July 30, 1963 E. P. COFIELD, JR 3,099,252

WRITING INSTRUMENT AND INK THEREFOR

Filed Dec. 22, 1958 3 Sheets-Sheet 1

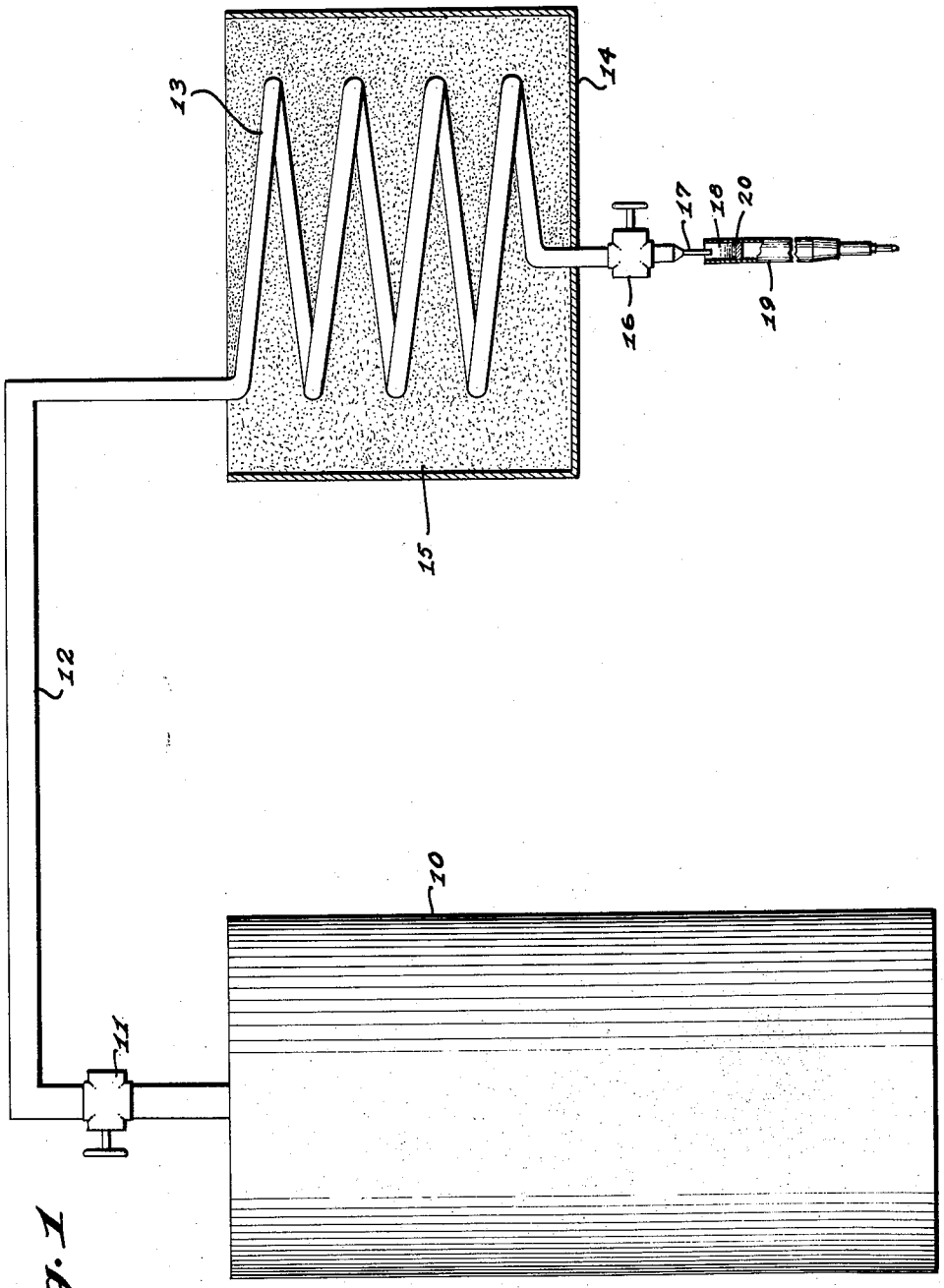

Fig. 1

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Fig. 2

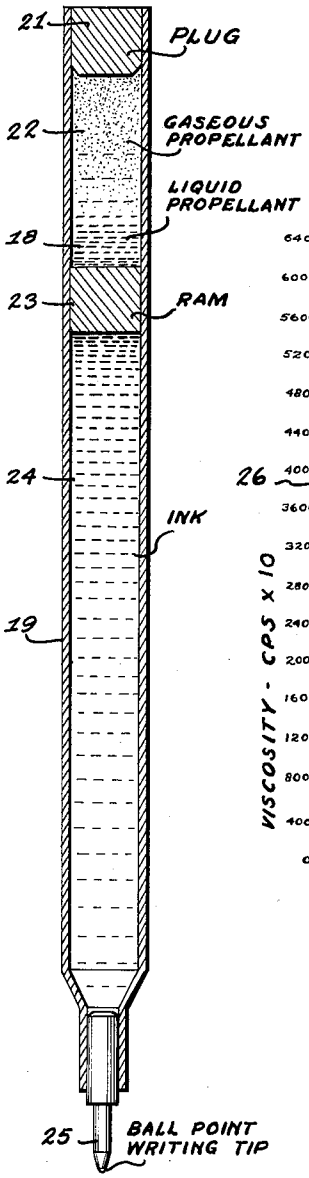

Fig. 3

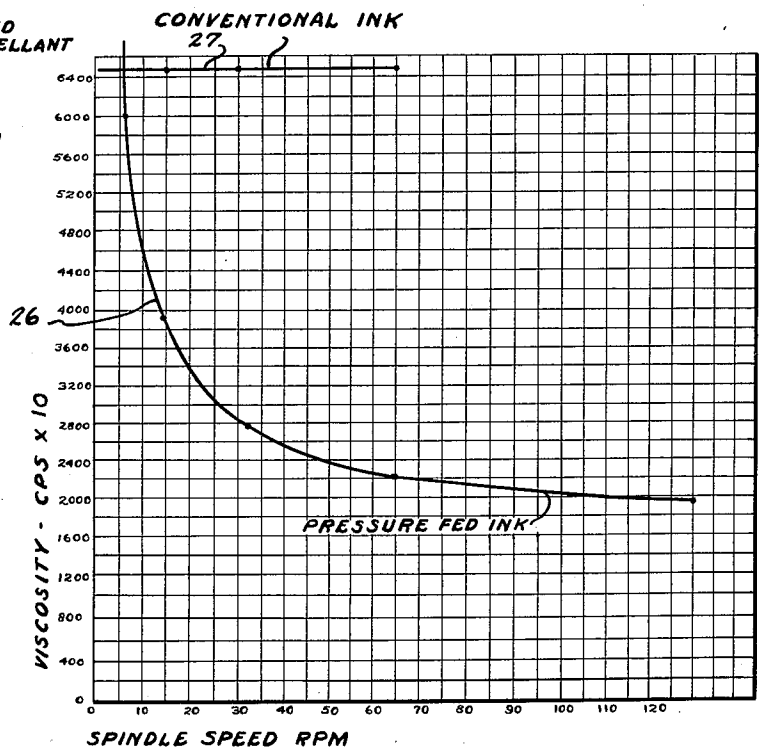

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Fig. 4

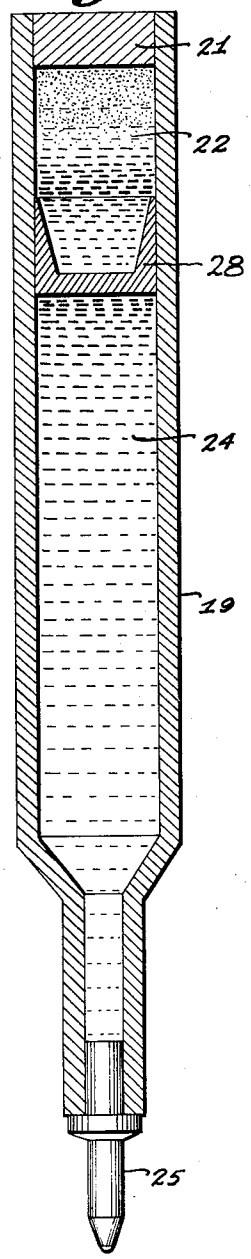


Fig. 5

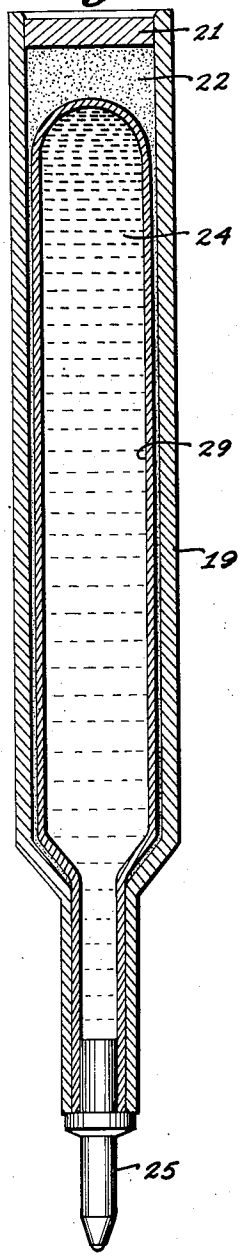
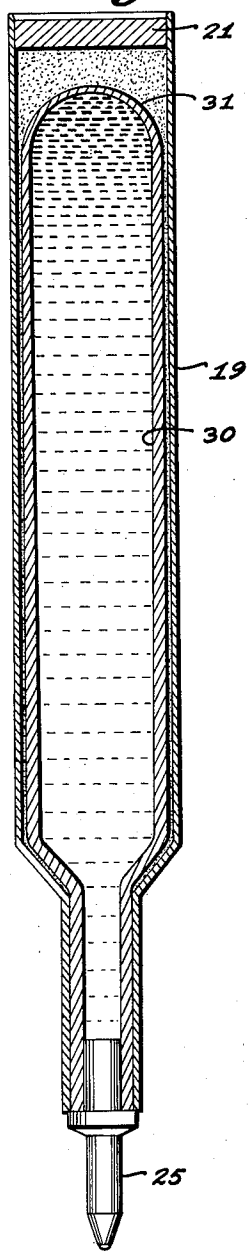


Fig. 6



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United States Patent Office

3,099,252

Patented July 30, 1963

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3,099,252

WRITING INSTRUMENT AND INK THEREFOR

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Filed Dec. 22, 1958, Ser. No. 784,835
3 Claims. (Cl. 120—42.4)

This invention relates to writing instruments and more particularly to a fundamentally new type of ball point writing instrument in which the following coacting elements are combined with a ball point for the first time:

(1) An ink possessing a yield value of sufficient magnitude to resist movement under the force of gravity, and

(2) Means for creating a super-atmospheric pressure which would of necessity create a force in excess of that of gravity to effect necessary movement of the aforementioned ink in the writing instrument to the vicinity of the ball.

A number of long desired but heretofore unobtainable features in ball point writing instruments are provided for the first time in the writing instrument of this invention. Examples of such features may be described as follows.

