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METHOD OF TREATING AIRCRAFT FABRICS
AND PRODUCTS THEREOFLeo Roon, South Orange, N. J., assignor to Rox-
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corporation of New JerseyNo Drawing. Application October 24, 1941,
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The object of this invention is to protect the doped fabrics of aircraft against deterioration due to mildew and fungus growths.

It is the common practice in the manufacture of aircraft to cover the framework of various parts of the structure with fabric, usually linen, to thereupon shrink the fabric by sponging the same with water, in order to render it taut, and to thereafter apply a cellulosic dope to the exposed surface of the fabric.

Experience has shown that those portions of the fabric which cover dead air spaces in e. g., aerofoils, stabilizers, rudders, elevators and ailerons, which are sealed so that their interiors are not susceptible of ready periodical inspection, often mildew badly under the dope finish. It is not uncommon that the mildewing or fungicidal growths so weaken the fabric that only the dope finish serves to hold the parts together. This pernicious condition of the fabric is concealed by the exterior finish which appears sound and serviceable while the underlying structure is, in fact, inherently dangerous and liable to failure during flight.

I have discovered that doped aircraft fabrics may be effectually protected against deterioration from the causes stated by the use of a mildew proofing agent, especially copper naphthenate. It was found that copper naphthenate, prepared according to the method of United States Letters Patent No. 2,113,496 of April 5, 1938, was highly suitable for this purpose and I have incorporated it in the fabric in two distinct ways.

According to the first method, I prepared a copper naphthenate emulsion by compounding the following:

	Parts
Copper naphthenate (6% metallic copper based on the total weight of the copper naphthenate)	60
Concentrated ammonium hydroxide	8
Ethylene diamine	10
Water	10

The resulting copper emulsion contained approximately 4% copper. This emulsion was cut to a 1% solution with water and the resulting solution was used, instead of the plain water of conventional practice, to sponge the fabric after it had been secured to the framework of aircraft parts in order that the fabric might be shrunk over the framework. The thus treated fabric was allowed to shrink and dry. It was found to give equivalent shrinkage and consequent tautness to that of the usual water sponging. It

was also found to effectually introduce the copper into the fibres of the fabric.

After the fabric was dry, there was applied thereto the conventional clear cellulosic dope, aluminum dope and top coat enamel to form the usual waterproofing coating.

Treatments of the foregoing method, as stated, were carried out many months ago and at the time of this writing no sign of mildew or fungus growths have appeared. The thus treated fabric remains as strong and serviceable as when applied to the framework. Comparative samples, prepared at the same time, with the conventional plain water sponging and subsequent clear dope, aluminum dope and top enamel finish and subjected to the same atmospheric conditions, have badly deteriorated during the intervening period.

According to my second copper naphthenate treatment, I prepared a cellulosic dope by compounding the following formula:

	Parts
Cellulose nitrate (containing 30% alcohol) ..	133
Glycol sebacate (60% solids in toluene) ..	19
Ethyl acetate	142
Butyl acetate	146
Butyl alcohol	55
Aromatic petroleum naphtha	246

To this was added 7½% (by weight of the above formula) of a solution of copper naphthenate in toluol containing 6% of copper metal, so as to incorporate the copper naphthenate directly into the dope.

The resulting dope was sprayed onto aircraft fabric which had been prepared by fastening it to a framework and sponging it with plain water and allowing it to shrink and dry in the usual way before the dope was applied.

Under present day practice a small amount of chrome green, ground in castor oil, is commonly incorporated in the first clear dope coating as a guide for spraying. This is, however, not necessary here for the clear dope formula, including the added copper naphthenate, has a green color which coincidentally acts as a spraying guide and enables the operator to see that the clear coat is uniformly applied.

When the copper naphthenate dope was applied two entirely unforeseen phenomena were noted. In the first place, the penetration of the dope into the fibres of the fabric was materially increased over that of the same dope free of copper naphthenate content. This is highly desirable and a much sought for advantage. In the second place, the presence of the copper naph-

thenate seemed to produce a better sealing coat on the fabric, so that the same number and same thickness of sealing coats, the final finish was smoother.

Instead of using a nitrocellulose dope and incorporating the copper naphthenate therein as described, I may employ other forms of dope such, e. g., as a cellulose acetate butyrate dope. By way of example, there was prepared a dope in accordance with United States Navy specifications as follows:

	Pounds
Cellulose acetate butyrate.....	90
Triphenyl phosphate.....	10
Diacetone alcohol.....	135
Ethyl acetate.....	315
Toluene	180
Acetone	270

To this dope was added a copper naphthenate solution using toluene as a vehicle. The resulting product was unsatisfactory for the copper naphthenate sweated out and made a non-continuous film. The indications were that copper naphthenate could not be satisfactorily used in a cellulose acetate butyrate dope. However, after much experimentation, it was discovered that a compatible film, yielding excellent results, could be obtained by introducing the copper naphthenate into such dope in an ethyl acetate vehicle instead of a toluene vehicle.

The copper naphthenate in ethyl acetate was added to the above cellulose acetate butyrate dope formulation in such amounts that the quantity of copper present was approximately 2% or 3% by weight, of the solids in the dope. This dope, with the copper naphthenate therein, was applied to the fabric in a quantity to give .625 ozs. of film per square yard, per application, as commonly required by United States Navy specifications. This procedure produced .357% of copper on the fabric or .309% of copper on the basis of the film and fabric. Tests, subsequently carried out on samples of this treatment, were highly satisfactory.

