps wherein the flow is proportional to the lengths of stroke in the number of strokes of the pump. Alternatively, a separate meter can be utilized to measure and/or control the amount of material dispensed by each pump.

Each "charge" of paint colorant utilized in tinting a batch of paint consists of measured amounts of one and usually several of the various paint colorants, as may be required to modify the color of the base paint to produce the desired color. The measured amounts of the several different colorants which make up each charge of colorant can be delivered to the appropriate single tube delivery line 21 or 22 either in succession or simultaneously. Thus, in the dispensing console shown in FIG. 2, the discharge lines *d*1–*d*12 terminate in fittings *d*1'–*d*12' respectively adapted to receive a mating quick disconnect coupling member 21', 22' on the delivery lines 21 and 22 so that one of the delivery lines can be connected in succession to appropriate ones of the fittings *d*1'–*d*12' to receive the measured amounts of each of the different colorants. The fittings *d*1'–*d*12' and quick disconnect couplings 21' and 22' are preferably of a type having valve mechanism built therein and so arranged as to close the outlets of the fittings *d*1'–*d*12' and the inlet end of the delivery line 21, when the coupling member 21' or 22' is removed. Such valved fittings and quick disconnect couplings are well known and detailed illustration or description is deemed unnecessary. However, it will be appreciated that the valved fittings and couplings will minimize possible loss of colorant to not only improve accuracy of delivery of the colorant but also to prevent contamination of the apparatus. In the form shown in FIGS. 3 and 4, the discharge lines *d*1–*d*12 deliver through check valves 31 to a common colorant manifold 32 and the manifold has an outlet fitting 32' which is adapted to receive the quick disconnect couplings 21' or 22' on the delivery lines 21 and 22. The check valves are arranged to open for flow from the delivery lines to the manifold and to close to prevent return flow so that backflow of colorant into a discharge line is prevented. With this arrangement, colorant from several discharge lines can be delivered to the common manifold simultaneously for flow through the respective single tube delivery line.

Control of the amount of colorant delivered by the pumps P1–P12 can be controlled by either starting and stopping the pump or by operating the respective valves V1–V12 to control bypassing of the outlet of the pump. For example, the pumps P1–P12 can be individually driven by separate motors (not shown) and the individual pumps then driven through a number of revolutions to pump the desired amount of colorant to the respective discharge line, and the pump then stopped. In the form shown in FIG. 4, the pumps P1–P12 are driven by a common motor 54 and the valves V1–V12 are operated to control flow of the pump discharge between the return lines R1–R12 and the respective discharge lines *d*1–*d*12 to deliver the desired amount of each colorant to the respective discharge line. Individual ones of the valves V1–V12 could thus be manually operated to pass the colorant from the outlet of the respective pump to the respective discharge line for a selected number of revolutions of the pump and then returned to its bypass position in recirculate colorant to the respective reservoir. However, in order to simplify operation, the valves are preferably electrically operated and provision made to enable preselection of the colorant to be dispensed as well as the amount of the colorant. Since several colorants are commonly utilized in tinting each batch of paint, a plurality of color selector switches, shown in FIGS. 3 and 5 are three in number and designated 41*a*, 41*b* and 41*c* are provided to enable preselection of three different colorants. A corresponding number of meters designated 42*a*, 42*b* and 42*c* are provided and arranged to enable presetting of the amount of the respec-

tive colorant to be dispensed. The selector switches 41*a*, –41*c* can be multiple position selector switches having a number of positions corresponding to the number of different colorants and herein shown as rotary selector switches having a number of positions corresponding to the number of different colorants. The individual terminals of each selector switch designated K, L, M, N, P, Q, R, S, T, V, W, Z are individually connected through a multiconductor cable to respective ones of the valve operators V1'–V12'. As diagrammatically shown in FIG. 5, each of the three selector switches are so connected to the plural valve operators so that the movable contact of each selector switch can be set to establish a circuit to a selected one of the valve operators.