The marks deposited upon paper or other writing surfaces by the ordinary ball point writing instrument are extremely thin and due to the transparency of the colorants used, such marks cannot be satisfactorily reproduced by many types of reproduction equipment used in business offices, drafting rooms, scientific laboratories, and the like. The writing instrument of this invention makes use of an ink which contains sufficient quantities of pigment-type colorants to enable the marks made therewith to be easily reproduced by business type reproduction or copying equipment.

A frequent cause of interruptions in the flow of ink in the ordinary ball point writing instrument, and therefore in the continuity of marks made on the writing surface, is the presence of minute air bubbles in the ball socket of the instrument. In extreme cases these air bubbles are capable of completely breaking the capillary ink seal which normally exists in the ball socket, thus forming a so-called "dry socket" condition, with the result that the entire mass of ink moves rearwardly and ultimately leaks from the rear vent opening of the writing instrument. Such air bubbles are frequently introduced into the ball socket by the rotation of the ball with the pen in an inverted position, as for example, when it is attempted to write upon a vertical surface such as a wall or when the pen is inverted and ball point is in contact with an absorbent material of a person's pocket or a lady's purse. The writing instrument of this invention prevents the introduction of such air bubbles, even under the aforementioned conditions, due to the continuous super-atmospheric pressure being exerted upon the ink, thus enabling the ink in the ball socket to successfully oppose the entry of any trouble-making air bubbles.

Another disadvantage of the presently used ordinary ball point writing instruments is the necessity for limiting the diameter of the ink reservoir, and thereby limiting the quantity of the ink supply in order to obtain a stable ink meniscus and thus minimize the possibility of rear-end leakage occurring through the breakage of the ink meniscus and the subsequent rearwardly running of the ink along the walls of the containing reservoir. The instrument of this invention completely eliminates the possibilities of rear-end leakage occurring since a closed reservoir is employed, and also permits the use of considerably larger supply of ink than would be otherwise obtainable.

Many of the dyes and other ingredients used in the

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inks of the currently used ball point writing instruments are quite corrosive with the result that the usable life expectancy of such instruments is unduly limited. The writing instrument of this invention permits the use of a much wider variety of ink ingredients that afford a resultant reduction in the corrosivity of the ink, in addition to the obtainment of such other advantages as superior lightfastness, greatly increased resistance to water bleed, and a reduction in manufacturing cost.

