

UNITED STATES PATENT OFFICE

L. OTTO P. MEYER, OF NEWTOWN, CONNECTICUT.

IMPROVEMENT IN THE MANUFACTURE OF SAFETY-MATCHES.

Specification forming part of Letters Patent No. 149,324, dated April 7, 1874; application filed March 20, 1874.

To all whom it may concern:

Be it known that I, L. OTTO P. MEYER, of Newtown, in the county of Fairfield and State of Connecticut, have invented certain Improvements in the Composition of Safety-Matches, of which the following is a specification:

My said improvements relate to the safety-match originally patented by I. W. Hjerpe. Hjerpe did not make his paste suitable otherwise, but for sticks previously dipped in sulphur, and sulphur is objectionable as ingredient for matches, the most objectionable for chlorate matches. Hjerpe's paste contains chlorate of potassa and bichromate of potassa. Bichromate, in said combination and in Hjerpe's specified proportions, behaves similarly objectionable as sulphur. By its omission Hjerpe's match is rendered not ignitable on the special igniting-surface. (Nevertheless Hjerpe's match may be esteemed far superior to any other sulphur-dipped match.) By an error chromate of potassa is mentioned in Hjerpe's specification of patent, and I am authorized to state that the simple chromate is not found serviceable for his paste. My said improvements relate the most to the safety-match already patented by me; and consist in certain modifications of its manufacture, as found best suitable, since obtaining improved surfaces for igniting my matches. The object of said modifications is to improve the paste for the process of drying, so that, with greater certainty, the paste-points properly shrink and become firm and hard, not porous nor bulky, and suitable for dipping in highly heated wax. Said object I obtain, partly, by preparing my paste with acetic acid and alcohol, but more fully or better by acetic acid mixed with a little acetate of iron.

Matches made by my modified manufacture have stood the test of time—already over a year—and the following is a description of their quality: First, my matches ignite by no friction, but on a special prepared surface, by a hard or very quick stroke. Adults, after a little practice, ignite my matches easily on short igniting-surfaces—more easily the more

long the igniting-surface. In the hands of little children, my matches are harmless. Secondly, my matches do not ignite if violently rubbed together; or if stepped upon; nor by rolling them under feet; nor by a heat below 450° or 500°, Fahrenheit. They stand a heat high enough to char them black without igniting. Thirdly, my matches and their igniting-surfaces contain no elements for spontaneous combustion. The igniting-surface is not inflammable. Fourthly, as igniting-surface, (which means a special-prepared surface for igniting my matches,) Hjerpe's painted igniting-surface may serve; but my surfaces, made of vulcanized india-rubber compound, are of better service. Said rubber contains no phosphorus, nor any other poison; and, if damp or wet, is easily rubbed dry; can be cleaned by scraping, or by hot water, and may serve for years. Fifthly, my matches are free from phosphorus, sulphur, or poison. The match-paste is healthy to eat, at least harmless, especially if containing pumice, and no emery or flint. Sixthly, the ignition of my match produces no offensive explosive noise, nor sparks flying. The match burns without any smoke, without odor, and without adulterating the air, if the sticks are of suitable wood. Seventh, my matches, at the last stage of manufacture, are dipped in highly-heated paraffine-wax, so as to soak the sticks and to coat the paste-points, thereby increasing their resistance to humidity, as facilitating ignition of the sticks. Some of my matches—of two and a half inches in length—are prepared to burn about three minutes, if the burning-point is pointed upward. Eighthly, the residue of the burned match-points, whenever the flame is extinguished, is not red-hot coal, nor glassy slack, but a dust, harmless in every respect. Ninthly, the manufacture of my match is simple, and offers no unhealthy labor to employes. Tenthly, the cost of using my match is reduced by dispensing with the small wooden or paper boxes with painted igniting-surfaces, and by the use of my rubber-surfaces.