Individually presettable metering means 42*a*–42*c* are provided for controlling the duration of opening of the valves V1–V12 to thereby control the amount of colorant dispensed. The metering means 42*a*–42*c* are of known construction and, for example, can be electrically operated counters of the type manufactured by Bliss Eagle Signal Company, Davenport, Iowa, Series HZ170. The counters have knobs 48 which are manually presettable to determine the number of counts to be measured by the counters and the counters are operative to control application of power to an output circuit 49 leading to the movable selector arm 50 on a respective one of the selector switches 41*a*–41*c*, to control energization of the valve operators V1'–V12' for a number of revolutions of the pump, corresponding to the setting of the knob 48. As shown in FIG. 5, power is supplied from conductors 51 and 52 connected through a suitable source of electrical power under the control of a main switch 53. The main switch, when closed, applies power to the pump drive motor 54 and also applies power through conductors 55 to the counters 42*a*–42*c*, which counters are otherwise connected through conductors 56 to the other power supply conductor 52. Counting pulses are applied to the several counters from a count switch 57 which is connected through conductors 58 to the several counters, and which count switch is periodically closed and opened under the control of a cam 59 driven in timed relation with the metering pumps. The speed at which the cam 59 is driven is correlated with the volumetric displacement of the metering pumps during each revolution so that the cam operates the count switch 57 each time a selected volume has been displaced by the metering pump, which volume is preferably a fraction of the usual volume used in measuring colorant and may, for example, be one-eighth gallon or one-fourth gallon, etc. The aforementioned counters are of the type which do not begin the counting operation until the cycle of operation has been initiated by closing of a start switch 61 connected through conductor 62 to each of the counters. With these counters, the knobs 48 can be present to a preselected number of counts which will deliver the desired amount of a particular colorant, but the counters will not establish a circuit to the valve operators V1'–V12' until the start switch 61 is closed. At that time, the counters control the application of power to the output circuits 49 and through the associated selector switch 41*a* to the respective one of the valve operators V1'–V12b: determined by the position of the selector switch. The selected ones of the valves V1–V12 are then moved to their discharge position to pass the pump discharge through the respective discharge line to thereby deliver the metered quantity of colorant. With the multiple selector switches and counters shown in the form of FIGS. 4 and 5, a plurality of different colorant can be preselected by adjusting the selector switches 41*a*–41*c* and the amounts of each of the respective colorants can be preset by adjusting the knobs 48 on the counters 42*a*–42*c* so as to effect simultaneous delivery of the several colorants to the discharge manifold. Alternatively, the colorants can be dispensed in succession to the colorant manifold 32 by utilizing only one of the selector switches and the corresponding counter to dispense only one colorant at a time. In the form shown in FIG. 2 wherein the colorants are delivered to individual discharge couplings D1'–D12', only a single selector switch 41 and counter 42 are utilized.