In the past, there have been a number of attempts made to overcome one or more of the aforementioned disadvantages of the ordinary ball pen through the use of super-atmospheric pressures in a ball point writing instrument. As pointed out below, these attempts were not successful due to the failure of the particular device to employ an ink possessing a yield value of the sufficient magnitude to prevent oozing of ink from the point while the ball is static.

In Birgy French Patent 1,055,674, there is disclosed a ball point writing instrument containing an ink having a Newtonian viscosity of more than 150 stokes at 20° C. and a medium which will produce a super-atmospheric pressure. The use of an ink of high Newtonian viscosity was an attempt to prevent the ink from oozing between the ball and socket. It should be noted that the use of an ink having merely a high Newtonian viscosity does not prevent oozing when such ink is subjected to a super-atmospheric pressure; it merely reduces the rate at which oozing occurs. The Birgy instrument differs from the writing instrument of the present invention in that the ink employed therein is not disclosed or in any way suggested to possess a yield value.

In Auffret French Patent 1,053,515, there is disclosed a ball point writing instrument containing a pressure-producing medium, which is self-regulating; that is, the pressure is maintained at some constant value as the ink supply is depleted, and a means for physically separating the pressure-producing medium from the ink. The instrument of this disclosure differs from the writing instrument of the present invention in that the instrument it discloses does not utilize an ink having a yield value of sufficient magnitude to prevent oozing of ink from the point when the ball is static. In the absence of such an important property, the ink will ooze between the ball and socket under the influence of the super-atmospheric pressure.

In Conte Belgian Patent 517,217, there is disclosed a ball point writing instrument containing a gaseous-liquid propellant together with a piston member to separate the propellant from the ink supply, but like the reference discussed above, this instrument does not contain the special type ink that is employed in the present invention and therefore the Conte writing instrument is also one in which ink will ooze from the point while the ball is static.

In accordance with the present invention, I have discovered an effective and practical solution to the above-mentioned problems, which comprises using a gaseous-liquid propellant mixture for effecting movement of an ink possessing judiciously controlled rheological properties.

The writing instrument of the present invention is illustrated in a non-limiting form in the accompanying drawings in which:

FIG. 1 is a diagrammatic representation of the system used for filling the writing instrument with the gaseous-liquid propellant;

FIG. 2 is a longitudinal sectional view of an ink reservoir showing the ink supply and gaseous-liquid propellant;

FIG. 3 is a graph illustrating the ink characteristics;

FIG. 4 is a view similar to FIG. 2 and illustrates a modification of the ink tube which uses a flexible cup

type of seal between the ink supply and the pressure chamber.

FIGS. 5 and 6 illustrate further modification of the ink tube shown in FIG. 2, and in which flexible sacs are used for containing the ink.

Referring now to the several figures in the drawings and generally in the order in which they occur, the propellant filling system shown in FIG. 1 comprises a pressurized container **10** which contains a supply of the propellant, an illustrative but non-limiting example of which is the product known in the trade as "Freon," e.g. No. 114. The propellant contained in the chamber **10** is a gaseous-liquid mixture and is in gaseous form when metered through a valve **11** and flexible tube **12**, the latter being connected to cooling coils **13** located in a vessel **14**, which contains a freezing mixture indicated at **15**, such as acetone and Dry Ice. This freezing mixture lowers the temperature of the propellant in the cooling coils **13** sufficiently to change it from a gaseous to a liquid state. A valve **16** is connected to the end of the cooling coils **13** and is used for metering a supply of the liquid propellant through a small diameter tube **17**, into the chamber **18** of the ink tube or reservoir **19**.

Immediately upon filling the chamber **18** with the liquid propellant **20**, it is removed from the filling system and a plug **21** inserted in the open end of the chamber **18** is shown in FIG. 2.

Referring now to FIG. 2, a plug **21** is advantageously coated with shellac before inserting in the open end of the tube so as to provide a permanent gas-tight fit. As indicated at **22**, the propellant supply is confined between the fixed plug **21** and a movable ram **23**. Also, as indicated at **22**, this propellant is now in the form of a gaseous-liquid mixture, that is, a portion of the liquid fed into the chamber **18** by the system described above in connection with FIG. 1, has now reverted to a gaseous state because of the rise in temperature encountered in the ink tube as compared with the exceedingly low temperature existing in the cooling coils **13** above. This mixture of gas and liquid is maintained in equilibrium as described hereinbelow under static condtions, but varies with changes in the volume of the ink as it is used in writing.

The ink supply is shown at **24** in FIG. 2 and is confined between the ball point **25** at one end and the movable ram **23** at the other end. In the normal use of the pen or writing instrument, the ink supply **24**, illustrated in FIG. 2, is gradually used up with a corresponding decrease in volume and at the same time the volume of the gaseous-liquid propellant **22** is increased proportionately and causes the ram **23** to be propelled downward or forward toward the ball point **25** until the supply of ink **24** is exhaused.

