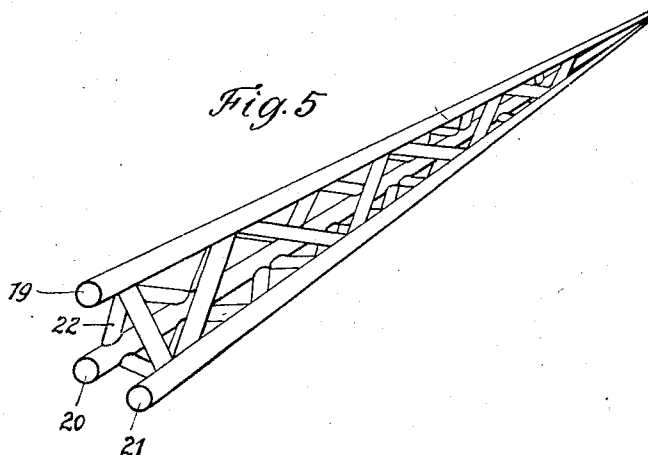
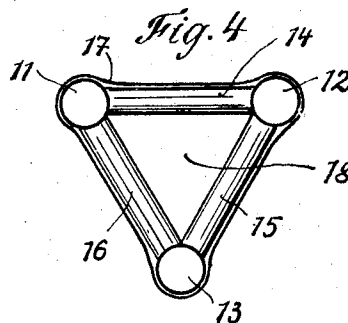
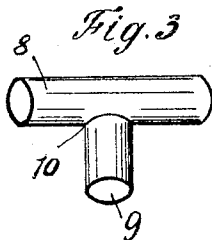
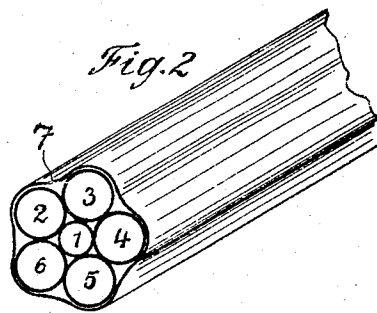
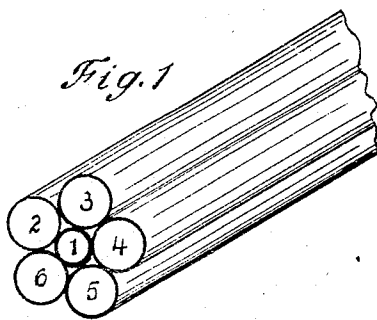


April 15, 1941.

A. SCHMID
STRUCTURAL MATERIAL
Filed June 26, 1937

2,238,427



Inventor:
Alfred Schmid
By *Alfred Schmid*
His Attorney.

UNITED STATES PATENT OFFICE

2,238,427

STRUCTURAL MATERIAL

Alfred Schmid, Berlin-Dahlem, Germany

Application June 26, 1937, Serial No. 159,597
In Germany July 9, 1936

4 Claims. (Cl. 154—43)

This invention relates to a new, tubular, light structural material.

A light structural material which is to be used primarily for the construction of air-ships and aeroplanes has to satisfy a number of different requirements. In the first place it must be of great strength and light weight and it must be capable of being used for many different kinds of constructions and must be very resistant to atmospheric influences. These requirements have not been satisfactorily met by the structural materials, such as wood and metals, which have hitherto been used.

A second and more important requirement which must be satisfied, is that the structures can be rapidly constructed from the material, that is to say they can be firmly united in a short time, so that the main cost of an aircraft is not, as previously, the cost of the working hours necessary for its construction, while that of the structural material itself is relatively small.

The present invention solves this problem by using as the structural material circular, non-circular or polygonal tubular elements which are made of a cellulose derivative, or of paper or cellulose fibrous material which contains either superficially or throughout so much cellulose derivatives or is impregnated or saturated with a cellulose derivative to such an extent, that a plurality of such tubes can be quickly and firmly united with one another and stuck together to form a unit by the use of a solvent. The solvent may or may not contain a cellulose derivative.