As previously described, substantially all of the colorant is purged from the single tube delivery lines 21 or 22 after a charge of colorant consisting of preselected amounts of one or more selective colorants have been delivered to the line. A gaseous fluid such as air, carbon dioxide or nitrogen is preferably used to initially purge the substantial portion of the line and, for this purpose, provision is made for delivering the gaseous fluid under pressure to the inlet end of the single tube delivery line. In the form shown in FIGS. 4 and 5 utilizing a manifold, the inlet end of the manifold is connected as by a line 68 to a purging fluid supply manifold 69. The line 68 preferably has a check valve therein to prevent flow of colorant from colorant manifold 32 to purging manifold 69. As diagrammatically shown in FIG. 4, air under pressure is supplied to the manifold 69 from a source of air pressure through a regulator 64, control valve 65 and line 66, and a gauge 67 is provided to facilitate adjustment of the air pressure utilized to purge the line. The colorant material is quite viscous and a significant amount remains in the line and manifold after the gas purging operation. A purging liquid is therefore used to complete purging of the delivery line. However, it is generally desirable to minimize the amount of purging liquid which is utilized so as to not adversely effect the quality or viscosity of the batch of paint. Only a relatively small amount of purging liquid is required if the purging liquid is dispersed into a gaseous fluid carries for passage therewith through the single tube delivery line. An apparatus suitable for this purpose, and which is itself of known construction, is illustrated in FIG. 6. This apparatus includes a closed vessel 71 adapted to receive a quantity of purging liquid 72 through a filler opening 73. The filler opening is closed and sealed as by a removable cap 74. A fluid outlet 75 is provided at the lower end of the container and a gaseous fluid such as air under pressure is supplied to an air inlet 76 through a passage 77 leading to the outlet 75 and the gaseous fluid is supplied through an upwardly extending pressurizing tube 78 to the interior of the vessel 71 above the liquid level therein so as to pressurize the liquid to the same pressure as that existing at the outlet 75. Purging liquid 72 from the container is then metered into the gaseous fluid flowing to the outlet 75 through a liquid outlet passage 79 under the control of a metering valve 18. The metering valve is adjusted to slowly dispense the purging liquid 72 into the gaseous fluid flowing through the outlet 75 and the purging liquid is carried with the fluid stream through the manifold and through the single tube delivery line. Only a relatively small quantity of purging liquid, for example, one quart, is found necessary to substantially completely purge a charge of colorant from the line. When using a gaseous fluid to carry the purging liquid through the delivery line, improved purging is achieved with a minimum of purging liquid when the delivery line has an internal passage of the order of at least three-eighths inch and preferably larger such as one-half inch, five-eighths inch or three-fourths inch. A clear plastic tube or line can be advantageously used to facilitate visual checking and cleaning operations. Any suitable arrangement may be utilized to deliver the purging liquid to the single tube delivery line and, as shown in FIG. 4, the purging fluid outlet 75 of vessel 71 is connected to the purging fluid manifold 69. As also shown in FIG. 4, air under pressure is supplied under the control of regulator 64 through line 86 to the air inlet 76 of the purging vessel 71.

The colorants utilized in tinting paint are very strong and even very small traces of some colorants may produce contamination when tinting a different batch of paint utilizing different colorants. Accordingly, provision is also made for cleaning the traces of any colorant from the line after tinting of one batch of paint and before tinting another batch with different colorants. This is achieved by passing a cleaning fluid through the line. It is found that cleaning of the line is markedly facilitated if the cleaning fluid is also passed along in a gaseous carrier and the cleaning fluid can either be introduced into vessel 71 after purging has been completed or an additional pressurized vessel 91 may be utilized for passing clean-

ing fluid. As diagrammatically shown in FIG. 4, the additional vessel 91 has a control valve 92 for regulating flow of cleaning fluid into the gaseous fluid and gaseous fluid such as air under pressure is supplied to the vessel 92 through a line 94. The cleaning fluid vessel 91 has its outlet connected to the purging fluid manifold 69 so as to supply cleaning fluid to the colorant manifold 32 and colorant delivery lines, under control of valve 92. The cleaning fluid can be water, with or without some solvent and, when the cleaning fluid is passed through the single tube delivery line, the outlet of the delivery line is arranged to discharge the same to drain so as to avoid contamination of the batch of base paint with the cleaning fluid. In the embodiment of FIG. 2 which does not utilize a colorant manifold, the purging fluid manifold 69 can be provided with a fitting 68' adapted to receive the quick disconnect coupling 21' or 22' on one of the colorant delivery lines.