The gaseous-liquid mixture is obtained by the use of a liquid, or a mixture of liquids, which possesses a vapor pressure, at the minimum temperature at which the writing instrument will be used, of sufficient magnitude to overcome the yield value of the ink and thus effect movement of the ink from the ink reservoir to the vicinity of the rotatable ball. Another limitation on the liquid or mixture of liquids is that the vapor pressure at the maximum temperature to which the writing instrument might reasonably be exposed must not be of a sufficient magnitude to overcome the yield value of the ink in the restricted annular passageway between the ball and its socket, and thus lead to the condtion referred to above as "oozing."

The term "gaseous-liquid mixture" is used because when a liquid or mixture of liquids covered by the above description is confined in a closed container, in this instance between the rear plug **21** and the movable ram **23**, the liquid partially vaporizes, thus forming a gaseous phase which is separate and distinct from the parent liquid phase. Vaporization continues until a vapor pressure is reached at which an equilibrium condition exists; that is, the rate at which vaporization is occurring is equal to the rate at which the vapors are condensing and returning to the liquid phase. If the equilibrium condition is disturbed; for example, through the movement of the ram **23** as the ink supply is depleted through writing, the vapor pressure drops momentarily due to the increased volume of the container, but is immediately restored by an increase in the rate at which the liquid vaporizes. As soon as the vapor pressure reaches its previous level, equilibrium is once more established and the magnitude of the pressure exerted upon the movable ram **23** and thereby on the ink will be the same that existed prior to the time that the equilibrium was disturbed. This process occurs almost instantaneously, thus the pressure exerted upon the ram **23** will be, for all practical purposes, of a constant value as long as both the gaseous and liquid phases are present. In order to insure that a liquid phase will be present upon the exhaustion of the ink supply, it is of course necessary to introduce at least a minimum quantity of the propellant **22** at the time that the writing instrument is loaded as described hereinabove. While this minimum quantity is subject to some variation, in general, it has been found that about one volume of liquid propellant to six volumes of ink will produce satisfactory results.

Other requirements which must be met by the propellant are that it be non-toxic and non-reactive, at least to a usable degree, with the other materials employed in the construction of the writing instrument and in the ink.

One class of materials containing many individual members which meet the above-enumerated requirements are the chloroflurohydrocarbons sold under the trade names of "Freon" and "Genetron." These are well known materials which are widely sold and are commonly used as the propellant medium for dispensing paints, deodorants, insecticides, and the like from the so-called aerosol containers.

The suitability of inks for use according to the present invention can only be determined from certain rheological or flow properties of the inks in question. The rheological property of primary importance is yield value. Other rheological properties which are generally present in an ink possessing yield value are thixotrophy and plastic viscosity. Thus, the inks of the present invention could be defined broadly as dispersions of solids in liquids with such dispersions possessing certain rheological properties.

Yield value of an ink is that property which determines whether or not the ink will move or flow when a force or pressure of a specified magnitude is applied thereto. If the applied force is less than the yield value of the ink, no movement or flow of the ink will occur. On the other hand, if the applied force is greater than the yield value of the ink, the ink will flow as long as the application of the force is continued. Thus, yield value may be defined as the threshold value which must just be exceeded by an applied force if flow is to occur. As a matter of practical application, it has been found that the yield value of a given ink is influenced by the dimensions of the enclosing container. For example, the ink in the writing instrument of the present invention is present in both the reservoir, which may be of any diameter up to several tenths of an inch, and in the annular passageway between the ball and its enclosing socket; the clearance between these two members is so small that it is usually measured in microns. Thus, it is possible for an applied force or pressure of a given magnitude to cause an ink to flow or move in the reservoir of the writing instrument of the present invention and for the same pressure to be unable to cause the ink to ooze between the ball and socket.

The yield value of an ink, determined in a standardized container for reference purposes, is a function of several variables, including the quantity and nature of the pigment or pigments employed, the quantity and nature of the liquid components of the ink, as well as the presence or absence of certain materials generally classified as

surface active materials. For a specific set of ingredients, the relative concentration of the pigment will largely determine the yield value of the ink. As already previously stated, the yield value of the ink of the present invention must be such that movement or flow of the ink can be initiated in the ink reservoir by the super-atmospheric pressure exerted by the pressure-producing medium yet cannot be initiated in the narrow passageway between the ball and socket. The yield value of the ink must also be of such value that the additional shearing force of the rotating ball, when added to the force exerted by the pressure-producing medium, is sufficient to force the ink between the ball and socket during writing.