After applying the copper naphthenate dopes, as hereinbefore stated, subsequent coatings of aluminum dope and top coat enamel were superimposed, as in the first example, and the resulting structure was exposed to the influence of mildew, along with comparative samples which had been prepared in the same way, but without including the copper naphthenate. During the period which has since transpired, the said comparative samples have badly deteriorated while the fabric which was treated with the copper naphthenate dope continues to retain its original condition and strength.

The discoveries hereinbefore described are of much practical importance for thereby a pernicious source of aircraft failure, with all-too-frequent loss of life to trained flyers and technicians, is eliminated and safety is assured through the exclusion of the causes stated.

It is to be also noted that the employment of this invention does not entail any additional mechanical operation to the conventional method of aircraft finishing, nor is training in any special technique required of the workmen who ordinarily fabricate and finish the fabric thereof. In the water-copper naphthenate treatment, the copper naphthenate is merely added to the sponging water and said water is thereafter applied in the same way as heretofore. According to the copper naphthenate dope treatment, the copper naphthenate solution is simply added to

the dope, as during the course of manufacture thereof, and thereafter the spraying operator applies such modified dope in the same old way, but without the necessity of adding chrome green, ground in castor oil, as a color guide.

I have referred to clear dope in the foregoing explanation, but it is to be noted that the copper naphthenate may also be added to colored dopes as well, these being used particularly where separate superimposed color coatings are to be omitted.

The tests carried out in my research with respect to this invention, showed that copper naphthenate produced the best results as an aircraft fabric mildewproofing agent. Alternates, but not so satisfactory, are mercury naphthenate, copper or mercury resinsates, zinc naphthenate, phenol mercury oleate, tolyl mercury salicylate and certain fungicides which are compatible with the particular dope formulation to be employed.

The foregoing description sets forth two illustrative ways of accomplishing the object of this invention, but the invention is to be understood as fully commensurate with the appended claims.

Having thus fully described the invention, what I claim as new and desire to secure by Letters Patent is:

1. The method which comprises, attaching a textile fabric to a structural framework of an aircraft, thereafter applying a shrinking agent to the fabric and allowing the fabric to shrink and dry, thereafter applying a sealing agent to the exposed surface of the shrunk fabric, and adding a mildew-proofing composition to one of said agents prior to the application of such agent to the fabric so that the mildew-proofing composition is applied conjointly therewith.

2. The method which comprises, attaching a textile fabric to a structural framework of an aircraft, thereafter applying a shrinking agent to the fabric and allowing the fabric to shrink and dry, thereafter applying a cellulosic doping agent to the exposed surface of the shrunk fabric, and adding a mildew-proofing composition to one of said agents prior to the application of such agent to the fabric, so that the mildew-proofing composition is applied conjointly therewith.

3. The method which comprises, attaching a textile fabric to a structural framework of an aircraft, thereafter applying a shrinking agent to the fabric and allowing the fabric to shrink and dry, thereafter applying a cellulose acetate butyrate doping agent to the exposed surface of the shrunk fabric, and adding a mildew-proofing composition to one of said agents prior to the application of such agent to the fabric, so that the mildew-proofing composition is applied conjointly therewith.

4. The method which comprises, attaching a textile fabric to a structural framework of an aircraft, thereafter applying water and a mildew-proofing agent to the fabric to shrink said fabric, and, after the fabric has shrunk and dried, applying a protective coating to the exposed surface of the fabric.

5. The method which comprises, attaching a textile fabric to a structural framework of an aircraft, thereafter shrinking said fabric, and applying to the exposed surface of the shrunk fabric a protective coating containing a mildew-proofing agent.

6. The method which comprises, attaching a textile fabric to a structural framework of an aircraft, thereafter shrinking said fabric, and applying to the exposed surface of the shrunk fab-

ric a coating of cellulosic dope containing a mildew-proofing agent.

7. The method which comprises, attaching a textile fabric to a structural framework of an aircraft, thereafter shrinking said fabric, and applying to the exposed surface of the shrunk fabric a coating of a cellulose acetate butyrate dope containing a mildew-proofing agent.

8. The method which comprises, attaching a textile fabric to a structural framework of an aircraft, thereafter shrinking said fabric, and applying to the exposed surface of the shrunk fabric a coating of a cellulose acetate butyrate dope containing a copper salt.

9. The method which comprises, attaching a textile fabric to a structural framework of an aircraft, thereafter shrinking said fabric, and applying to the exposed surface of the shrunk fabric a coating of a cellulose acetate butyrate dope containing copper naphthenate.

10. An aircraft part comprising a structural frame-work of an aircraft, and a shrunk-taut covering of textile aircraft fabric thereover, said fabric being impregnated with a mildew-proofing agent.

11. An aircraft part comprising a structural frame-work of an aircraft, and a shrunk-taut covering of textile aircraft fabric thereover, said fabric being impregnated with a cellulosic dope containing a mildew-proofing agent.

12. An aircraft part comprising a structural frame-work of an aircraft, and a shrunk-taut covering of textile aircraft fabric thereover, said fabric being impregnated with cellulose acetate butyrate dope containing a mildew-proofing agent.

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