June 28, 1949. G. HALPERN 2,474,312

STYLUS

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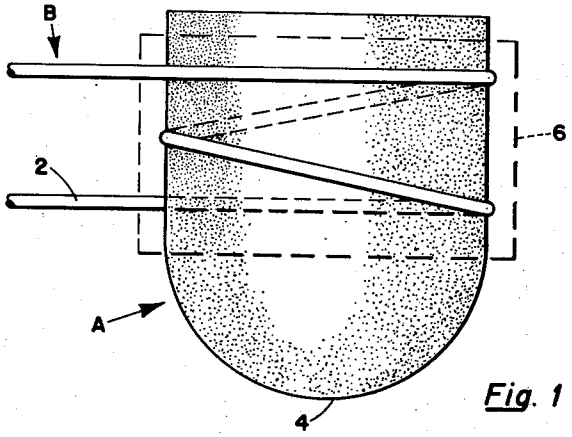

Fig. 1

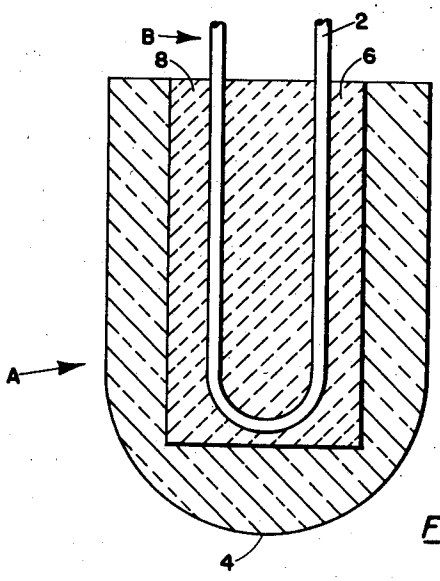

Fig. 2

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STYLUS

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15 Claims. (Cl. 219—21)

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This invention relates to a stylus adapted to be heated and to inscribe markings on a heat-sensitive surface.

Heat-sensitive surfaces of the type under discussion generally comprise a fabric web such as paper upon which a heat-sensitive coating is applied, the coating being of such a chemical composition that as heat is applied to any portion thereof, it decomposes and its color changes. Such heat-sensitive surfaces are used for a variety of purposes, the most common of which is as a recording medium for use in cardiographic and encephalographic apparatus.

In such instruments, a stylus of low inertia is caused to vibrate in accordance with amplifications of electrical impulses generated either by the heart or the brain and the heat-sensitized paper is caused to move under the stylus at a predetermined rate, the markings which the stylus leaves on the paper thus corresponding to the detected electrical impulses. Styluses for use in such apparatus must therefore have an exceedingly low inertia since they must be responsive to rapidly varying impulses of relatively small intensity. The styluses must at the same time be heated to a temperature at their point of contact with the heat-sensitized surface sufficient to cause chemical change in that surface or in the coating thereon, the chemical change resulting in the inscribed marking.

As employed heretofore, the stylus element has been shaped from a thin element of high resistance wire, usually a suitable nickel-chromium alloy, and an electrical current is passed through the wire for heating purposes. However, the interaction between the wire and the chemical compounds of the heat-sensitized surface has been such as to affect the stylus to render it capable of use over but a small period of time. These deleterious effects have primarily arisen because the heat-sensitive compounds generally include compounds of sulphur, lead, chromium, cobalt, iron, nickel or copper. When these compounds are exposed to heat so that their temperature is raised to approximately 800° C., as by action of the stylus, they decompose to form the markings on the surface and their products of decomposition include the oxides, and when sulphur is present, the sulphides of the metals above enumerated. These oxides and sulphides are generally characterized by having an exceedingly high melting point. Residues of these oxides and sulphides tend to adhere to the stylus and, because of the chemical composition of the wire stylus, apparently tend to be adsorbed thereby and to some extent to enter into chemical combination therewith, and ultimately build up to considerable size.

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A number of deleterious effects stem from this, which effects both singly and cumulatively have made the employment of such styluses with heat-sensitized paper commercially impracticable. Among such effects may be mentioned the following:

(1) As the oxide and sulphide decomposition products build up on the surface of the stylus at the point where it contacts the heat-sensitized surface, they act to form an insulatory layer between the stylus and the heat-sensitized surface. Hence, in order to bring the heat-sensitized surface to its required marking temperature, the stylus wire must be heated to a temperature higher than that normally necessary. Although the stylus wire has desirable air characteristics, that is to say, it is resistant to progressive oxidation even when heated to relatively high temperatures, as its temperature increases, its resistance to oxidation and corrosion decreases. Consequently, the presence of the thermal decomposition products on the stylus causes a reduction in resistance to oxidation on the part of the stylus wire and thus a material decrease in effective life results.

(2) The decomposition products themselves appear to enter into chemical combination with the stylus wire. The exact nature of this combination is not known but it has been observed that in the presence of the decomposition products the stylus wire deteriorates at a far greater rate than would be expected from oxidation alone and that the deterioration takes place most rapidly at those points where the residues have attached themselves.