In the following tables, I and II, I give the ingredients and their proportions, by which is obtained the best results:

TABLE I.

	No. 1.	No. 2.
Ma'ch-paste:		
Pure strong gelatine, parts by weight	24	22
Ground pumice or emery flour.....	16	18
Chlorate of potassa.....	60	60
Acetic acid, No. 8.....	100	100
Liq. acet. sesquioxide or protoxide iron	71 1½	65 1½
Loss by evaporation, about	172½ 20½	166½ 18½
Weight when ready for dipping	152	148

TABLE II.

	No. 3.	No. 4.
Match-paste:		
Pure strong gelatine, parts by weight	18	18
Ground pumice or flint.....	30	29½
Chlorate of potassa.....	52	52
Red iron oxide		½
Rain-water	100	100
Acetic acid, No. 8	36	36
Alcohol	6	6
Loss by evaporation, about	148 13	148 13
Weight when ready for dipping	135	135

Rain-water may be added to any of my pastes, if reduced too much by evaporation.

The following table, III, gives ingredients and their proportions for Hjerpe's paste, as modified by me, so as to be suitable for wax-dipping. This paste contains bichromate of potassa, which is somewhat poisonous to handle. The small proportion of bichromate may be harmless; still, this paste is inferior in quality to my pastes, given in above two tables, especially the test of time.

TABLE III.

	No. 5.	No. 6.
Match-paste:		
Gum-arabic, parts by weight	20.00	
Gelatine		19
Bichromate of potassa	6.66	6
Chlorate of potassa	53.34	56
Emery flour.....	20.00	19
Rain-water	100 25	100 57
Weight when ready for dipping.....	125	157

The natural color of my pastes, Nos. 1, 2, and 3, if not containing emery, is white or cream color. The paste Nos. 1 and 2 is readily changed into other fine tints. They contain peroxide of iron, (if but protoxide was

added, it partly changes into peroxide;) and yellow prussiate of potassa produces therein a green or blue color; but the red prussiate colors when protoxide is present. One grain of said prussiates to one pound of paste produces a light-green tint; double or triple said portion of prussiate produces light-blue or dark-blue tint. Paste No. 4 is pink-colored.

I require pure ingredients; the chlorate of potassa to be free from chloride of potassium. If not pure, may be purified by dissolving in pure water and recrystallization. The selected white pumice in large lumps is preferable. Small traces of peroxide of iron, (yellow streaks,) sometimes found in pumice, do no harm. Traces of peroxide or protoxide of iron, found in acetic acid, are not injurious. The emery from Wellington mill, London, appears preferable to others; still, pumice is preferable to emery and flint. The common glue often contains chlorine and other impurities to be avoided, and I employ prussian-white, strong gelatine, or I. & G. Cox's London gelatine. The paraffine wax is wanted very pure. Its congealing-point may be at 115° Fahrenheit, or as high as obtainable. The preferred quality of wood for match-sticks is hereinafter described.

The mode of preparing my pastes: For pastes Nos 1 and 2, I dissolve the gelatine in the acetic acid and liquid acetate, either at common warm temperature or at moderate heat, and then add the other ingredients. For pastes Nos. 3 and 4, I dissolve the gelatine first in the water and acetic acid before adding alcohol and other ingredients. I employ, for preparing, mixing, and grinding of paste, utensils not decomposed by acetic acid, such as wedgwood or porcelain. I grind the pastes at a temperature ranging from 75° to 90° Fahrenheit, but heat somewhat higher answers as well. The pastes Nos. 1 and 2 have a strong vinegar odor at commencement of mixing and grinding, and for these in particular I have constructed a simple mill, consisting of a mortar attached on a vertically-revolving shaft. Its pestle, somewhat larger size than for the size of mortar, is held stationary in a slanting position by a stout cross-head, which can slightly yield to pressure by means of some springs.

