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PENCIL LEAD

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Our present invention relates to pencil leads that have particular utility with the type of statistical machine in which the electrical resistance of a pencil mark on a card is utilized as the basis of card classification.

An object of the invention is to provide a pencil lead useful for the foregoing purposes, in that the mark made therewith will have the requisite high electrical conductivity and this without sacrifice of the various desirable properties of known leads of good quality, including smooth writing of predetermined hardness or softness, durability and uniformity, and which in fact, differs in practical utility from known leads of corresponding quality, substantially only in that the electrical resistance of the mark is but a small fraction of that made by the conventional lead.

Another object is to provide a lead of the above type, the cost of production of which is no greater and in fact, may be less than that of ordinary leads of corresponding quality and which is not subject to deterioration in any respect and in particular, not subject to loss of its relatively high electrical conductivity characteristic, even though used long after it has been fabricated.

Another object is to provide a lead of the above type, which, despite its high electrical conductivity, has no ingredients therein apt to destroy or impair the card or other sheet upon which the pencil is used, and which has no toxic ingredient apt to cause injury or discomfort by contact with the fingers or with the tongue of the user.

According to the invention, there is used instead of or if desired, in addition to the wax or oils with which leads are impregnated in conventional practice, an electrolyte which may have physical characteristics approximating those of the wax found suitable for lead pencils and imparts the desired electrical conductivity.

While it is within the scope of the invention from its broader aspect to use as such electrolyte, any suitable ionizing agent, such as an acid or a base in appropriate dilution, or one of the weaker acids, it is preferred to use a salt of the type that is not toxic. While water might be used as the sole vehicle, this is not recommended as the same is subject to drying out. It is preferable to use a vehicle which is non-volatile at room temperature, desirably a polyhydric alcohol corresponding roughly in oleaginous consistency to the oils found suitable in the past for impregnating leads. Glycerine is suitable as the vehicle, but where less hygroscopicity is desired ethylene glycol or

other polyhydric alcohol such as manitol or sorbitol may be preferred.

Among salts suitable for the purpose, are sodium chloride, potassium chloride, aluminum chloride and stannate. A suitable weak acid that may be used in place of the salts is boric acid, acetic acid, or malic acid.

One desirable formula of electrolyte for impregnating the lead is 200 c. c. of glycerine and 80 c. c. water to 100 grams of sodium chloride. The sodium chloride in the formula set forth may be replaced by potassium chloride if desired. Where boric acid is used as the ionizing element, it is found preferable to use only 75 grams thereof with 200 c. c. of glycerine and 100 c. c. of water. The fired, relatively porous leads made of graphite and clay are kept in such electrolyte solution for about four hours at 100 degrees C. Vacuum may be applied if desired to facilitate impregnation. Some of the water will evaporate during this impregnating action, but there will still be a considerable quantity of water left and kept in the lead by the hygroscopic action of the glycerin. The leads after impregnation are preferably quickly rinsed in water and dried in sawdust in the usual manner.

While the use of sodium chloride is desirable because of its low cost, it is found in practice that when replaced by aluminum chloride, the conductivity of the lead is even further increased and for some purposes, aluminum chloride is, therefore, preferred.

In another embodiment of the invention, sodium stannate is used as the ionizing ingredient, preferably in proportion of 60 grams to 200 c. c. of glycerin and 100 c. c. of water. The sodium stannate electrolyte in the lead appears to impart at the region of the mark made therewith, a parchment-like finish to the paper and has certain advantages from that standpoint.

Since the impregnating medium used in the lead, unlike the oils and greases used in conventional leads is miscible with water, ordinary water soluble glue used to bond the wooden casing to the lead may be used therewith, without further treatment of the lead and a secure bond may thus be effected.

With the use of the various impregnating electrolytes referred to, the various objects are attained. The markings in all cases have sufficiently high conductivity to serve for classification by electrical resistance, they maintain the electrical conductivity without deterioration, the leads are non-corrosive and harmless to the touch and to the tongue, and the lead is not im-

paired in its writing qualities or durability nor is the paper adversely affected by the mark made therewith.

As many changes could be made in the above article and many apparently widely different embodiments of this invention could be made without departing from the scope of the claims, it is intended that all matter contained in the above description shall be interpreted as illustrative and not in a limiting sense.

Having thus described our invention, what we claim as new and desire to secure by Letters Patent is:

1. A pencil lead of a fired mix of graphite and clay, impregnated with an ionized sodium chloride solution.

2. A pencil lead of a fired mix of graphite and clay, impregnated with an ionized aluminum chloride solution.

3. A pencil lead of a fired mix of graphite and clay impregnated with glycerin, boric acid and a substantial proportion of water.

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