(3) As the residues build themselves up into bead-like form, the markings effected by the stylus becomes scratched, blurred and discontinuous.

The above effects have therefore tended to restrict the life of the heated styluses as heretofore known to approximately twenty minutes to one-half hour of continuous use.

As has been stated, the residues formed have exceedingly high fusion points, generally varying between 1,000° and 1,400° C. and hence will not liquify and fall from the stylus wire until heated to those high temperatures. In addition, their tendency to enter into chemical combination or amalgamation with the stylus wire requires that they be heated well above their fusion points before they can be removed.

I have discovered that the above disadvantages

can be minimized and well nigh eliminated by forming the stylus member of a hard abrasive resisting substance having a high fusion point and which is relatively chemically inert, particularly with respect to the heat-sensitive components of the surface over which the stylus is moved. It has been found that the life of such a stylus is relatively independent of its length of use and is limited only by the life of the heating element employed in conjunction therewith. That heating element, as will appear hereinafter, may be sealed from external oxidizing, corroding or other deteriorating influences, and thus a stylus is produced which may be employed with conventional heat-sensitive surfaces over extended periods of time without material decrease in effectiveness. By the employment of such a stylus, I have made practical from an economic point of view the utilization of heat-sensitive surfaces, particularly in delicate recording instruments, heretofore considered unfeasible because of the poor characteristics of prior styluses.

To the accomplishment of the foregoing objects and such other objects as may hereinafter appear, the present invention relates to a two-piece heated stylus as set forth in the appended claims and as described in this specification, taken together with the accompanying drawings, in which:

Fig. 1 is a side view of one embodiment of my stylus; and

Fig. 2 is a side cross-sectional view of another embodiment thereof.

This application is a continuation in part of application, Ser. No. 676,547, filed June 13, 1946, by the present inventor, now abandoned.

My stylus comprises essentially a heat absorbing and transmitting stylus member A and a heating element B therefor, the latter preferably being in the form of a high resistance wire **2** which has good air characteristics, that is to say, resists progressive oxidation even when heated to high temperatures. While a nickel-chrome alloy is preferably used, it will be understood that any of the well known wire elements having this characteristic may be employed in its stead.

The heating element B is placed close to and preferably in contact with the stylus member A, the heat from the heating element B being thus transferred to and absorbed by the stylus member A, the member A in turn transferring that heat via its tip **4** to the heat-sensitized surface over which it is caused to travel by any conventional mounting means (not shown).

In order to eliminate the deleterious effects upon the stylus which the decomposition products of the heat-sensitized surface have heretofore exerted, I have found it desirable to form the stylus member A of a hard abrasive-resistant substance which is either infusible or has a very high fusion point and which is relatively chemically inert, particularly with respect to the heat-sensitive components of the surface. Many substances having these properties and which may be shaped to act as a stylus are known in nature or are synthetically procurable. Gems, both semi-precious and precious, and either natural or artificial, conform to the above specifications. In particular, I have found that sapphire and diamond are exceptionally well suited to use in many styluses both because of their ready procurability, their desirable physical characteristics and their ability to be synthetically formed. A synthetic sapphire (aluminum oxide or corundum) has been used by me with exceedingly fine results. Among compounds suitable for the purpose here

described but not classifiable as gems I may mention silicon carbide, elemental silicon or boron, compounds thereof, and oxides, borides, carbides, selenides, carbonates, tungstates, molybdates, silicates, silicides and sulfides of vanadium, chromium, iron, cobalt, nickel, tungsten, molybdenum, manganese and tantalum, where such chemical combinations are found to exist.

By employing a stylus member A formed of any one of the compositions above described, I achieve the following effects:

(1) The stylus member A being relatively chemically inert, it may be heated to any desired temperature without substantial danger of destruction through oxidation or corrosion. Thus, no matter to what extent decomposition residues may accumulate on its tip **4** and act as a thermal insulation, it can still be heated to a temperature sufficient to ensure good marking on the heat-sensitive surface.

(2) Because of the inertness of the stylus member A to the decomposition products of the heat-sensitive surface, these products do not tend to decompose and destroy the stylus.

(3) Because of the said chemical inertness, the decomposition products do not tend to combine or amalgamate with the stylus and consequently are more readily removed therefrom by being heated to their fusion temperatures. Because of the characteristics of the stylus member A, this high temperature may be attained without danger to the stylus itself.

It will therefore be seen that the life of the stylus will be determined almost exclusively by the life of the heating element B. It is apparent that the element B must be heated to a higher temperature when my stylus member A is employed than when the wire **2** itself is the stylus. Since the wire **2** is no longer in contact with the heat-sensitive surface, the deteriorative effect thereon of the decomposition products of the heat-sensitive surface is negligible, only such residues as sputter or jump from the surface sufficiently to attach themselves to the wire **2** being affected. However, progressive oxidation can still take place.