The use of cellulose derivatives and of paper and fibrous materials impregnated or saturated with such derivatives for the manufacture of separate light tubular structural materials is well known. The present invention, however, makes use of the possibility of rapidly and firmly sticking together and building-up cellulose derivatives with the use of solvents for rapidly assembling to form a built-up unit a plurality of tubular elements which consist of cellulose derivatives, or of paper, cellulosic or other fibrous materials, which are impregnated or saturated with such derivatives. The built-up unit which is formed represents an ideal light structural part.

Instead of using paper or cellulosic fibrous materials, other natural or artificial textile fibrous materials, asbestos, animal fibrous materials and so forth as well as fabrics or other products made from such fibrous materials can be employed. Materials having particularly good properties are obtained if, for example, metal wires or metal fabric are embedded or cast in the said structural material.

The individual tubes can be made by casting, pressing, winding and sticking together rolls or sheets or in any other suitable manner. As the cellulose derivatives any known derivatives can

be employed; acetyl cellulose has proved to be particularly suitable owing to its slight combustibility and its property of being waterproof. Nitrocellulose also has been found to be very suitable particularly if some acetyl cellulose is added to it in order to reduce or eliminate its inflammability. As solvents, acetone, methyl alcohol and the like can be employed, and, in general, amounts of from 5 to 25% are sufficient depending on the viscosity which occurs. It is particularly advantageous to add small quantities of acetic acid, formic acid or the like to the solvent since a better swelling and more rapid adherence is thereby obtained.

The individual circular, non-circular or polygonal tubular elements of the same or differing cross-section, for example also of conical cross-section, can be stuck together in different ways, for example along a line along their periphery. The tubular elements, however, can also be connected either one into another or by means of cross connecting pieces of the same material to form new structures which have great mechanical strength. The important feature is that all the connections are made by means of a solvent which may or may not contain a cellulose derivative.

The tubes which are connected either one into another or by cross pieces or are stuck together in bundles can also be enveloped by a single enclosing casing made of cellulose derivative, for example a sheet of cellulose acetate or by a paper or fibrous material, for example a sheet of paper, which is impregnated or saturated with cellulose derivative, in which case a particularly desirable light structural material which can be used for many different constructional purposes is obtained.

The hollow space inside the tubes and between the tubes as well as that between the tubes and any envelope which may be provided may be wholly or partly filled with a light porous substance, for example solidified glue foam, by which means the structures are better supported on the inside and the liability to bend is reduced. Other suitable means may also be employed for the same purpose.

The light structural parts which have been made, in accordance with the invention, in one or other of the forms which have been described have the advantage that not only do they possess great strength and are of light weight but they can be built up in a relatively short time to form the most complicated structures and set very quickly, whereas the methods of sticking together wood and other materials which have previously been employed are complicated and expensive. Further in these light structural materials any tendency of the cellulose and cellulose derivatives to absorb water is eliminated

owing to the fibrous materials, and on the other hand the individual fibres are enveloped by the cellulose derivatives, so that the material is able satisfactorily to resist all the effects of weather.

The surface of the light structural parts can also be coated with waterproof varnish, for example gum lac. It is particularly advantageous however to add pigments to the cellulose derivatives, and preferably pigments having great covering power such as, for example, titanium white, lithopone and the like, for example in amounts of 5 to 25% calculated on the quantity of the cellulose derivative. The pigment can be added to the cellulose derivative which constitutes the material, or to the derivatives with which the fibrous materials are impregnated or saturated, or to the derivatives which are contained in the solvent used for sticking the individual tubes together, or to the derivatives with which the finished structural parts are coated. It has been unexpectedly observed that by this means the cellulose derivative is caused to harden or become horny and this has an extremely beneficial effect on the properties of the structural material, probably by reason of colloidal combination.

This effect is the more pronounced the greater the covering power of the pigment is.