From the foregoing it will be seen that tinting of batches of paint in mixing vessels at one or more tinting work centers in a paint facility can be readily effected. A charge of colorant consisting of accurately measured amounts of one or more different preselected colorants to be used in tinting a batch of base paint are delivered in succession or simultaneously into a single tube delivery line from selected ones of the colorant reservoirs at a colorant storage station. After the charge of colorant has been introduced into the delivery line, delivery of the charge from the line to the appropriate mixing vessel at the tinting work center is completed by passing a purging fluid including a purging liquid through the line while discharging the colorant and purging liquid into the mixing vessel. Only a relatively small amount of purging liquid is needed to effect purging of substantially all of the colorant from the line and delivery of the same to the mixing vessel. This arrangement effects accurate delivery of the selected amounts of the different colorants and also leaves the line clean so as to avoid buildup of colorant. Moreover, delivery of the several colorants into the single tube delivery line facilitates conveyance of relatively small amounts of colorants and dispersing of the same in the paint in the mixing vessel. The small amount of purging liquid used to clean the line further facilitates carrying and mixing of small charges of the colorant. Since there is no colorant in the single tube delivery line at the beginning of a dispensing cycle, no problems are encountered with settling or stratification of colorant in the line.

Purging of the line is effected after each charge of colorant is introduced into the line, and before a succeeding charge is fed into the line. Thus, when successive charges are used in tinting a batch of base paint, the line is purged after each charge of colorant to deliver that charge to the mixing tank. The base paint and colorant are mixed and color tested after each charge of colorant has been delivered to the mixing tank to determine whether the paint color meets the desired specifications and the additional amounts of colorant; if any, that may be required. After completion of delivery of all of the colorant required to complete tinting of a batch of base paint to the desired valve, the delivery line is cleaned to remove any traces that might contaminate colorants used in tinting a different batch of base paint, by passing a cleaning fluid through the line while discharging the cleaning fluid from the line to waste.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In a method of batch tinting paint by adding individually preselected amounts of selected paint colorants to a batch of base paint in a paint vessel at a mixing station to produce a paint of a selected color, the steps of storing a plurality of different paint colorants in paint colorant reservoirs at a storage station, delivering individually preselected amounts of the selected paint colorants to be used in tinting the batch of base paint to the inlet end of a single tube delivery line extending from the storage station to the mixing station and discharging the paint colorants from the delivery line into the paint vessel, and purging the paint colorant from the single tube delivery line after the preselected quantities of the selected paint colorants have been delivered to the inlet end of the delivery line by forcing a purging fluid including a purging liquid compatible with the paint colorant into the inlet end of the delivery line while continuing discharge of paint colorant and purging fluid from the delivery line into the paint vessel until substantially all of the paint colorant has been delivered from the line into the paint vessel.

2. The method of claim 1 wherein the purging fluid includes a gaseous purging fluid and said purging liquid is introduced into the gaseous fluid for passage therewith through the delivery line.

3. The method of claim 1 wherein purging of the line is effected by first introducing a gaseous fluid under pressure into the inlet end of the line to force a substantial portion of the colorant from the line into the paint vessel, and thereafter continuing passage of gaseous fluid into the inlet end of the line while slowly introducing said purging liquid into the gaseous fluid for passage therewith through the line.

4. The method of claim 1 including the step of thereafter removing any contamination producing traces of paint colorant that may remain in the line by passing a cleaning fluid through the line and discharging the cleaning fluid to waste before passing different colorants through the line for tinting a different batch of paint.

5. The method of claim 1 wherein the several selected paint colorants used in tinting each batch of paint are delivered in succession to the inlet end of the line.

6. The method of claim 1 wherein the several selected paint colorants used in tinting each batch of base paint are delivered concurrently to the inlet end of the line.

7. The method of claim 1 including the steps of thereafter mixing the base paint and paint colorant in the paint vessel, color testing the mixture to ascertain deviation of the tint of the mixture from the preselected color, delivering additional amounts of the selected colorants into the inlet end of the line to correct deviation of the tint of the mixture from the selected color, purging substantially all such additional colorant from the line with purging fluid while delivering the additional colorant and purging fluid from the outlet of the line to the mixing vessel, followed by remixing the re-color testing of the mixture.

