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AIRCRAFT PART AND COVERING THEREFOR

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This invention relates to fabric coverings for aircraft and methods of producing the same.

Heretofore cotton textile fabrics have been extensively employed for the covering of the frames of various parts of aircraft. It has been the practice to cover wing sections, ailerons, rudders, elevators, stabilizers, and fuselages with textile cotton fabric by tacking or adhesively securing the fabric over the frames, then shrinking the fabric so as to render the same taut and thereafter applying a number of coatings of various kinds of aeroplane dope.

This treatment of cotton fabric has been a source of much difficulty. Cotton fabrics are woven from cotton thread which is in turn formed from cotton fibres with the result that, in the finished product, there is a pronounced nap on the surface of the fabric caused by loose ends of fibres and threads. This nap is fuzzy in character and by no means uniform in depth.

When such a fabric is stretched over the frame of an aircraft part and shrunk into place, this nap projects from the exterior surface of the fabric to form quite an uneven surface. This surface must be rendered smooth and uniform in order to minimize friction with the air. Also the fabric must be appropriately treated to strengthen and stiffen it and at the same time minimize deteriorating effects of ultra violet rays of the sun. The usual treatment is also designed to prevent the skeleton of the frame from showing through.

According to prior practice the treatment of cotton fabric to accomplish these results and others has usually consisted in applying to the fabric a number of coatings of various kinds or types of aeroplane dope which are commonly of a cellulosic character. In doing this work, it has been the practice to apply the first coat of dope over the fabric by brushing the dope on. Brushing has been used for the application of this coating on the theory that, when the coating was brushed on, the fibres of the nap would be brushed or combed down and so embedded in the coating that they would not protrude from the surface thereof.

Experience has shown, however, that the amalgamation of the fibres into a smooth initial coat does not work out in practice, for it seems that the conventional nitrocellulose dopes have an inherent property, because of their very nature, of raising the fibres to the surface, so that not only a rough surface results, but usually a considerable portion of the fibres project beyond the same.

It is of course true that this condition is less prevalent when the first coat or coats are brushed on rather than when they are sprayed on, but it is the fact that such condition results no matter how these coats are put on. It may be noted, in this connection, that penetration of the finish through the body of the cotton fabric, so as to saturate the nap or loose ends on the other side thereof, is important as a protection against the capillary action of moisture and as a protection to the fabric against deterioration.

No satisfactory solution has been produced to my knowledge with respect to this penetration factor when applying the initial coating of cellulose dope to cotton fabric. Brushing materially improves the penetration, but it does not ensure uniform good results. Consequently, manufacturers have been forced to rely upon the penetration results which they could obtain by known methods, but have spent considerable time and effort in improving the external surface conditions, not only by applying numerous superimposed coats of dope over the initial coating, but also by sanding or "scuffing" each coating before the application of the next coating.

The purpose of sanding is to remove projecting fibres and also to smooth off the tops of minute projections of dope which accumulate about these fibres before the dope hardens. If one examines the surface of the first coating under a powerful magnifying glass, the entire surface will be a succession of projections and hollows. The sanding operation serves to level these off somewhat, but skill and care must be exercised in this work, so that the sanding is as uniform as possible. Absolute uniformity in this work, however, is out of the question because the fabric is more or less yielding and there is always the inherent danger of taking off too much material where the fabric is backed up by a rigid part of the frame and not enough material where the fabric is bridging a space between frame elements.

In the past it has been common practice to use at least one coating of aluminum dope over the initial coating of clear dope as this has been found to produce an easily sanded surface over which subsequent color coats can be applied to produce a smoother final surface. The incorporation of the aluminum coat, however, although standard practice, is objectionable from the standpoint of fire hazard for I have found that when an aluminum dope is incorporated into the finish, such finish becomes more combustible than when the aluminum dope is omitted. I am not prepared to explain the exact scientific rea-

sons for this, but I do know by reason of numerous experiments that such is the case.

In carrying out the prior practice, as hereinbefore described, it is not uncommon for the coatings superimposed upon the cotton fabric to weigh as much or more than the fabric itself. In other words, the treatment hitherto employed adds very materially to the weight of the fabric covering and, manifestly, correspondingly decreases the useful load carrying capacity of the ship.

The foregoing practice has long been employed in the aircraft art and although many of the stated difficulties have been recognized and their solution attempted, no one produced a more satisfactory treatment prior to this invention.

I have succeeded in overcoming the difficulties stated by employing, in lieu of cotton, a fabric, whose individual components are mechanically extruded filaments produced from plastic type materials. Filaments of this kind, of which rayon may be cited by way of example, are produced by mechanically extruding a plastic type material to form a filament of indeterminate length without laterally extending fibrous projections and having a substantially smooth cylindrical surface of substantially uniform diameter throughout such indeterminate length. "Vinyon" and "nylon" filaments may also be cited by way of further examples of mechanically extruded plastic type material filaments which may be used. These filaments employed are preferably twisted before use, so as to minimize their tendency to stretch. When filaments of this type are woven into a fabric, such fabric has a smooth uniform surface, entirely free from nap and practically free from loose ends.

In carrying out the method of this invention, I take such a fabric and apply it to the framework of a structural element of the aircraft, by tacking it in place thereon, or by securing it to the framework by an ordinary cellulosic dope or other suitable adhesive, or attaching it to the framework in any other appropriate manner. I then sponge the fabric with water and permit it to dry with consequent shrinkage, so as to render the fabric taut and free from wrinkles.