Finally, it has also been found that it is advantageous to treat the cellulose present in the fibrous materials with weak acids, for example acetic acid, formic acid and the like, since this treatment also has a beneficial effect on the properties of the structural material.

Various light structural parts made in accordance with the invention are illustrated diagrammatically and by way of example in the accompanying drawing.

Fig. 1 shows a light structural part which consists of the tubes 1 to 6 which are made of sheet cellulose derivative or of a sheet of paper impregnated with cellulose derivative. The individual tubes 1 to 6 are stuck together along lines running along their periphery by means of acetone or another solvent, which may or may not contain a cellulose derivative, so as to form the unit illustrated in the figure.

Fig. 2 shows a light structural part similar to that shown in Fig. 1 and consisting of a number of tubes 1 to 6 which have been stuck together. The part shown in this figure differs from that shown in Fig. 1 in that the bundle of tubes, after having been stuck together, is additionally enveloped by a jacket 7 consisting of sheet cellulose acetate or of a sheet of paper impregnated with a cellulose derivative. This envelope is stuck on in a similar manner and its surface can be coated with a waterproof varnish or with a mixture of a cellulose derivative with a pigment.

Fig. 3 shows a further form of construction in which the light structural part is formed from two tubes 8 and 9 which are stuck together at 10 to form a T-piece, a solvent which may or may not contain a cellulose derivative being employed for joining the two tubes.

Fig. 4 shows a cross-section through a further form of construction in which the tubes 11, 12 and 13 which have been made in the manner previously described are connected by tubular cross pieces 14, 15 and 16 which are stuck to them. The structural unit which is thereby ob-

tained is enclosed by the surrounding envelope 17, the surface of which can be treated in the manner previously described or in some cases can be specially treated. The internal space 18 can be filled in addition with a light porous material, for example solidified glue foam, as may also the internal spaces in the tubes 11 to 13 and in the tubes 14 to 16.

Fig. 5 shows a form which is specially suitable for aircraft construction in which the tubes 19 to 21, which have been made in the manner previously described and are to form the main beam, are conical. The tubes are connected on the triangle principle in order to obtain great strength. This triangular tubular pyramid is braced at suitable distances apart by the cross-pieces 22 which also consist of tubes made of cellulose derivatives or fibrous materials impregnated or saturated with cellulose derivatives. The cross-pieces 22 are stuck to the tubes 19 to 21 by means of a solvent to which a cellulose derivative may or may not be added.

I claim:

1. A light tubular structural unit comprising a plurality of parallelly disposed, tubular elements of circular cross section essentially composed of a cellulose derivative, said tubular elements being associated together in the form of a bundle and being adhesively united at their surfaces of contact with each other with the aid of a solution of a cellulose derivative.

2. A light tubular structural unit comprising a plurality of parallelly disposed, tubular elements of circular cross section essentially composed of a cellulose derivative reinforced with fibrous material, said tubular elements being associated together in the form of a bundle and being adhesively united at their surfaces of contact with each other with the aid of a solution of a cellulose derivative.

3. A light tubular structural unit comprising a plurality of parallelly disposed, tubular elements of circular cross section essentially composed of a cellulose derivative, said tubular elements being associated together in the form of a bundle and being adhesively united at their surfaces of contact with each other with the aid of a solution of a cellulose derivative, and an envelope essentially composed of a cellulose derivative closely surrounding said bundle of tubular elements, said envelope being adhesively united to the tubular elements at the points of contact therewith with the aid of a solution of a cellulose derivative.

4. A light tubular structural unit comprising a plurality of parallelly disposed tubular elements of circular cross section essentially composed of a cellulose derivative reinforced with fibrous material, said tubular elements being associated together in the form of a bundle and being adhesively united at their surfaces of contact with each other with the aid of a solution of a cellulose derivative, and an envelope essentially composed of a cellulose derivative reinforced with fibrous material closely surrounding said bundle of tubular elements, said envelope being adhesively united to the tubular elements at the points of contact therewith with the aid of a solution of a cellulose derivative.

ALFRED SCHMID.