In order to more fully protect the wire **2**, it is preferably encased by a suitable refractory cement indicated by the broken lines **6** of Fig. 1. This cement not only serves to fix the stylus member A within the coiled wire **2** but also simultaneously serves to seal the wire from the action of all external deteriorative influences. In addition, it improves the heat transfer characteristics between the wire **2** and the stylus member A by preventing direct heat radiation from the wire **2** and, because of its refractory nature, substantially inhibiting heat transfer to the atmosphere therefrom.

The embodiment illustrated in Fig. 2 presents certain advantages over the simpler construction of Fig. 1. In Fig. 2, the stylus member A is hollowed as at **8** and into the cavity thus formed is placed the wire **2** which constitutes the heating element B. The cavity is then filled with refractory cement **6**. It will be apparent that this construction materially improves the heat transfer characteristics between the heating element B and the stylus member A since substantially all of the heat generated by the resistance wire **2** is transferred to the stylus member A. This reduces the temperature to which the wire **2** need be heated and thus prolongs its life.

In addition, since the refractory cement **6** is generally lighter than the hard material of which the stylus member **A** is composed, the weight of

the stylus member A is somewhat decreased, thus decreasing its inertia and increasing the sensitivity of the stylus as a whole. This is of particular importance where the stylus is employed in sensitive measuring instruments.

Furthermore, the cement **6** is by this construction itself insulated and protected from the deteriorative effects of the decomposition products of the heat-sensitive surface. This is particularly important when silicious cements are employed. The effect of the decomposition products on the cement is such as to cause it to crumble or flake off, thus exposing the wire **2** to the deteriorative effects which the application of the cement **6** is designed to prevent. In the embodiment of Fig. 2, the cement is so positioned as to make it practically impossible for decomposition products to attack and destroy it.

It will be apparent that by constructing the heated stylus in the manner described, I have eliminated the disadvantages of styluses previously employed with heat-sensitive surfaces and have devised a stylus which is at once simple, effective and of long life. Many changes may of course be made in the specific design of the stylus without departing from the spirit of the invention as set forth in the following claims.

I claim:

1. A two-piece stylus for inscribing on a heat-sensitive surface comprising a heat absorbing and transmitting stylus member and a heating element therefor, said stylus member being formed of a substance from the group consisting of natural and artificial gems and silicon carbide.

2. A two-piece stylus for inscribing on a heat-sensitive surface comprising a heat absorbing and transmitting stylus member and an electrical heating element therefor comprising heat resistant wire of high electrical resistance, said stylus member being formed of a substance from the group consisting of natural and artificial gems and silicon carbide.

3. The two-piece stylus of claim 2, in which the wire at least partially envelops the exterior of said stylus member and is covered by a refractory cement, the cement thus serving to fasten the wire to the stylus member and simultaneously to seal the wire from the action of external deteriorative influences.

4. The two-piece stylus of claim 3, in which the stylus member is formed of a gem.

5. The two-piece stylus of claim 3, in which the stylus member is formed of aluminum oxide.

6. The two-piece stylus of claim 3, in which the stylus member is formed of a diamond.

7. The two-piece stylus of claim 3, in which the stylus member is formed of silicon carbide.

8. The two-piece stylus of claim 1, in which the stylus member is formed of a gem.

9. The two-piece stylus of claim 1, in which the stylus member is formed of aluminum oxide.

10. The two-piece stylus of claim 1, in which the stylus member is formed of a diamond.

11. The two-piece stylus of claim 1, in which the stylus member is formed of silicon carbide.

12. A two-piece stylus for inscribing on a heat-sensitive surface comprising a heat absorbing and transmitting stylus member formed of a gem and having a recess, an electrical heating element therefor of heat resistant wire having high electrical resistance which is received within said recess, and refractory cement filling said recess for fastening said wire to said stylus member and sealing it within said recess.

13. A two-piece stylus for inscribing on a heat-sensitive surface comprising a heat absorbing and transmitting stylus member formed of aluminum oxide and having a recess, an electrical heating element therefor of heat resistant wire having high electrical resistance which is received within said recess, and refractory cement filling said recess for fastening said wire to said stylus member and sealing it within said recess.

14. A two-piece stylus for inscribing on a heat-sensitive surface comprising a heat absorbing and transmitting stylus member formed of a diamond and having a recess, an electrical heating element therefor of heat resistant wire having high electrical resistance which is received within said recess, and refractory cement filling said recess for fastening said wire to said stylus member and sealing it within said recess.

15. A two-piece stylus for inscribing on a heat-sensitive surface comprising a heat absorbing and transmitting stylus member formed of silicon carbide and having a recess, an electrical heating element therefor of heat resistant wire having high electrical resistance which is received within said recess, and refractory cement filling said recess for fastening said wire to said stylus member and sealing it within said recess.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,200,810	Clemens	Oct. 10, 1916
1,395,635	Finizio	Nov. 1, 1921
1,656,690	Blackburn	Jan. 17, 1928
2,031,532	Goldman	Feb. 18, 1936
2,248,057	Bond	July 8, 1941

FOREIGN PATENTS

Number	Country	Date
246,565	Great Britain	Jan. 28, 1926