A rheological property of importance in any ink is viscosity. Viscosity as a generic term is that property of a liquid which determines the rate at which a liquid will flow upon application of a force of given magnitude, assuming, of course, that the applied force is of sufficient magnitude to overcome any yield value of the ink. However, in the present invention it is of greater significance that viscosity is also that property of an ink which determines the freedom of rotational movement of the ball in its enclosing socket during writing. Thus, an ink of high viscosity will exert a greater drag upon a rotating ball than an ink of lesser viscosity.

In some types of materials, usually pure liquids or solutions of solids in liquids, the viscosity of any given sample will remain constant regardless of the rate at which a force is applied thereto. This is usually defined as "Newtonian" viscosity. Therefore, in the presence of a rotating ball, the viscosity of an ink falling into this rheological classification would remain constant irrespective of the speed or rotation of the ball. In other types of materials, usually but not necessarily suspensions or dispersions of solids in liquids, the viscosity of the material will vary with the rate at which a force is applied thereto. When used in referring to a material possessing a yield value, this is referred to as plastic viscosity. Accordingly, the viscosity of an ink falling into that category would be at a maximum in the presence of a non-rotating ball and would be reduced to some lesser value, which would be dependent upon the actual rate of rotation of the ball, as the ball rotated. Thixotrophy is closely related to the phenomenon of reducible plastic viscosity and may be considered as that rheological property which determines the persistency of a reduced viscosity. Thus, once the plastic viscosity of a highly thixotropic ink is reduced, it will remain at the reduced value for a measurable period of time.

The magnitude of the plastic viscosity of an ink, the type of viscosity displayed by an ink upon exposure to the shearing action of the rotating ball, and the thixotrophy of an ink are interrelated functions of several variables. Insofar as the magnitude of the plastic viscosity is concerned, the viscosity of the liquid component as well as the quantity and type of pigments used are probably the controlling factors; whether or not an ink displays a reducible plastic viscosity and the persistence of the reduced plastic viscosity (thixotrophy) are generally dependent upon the concentration of the pigment or other solid matter present, but the type of solid particle employed can exert considerable influence.

There are certain limits which the plastic viscosity characteristics of the ink of the present invention must satisfy. These limits are primarily applicable at relatively high rates of shear since these are the shear rates which best approximate the conditions existing in the vicinity of the rotating ball. When measured at high rates of shear, the reduced plastic viscosity of the ink must not be such that undue drag is exerted on the rotating ball, otherwise, the instrument will be classed as a "hard writer." If the reduced plastic viscosity is too low, the writing instrument will deposit irregular blobs of ink during use. While it is difficult to define these limiting values precisely, 1000–3000 cps. at 25° C. for the minimum value and 50,000–60,000 cps. at 25° C. for the maximum value would be realistic.

In Cofield et al. United States Patent 2,715,388, there is disclosed an ink in a ball point writing instrument possessing a plastic viscosity which is reducible by the shearing action of the rotating ball, but the ink in this reference possesses a yield value of such an insignificant magnitude that it will flow under the force of gravity. While the writing instrument of the present invention likewise possesses an ink having a plastic viscosity which is reducible under the shearing action of the rotating ball, the ink of the present invention differs in that the ink of the present invention possesses a yield value of such a magnitude that super-atmospheric pressures, i.e., forces in excess of that of gravity, are required to effect movement or flow of the ink to the vicinity of the ball. The ink of the present invention will therefore not function in a ball point writing instrument that employs only gravitational forces.

In Cofield United States Patent 2,853,972, there is also disclosed a ball point writing instrument utilizing an ink possessing both a plastic viscosity reducible by the shearing action of the rotating ball and a yield value. In a like manner, this disclosure differs from the writing instrument of the present invention in that the magnitude of the yield value was such that the writing instrument of United States Patent 2,853,972 was operable under only gravitational force.

The interrelation of the super-atmospheric propellant and the yield value of the ink may be best illustrated by referring to the coacting functions of these elements in providing some of the previously-mentioned features which have not been obtainable heretofore in ball point writing instruments.

The usability of the writing instrument of the present invention in making marks which can be reproduced satisfactorily is first dependent upon the use of a relatively high concentration of pigment in the ink. By virtue of its high pigment content, the yield value of such an ink would be too high for use in the ordinary ball point writing instrument which operates at atmospheric pressures, hence the requirement for the super-atmospheric propellant. The plastic viscosity of such an ink would also be of sufficient magnitude to exert a considerable drag on the ball; however, because of the reducible plastic viscosity feature of the ink, the user of the writing instrument is able to write or otherwise mark by exerting no more effort than would be required for an ordinary ball point instrument using an ink having a Newtonian viscosity of considerably less magnitude.