My mode of preparing match-sticks: I prefer whitewood for sticks. The whitewood is first prepared in hot water and steam, and then cut, with a knife-machine, into thin sheets of one-tenth to one-twelfth of an inch thickness; and then, in another knife-machine, I staple a number of said thin sheets on top of each other, and each down stroke of the knife cuts a number of small square sticks, which are afterward cut into lengths of four and three-fourths to five inches, the double length of a single match, and then dried at a high heat. The steaming of the wood and drying at high heat improves the quality of the sticks.

for the contact with match-paste, and for burning without odor or smoke.

Preparatory to dipping with paste: Wooden dipping-boards, or dippers, are not suitable for my improved manufacture, and I have constructed my dippers out of steel plates of one-sixteenths of an inch thick. Three plates are flatwise arranged, so that the whole thickness of the dipper is three-sixteenths of an inch. Each dipper is perforated with small holes, just large enough to allow match-sticks easily to drop through. The middle steel plate is movable. For the process of filling, I adjust the dipper in a horizontal press, its surfaces horizontally, its holes open clear through, and so that the sticks can drop through only to about half of their length. I place a block, with holes corresponding to those in the dipper, on top of the dipper. This block is to guide the sticks to a proper straight position. After having passed match-sticks over the surface of said top block till all holes are filled, I tighten the sticks in their places by the middle steel plate, screwing it forward by means of the press, and securing it by wedges horizontally put in. I remove the top block before taking the dipper from off the press. One surface of the steel dipper is smooth, and, if filled, has nothing but sticks projecting, so that at the last stage of the manufacture a knife sliding along its smooth surface can cut the match-sticks into single length.

My mode of dipping with paste: My dipping-pans are of porcelain or lined with glass. I dip my pastes at a temperature as employed for grinding, the sticks of at least the same heat, and I allow the points first dipped somewhat to dry, just enough to keep shape, before turning them over for dipping the opposite points.

My mode of drying my matches: I dry the matches newly dipped with paste first at a moderate heat or common warm temperature for a few hours, and afterwards employ heat, gradually rising to about 200° to 300° Fahrenheit, till perfectly dry.

My mode of wax-dipping match-points: I melt paraffine wax in two pans in close proximity. In one pan I heat the wax to about 220° Fahrenheit, and in the other only to about 8° to 10° above its congealing-point.

The dried matches, still in steel dippers, I dip first in the highly-heated wax about one-fourth of an inch deep, and let them stand in it for about one to three minutes, and then withdraw them slowly, and dip them directly one-fourth of an inch deep in the less-heated wax for about one-fourth minute, and then withdraw them slowly, allowing at least one-half minute for the wax on the sticks to congeal before turning them over and dipping the opposite ends in similar manner. The highly-heated wax drives out and replaces air. The less heated sets a suitable coat. Sticks of very porous wood, or if highly heated, need but short time for said first dip in wax. Such matches as are required to burn a great length of time, with inflamed point upward, I dip a little deeper in wax.

I have also obtained somewhat good results, but less perfect wax-coating, by the mode of cutting the matches into single length, and tying them together into bundles preparatory to the processes of drying at high heat and of wax-dipping.

I will not be understood to say that my matches cannot possibly ignite on common surfaces. They may possibly ignite on highly-heated surfaces, or on some sulphurets, or on surfaces where rubbing of phosphorus matches has deposited phosphor; but in such cases either very high heat or exceedingly hard friction must aid, and which detracts not the least from the good quality of my matches. The pastes No. 5 and 6 I do not call my pastes, although they have been modified by me.

Definition of my invention: The within-described manufacture varies from the specifications of my former patents. All the modifications are invented by me, but I consider them in the scope of my former patents, except my present claim.

What I claim as my invention in the preparation of safety-matches is—

The employment of acetates of iron or of alcohol, in combination with certain ingredients, substantially as herein described.

L. OTTO P. MEYER.

Witnesses:

EDGAR F. HAWLEY,
HENRY SANFORD.