8. In a method of batch tinting of paint by adding preselected amounts of selected paint colorants to a batch of base paint in a paint mixing vessel at a mixing station to produce paint of a selected color, the steps of storing a plurality of different paint colorants in paint colorant reservoirs at a storage station remote from the mixing station, delivering a charge of paint colorant consisting of preselected amounts of one or more selected paint colorants to be used in tinting a batch of base paint to the inlet end of a single tube delivery line extending from the storage station to the mixing station and discharging colorant into the paint mixing vessel at the mixing station, passing a gaseous fluid under pressure into the inlet end of the delivery line after the charge of paint colorant has been delivered to the line while continuing discharge of the colorant into the mixing vessel to discharge a substantial portion of the charge of colorant from the line, and thereafter dispersing a purging liquid compatible with the colorant in a gaseous fluid carrier and introducing the purging liquid and gaseous fluid carrier under pressure into the line for passage through the line, and discharging the purging liquid and colorant from the line into the paint mixing vessel until substantially all the charge of paint colorant has been delivered from the line to the mixing vessel.

9. In a method of batch tinting of paint wherein a first charge of paint colorant consisting of one or more preselected amounts of selected paint colorants are added to a batch of base paint in a paint mixing vessel at a mixing station; the paint and colorant then mixed and compared to a color standard; and at least one succeeding charge of paint colorant then added to the base paint in the mixing vessel consisting of one or more selected paint colorants in amounts to correct deviation of the paint colorant mixture from the color standard; the

steps of storing a plurality of different paint colorants in paint colorant reservoirs at a storage station, delivering said charges of paint colorant to the inlet end of a single tube delivery line extending from the storage station to the mixing station and discharging the colorant from the line into the mixing vessel and, after delivery of said first charge and each succeeding charge of colorants to the line, purging the charge previously delivered to the line by dispersing a purging liquid compatible with the colorant in a gaseous fluid carrier and introducing a purging and gaseous carrier under pressure into the inlet end of the line while delivering the purging fluid and colorant from the line into the mixing vessel to thereby discharge substantially all of each charge of colorant to the mixing vessel before a succeeding charge is delivered to the line.

**10.** The method of claim **9** including passing a cleaning fluid through the line after all of the charges of colorant required to tint a batch of paint have been delivered to the tank and discharging the cleaning fluid to waste.

**11.** In a paint manufacturing facility for batch tinting paint by adding preselected amounts of selected paint colorants to a batch of base paint in a paint mixing tank to produce a selected paint tint, the paint manufacturing facility including at least one mixing station having a paint mixing tank and a remote paint colorant storage station having a plurality of colorant reservoirs containing different paint colorants, the improvement comprising a common flow conduit extending from the storage station to the mixing station for conveying the several colorants to be utilized in tinting a batch of paint from the storage station to the mixing tank at the mixing station, means at the storage station operable to deliver preselected amounts of selected colorants to the inlet end of the common flow conduit, and means at the storage station operable after termination of delivery of the preselected amounts of the selected colorants to the inlet end of the line for dispersing a purging liquid compatible with the colorant in a gaseous fluid carrier and for introducing the purging liquid and gaseous fluid carrier under pressure into the inlet end of the conduit for flow through the line to purge substantially all of the colorant from the line and effect delivery of substantially all of the preselected amounts of colorant to the mixing tank.

**12.** The combination of claim **11** wherein said means for delivering colorant to the line includes a plurality of colorant metering means each having a separate outlet, and means on the inlet end of the delivery line adapted for selective connection to the outlets of each metering means to enable sequential delivery of measured quantities of different paint colorants to the line.

**13.** The combination of claim **11** including a colorant manifold connected to the inlet end of the delivery line, said means for delivering colorant including means operable to simultaneously deliver measured amounts of selected ones of the colorants to the manifold for flow to the delivery line, said means for introducing said purging liquid into the line including means connected to the manifold at a point remote from the connection of the delivery line thereto to pass the purging fluid through the manifold into the delivery line.

**14.** The combination of claim **11** wherein the facility has more than one mixing station and a separate delivery line extends from the colorant storage station to each mixing station.

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