The use of a sealed unit, which completely eliminates the possibility of rear end leakage, is possible primarily because of the use of the super-atmospheric propellant. However, if it were not for the yield value of the ink, there would be a continuous oozing of the ink between the ball and socket due to the pressure exerted by the super-atmospheric propellant. The function of the reducible plastic viscosity is the same as in the preceding paragraph.

Thus, in the selection of component elements for use in the writing instrument of the present invention, one must first determine the objective to be accomplished. If it is desired, for example, to achieve an instrument for use in a drafting room, the opacity of the marks is of primary importance. Hence, one would first select a combination of pigments, liquid components, etc., which would provide an ink which would deposit properly upon the writing surface. Upon determining the rheological characteristics of the ink, one would then select a propellant which provides a super-atmospheric pressure of sufficient magnitude to cause the ink to flow in the reservoir but of insufficient magnitude to cause the ink to ooze between the ball and its enclosing socket.

The narrow range of temperatures to which a writing instrument would be exposed in a location such as a draft-

ing room would obviously allow greater latitude in the selection of a propellant than, for example, in a writing instrument which must be operable wherever its user happened to be. Likewise, a writing instrument designed for general use would have to satisfy a less stringent requirement for opacity of the written deposit than an instrument destined for use in the drafting room; hence, a greater latitude in the selection of ink ingredients would be possible which, in turn, would be of help in obtaining a propellant which would be operable over the wider temperature range required by the general purpose writing instrument.

An illustrative but non-limiting example of the components utilized in a writing instrument, in this instance for use in a drafting room, is as follows:

EXAMPLE 1

Ink

Add one part Lampblack (Lampblack Bear Germantown, Monsanto Chemical Company, Camden, N.J.) to five parts Polyester Resin L–796 (a resin manufactured by the Specialty Resins Company, Lynwood, California, from phthalic anhydride (1.0 mol) and ethylene glycol (2.2 mol) having the following physical properties: Viscosity: Gardner Z–2; acid Number: 3.0; hydroxyl number: 7.95 meq. OH per gm. resin; and free glycol: 10.8%). Mix until a smooth dispersion is obtained and heat at 170°–180° F. for 18–24 hours or until all of the carbon particles are thoroughly wetted. Cool and pass three times through a three-roll steel mill. The viscous paste thus formed is ready for use, possessing a plastic viscosity which was reducible upon the application of an increasing rate of shear as illustrated in FIG. 3.

Propellant

Freon No. 114, manufactured by E. I. du Pont de Nemours and Company, Inc., was utilized with the ratio of ink to propellant being approximately six to one.

Writing Instrument

The writing instrument consisted of a brass ink reservoir **19** having an inside diameter of approximately 0.180″. The lower end of the ink reservoir had a reduced inside diameter of approximately 0.100″ into which was pressed a ball point writing tip **25**. Into this unit was loaded, using the procedure described hereinabove, the ink and propellant of this example in a volumetric ratio of approximately six to one with a cylindrical rubber ram **23** separating the ink from the propellant. The reservoir was sealed by pressing a brass plug **21**, coated with shellac, therein. In the writing instrument thus described, the ink possessed a yield value which was just overcome in the reservoir by the application of a super-atmospheric pressure having a magnitude of 1½ p.s.i.g.; a super-atmospheric pressure of 5 p.s.i.g. was required to overcome the yield value in the narrow passageway between the ball and socket and thus cause oozing.

Numerous other pigments were found to be suitable for use in inks of a type suitable for use in the writing instrument of the present invention. These included:

Phthalo Blue Teglac Dispersion E9595 (Harmon Color and Chemical Works, Hawthorne, N.J.)

Sterling FT Carbon Black (Godfrey Cabot and Company, Boston, Mass.)

Acetylene Black (Shawinigan Resins Co., Springfield, Mass.) mixed with Sterling FT Carbon Black in a ratio of 1:5

Monofast Blue A5712 (H. Kohnstamm and Co., Inc., 83–93 Park Place, New York 7, N.Y.)

Solfast Skyblue Toner CPX 495 (Sherwin-Williams Co., Pigment, Color & Chemical Div., 260 Madison Ave., New York 16, N.Y.)

Perm. Pigment Blue S65–F–325 (Hilton-Davis Chemical Co., 2235 Langdon Farm Rd., Cincinnati 13, Ohio)

Molacco Black (Columbian Carbon Co., 380 Madison Ave., New York 17, N.Y.)