I next apply reinforcing tapes and patches over seams and other points where reinforcement is desired. For this purpose I preferably use strips of the same material, the edges of which are raveled or pinked, so as to readily embed and hold in the dope or other appropriate cement which is used to attach them.

I next preferably spray one coat of opaque cellulosic dope over the exterior surface of the fabric. Any appropriate opaque dope may be employed in this connection. In fact, I may use aluminum dope, but with this invention it is not necessary and I prefer not to use it, for it is my desire to eliminate fire hazard as much as possible. I need not apply a clear base dope as heretofore and may apply the opaque dope directly to the raw fabric.

Very satisfactory results have been obtained by using as this first spray coating, a clear cellulose dope, pigmented black to render it opaque. By doing this, the frame will not show through and the black coating will protect the fabric from ultra violet rays. This dope may be sprayed hot or cold as desired, but in any event, I have found that I get remarkably good penetration. In fact, it is possible to penetrate entirely through the thickness of the fabric. The opaque dark colored dope is a highly satisfactory indicator of the degree of penetration and at the same time it serves as a color guide to facilitate the application of a subsequent coating.

One example of a dope which may be satisfactorily employed as described is the well known United States Navy dope formulation set forth in the first column of page 2, lines 12—18 of United States Letters Patent No. 2,330,998, issued October 5, 1943 to Roxalin Flexible Finishes, Inc., as assignee of Leo Roon.

This United States Navy dope embodies the following ingredients:

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

The foregoing is a clear dope, but it may be rendered opaque for use as hereinbefore described by adding thereto appropriate carbon black in satisfactory amounts to give the desired result, say approximately 19 pounds.

I do not require a dope to cover or mat down the nap, but rather one which will protect against the ultra violet rays, preclude the showing through of the skeleton frame, and one which will properly secure the filament of the fabric together against relative shifting with respect to one another and will at the same time fill in the interstices of the weave and the slightly undulating surfaces of such weave. It is found that, after the pigmented dope has been sprayed as described to form the initial coating, a very smooth surface results. I may in some cases slightly sand or scuff this surface to insure a better bond for a subsequent coating and to remove any foreign matter or dust that may adhere to the coated surface.

I next superimpose upon the dark pigmented coating one or more additional cellulosic dope coatings, which may be either clear or colored to give a finish of the desired color. The Navy dope formulation hereinbefore given may be used either clear or pigmented for this purpose. Very satisfactory results have been obtained by applying over the dark pigmented coat one cross coating sprayed hot, although the spraying may be cold without departing from this invention.

After application of this cross coating, I have found that, in practically all cases, there results a smooth, uniform finish which is perfectly satisfactory for all purposes, including general weather resistance, so that the aircraft element so prepared, is ready for use.

My work in connection with this invention has shown certain things the knowledge of which is useful in practically carrying out the present invention. For example, I have found that I can obtain a thoroughly satisfactory finish for all purposes, by employing a much less aggregate thickness of coatings over the surface of the fabric. This means that the coatings will be of less weight than heretofore considered essential. The difference in weight, however, can be made up by using a heavier and consequently stronger fabric base and thus the finished coated fabric of this invention will possess greater inherent strength than adequately coated cotton fabric of similar surface. Some indication of the amount of saving in weight of coating material has been given by my experiments, for a saving of at least 25% or 30% of the total weight of the finished covering is indicated.

In certain tests which I made I took strips of the fabric which I employ, of identical character, width and length. I applied dope finishes including aluminum dopes to certain of these strips and I applied to other like strips dope finishes with a dark pigmented dope in lieu of the aluminum. I then ignited corresponding ends of these strips and observed the speed of burning. It was clearly apparent from these tests that the strips embodying an aluminum dope burned much more rapidly and were consumed much quicker than the strips wherein the aluminum dope was lacking. This clearly demonstrated that the present invention very materially lessens the fire hazard over prior conventional practice.

It will be apparent that the present invention constitutes an important advance in aircraft construction for it not only materially speeds up production, but constitutes a very definite safety factor. Some of the plastic type films to which I have hereinbefore referred may, in the raw, cost more than the equivalent yardage of cotton fabric, but the saving in coating materials and in their time of application and the number of coatings required, will more than offset the difference in price of the fabric itself, while the superiority of the finished product, from the standpoints of appearance, strength and durability, commend it to universal application.

The foregoing detailed description sets forth the invention in its preferred, practical forms, 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. In an aircraft, a structural framework of an aircraft part, and a covering comprising a shrunk-taut woven, mechanically extruded, organic filament fabric secured to and covering said framework, and at least one coating of cellulosic dope impregnating said fabric.

2. In an aircraft, a structural framework of an aircraft part, and a covering comprising a shrunk-taut woven, mechanically extruded, organic filament fabric secured to and covering said framework, and at least one coating of cellulosic dope impregnating said fabric, said cellulosic dope including a pigment to render it opaque.

3. In an aircraft, a structural framework of an aircraft part, and a covering comprising a shrunk-taut woven, mechanically extruded, organic filament fabric secured to and covering said framework, a coating of a dark, opaque cellulosic dope over and impregnating said fabric, and a superimposed coating of colored dope over the opaque coating.

4. In an aircraft, a structural framework of an aircraft part, and a covering comprising a shrunk-taut woven, mechanically extruded, organic filament fabric secured to and covering said framework, the individual filaments of the fabric being twisted, and at least one coating of cellulosic dope impregnating said fabric.

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