Liquids (vehicles) which were found to be usable in inks of the present invention included:

Mineral oil varnish consisting of 33 parts Dymerex Resin (Hercules Powder Co., Wilmington, Del.) dissolved in 100 parts Red Line 1000 Mineral Oil (Union Oil Co., Los Angeles, Calif.)

Solution of 100 parts Amberol 820 (Rohm and Haas Co., West Washington Square, Philadelphia, Pa.) in 100 parts Dipropylene Glycol (Union Carbide Chemicals Co., New York, N.Y.)

Solution of 100 parts Beckosol No. 24 (Reichhold Chemical Co., White Plains, N.Y.) in 100 parts Santicizer 8 (Monsanto Chemical Co., St. Louis, Mo.)

Solution of 90 parts Amberol 820 (Rohm and Haas Co., West Washington Square, Philadelphia, Pa.) in 100 parts Carbowax 300 (Union Carbide Chemicals Co., New York, N.Y.)

Paraplex G–50 (Rohm and Haas Company, West Washington Square, Philadelphia, Pa.)

The modifications shown in FIGS. 4, 5 and 6 operate on the same general principles described above for the arrangement illustrated in FIG. 2 with an ink having the hereinabove described rheological properties. The modification in FIG. 4 is characterized especially by a flexible cup-shaped follower **28**, which under the pressure of the gaseous-liquid propellant **22**, is forced against the walls of the ink tube **19** to form a tight seal between the propellant **22** and the ink supply **24**.

The modification shown in FIG. 5 contains a thin-walled sac **29** made from a suitable flexible material and mounted in the chamber **19**. The opening to the sac contains the ball point **25**. The sac **29** is so positioned that chamber **19** is adequately sealed at its smaller end. An ink **24** having the proper rheological properties is contained in sac **29**. A liquid-gaseous propellant **22** is contained in chamber **19** and is separated from the ink **24** by the walls of the sac **29**. The liquid-gaseous propellant **22** exerts a continuous pressure on the walls of the sac and due to the flexible nature of these walls this pressure is transmitted directly to the ink **24**, thus tending to always keep the ink in direct contact with the ball contained in point **25**. As the ink supply is depleted, the pressure exerted by the liquid-gaseous propellant **22** tends to collapse the walls of the sac **29** so that pressure is continuously exerted on the ink.

A unit operating on the same principle is shown in FIG. 6. In this latter unit, the thickness of the sac wall is continuously varied with the thickest section being at the point end **30** and thinnest section at the rear end **31** of the sac. This arrangement aids in preventing a premature collapse of the sac before the ink supply is completely depleted.

This is a continuation-in-part of my copending application Serial No. 499,076, filed April 4, 1955, now abandoned.

The above described structures, procedures, and materials are subject to variations and modifications within the scope of this invention as defined in the appended claims.

I claim:

1. A pressurized ball point pen, comprising an ink reservoir having one end thereof closed and the other end fitted with a rotatable ball point, a supply of ink contained in said reservoir for feeding to said ball point, and a supply of gaseous-liquid propellant arranged in said reservoir to create a uniform superatmospheric pressure rearwardly of said ink supply for exerting a feeding force thereon greater than the force of gravity, said ink being characterized by a yield value requiring said superatmospheric pressure to effect flow thereof for feeding to said ball point and the yield value of said ink being such

that under said superatmospheric pressure the ink will not pass the ball point in the absence of the shearing force applied thereto by rotation of said ball point, said yield value of the ink being produced by the pigment concentration thereof and said pigment concentration being selected to provide a desired opacity in said ink upon being transferred to a writing surface.

2. A pressurized ball point pen, comprising an ink reservoir, a supply of ink contained in the reservoir, and a supply of gaseous-liquid propellant located so as to apply uniform superatmospheric pressure to the ink supply as the ink is consumed at the ball point during writing, said ink being characterized by having a yield value sufficiently high to resist flow of the ink under the force of gravity and requiring superatmospheric pressure to overcome said yield value of the ink and effect flow of the ink from the ink reservoir to the ball point, the relation between the yield value of said ink and the superatmospheric pressure supplied thereto being controlled so that the ink will not ooze around the ball point when the pen is not in use, said yield value of the ink in the confined space at the ball point being sufficient to prevent passage of the ink from the ball point in the absence of

rotation of the ball, but being overcome by the combined shearing force of the ball during rotation and the force of said superatmospheric pressure to effect feeding of the ink by the rotating ball to the writing surface, said ink comprising a mixture of pigment and liquid vehicle wherein the ratio of pigment to vehicle is of the order of 1 part pigment to 5 parts vehicle.

3. A pressured ball point pen as defined in claim 1 and in which the pigment is dispersed in a resinous vehicle.

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