

UNITED STATES PATENT OFFICE

2,019,834

PRODUCTION OF PLYWOOD AND OTHER
JOINED WOODEN ARTICLES

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No Drawing. Application July 11, 1930, Serial No.
467,384. In Germany July 24, 1929

5 Claims. (Cl. 144—309)

The present invention relates to the produc-
tion of plywood and other joined wooden articles.

In the production of plywood and other joined
wooden articles in which at least one thin slab
of wood is combined with another wooden sur-
face the single wooden layers are usually joined
with the aid of adhesives made from common
glue or from casein, the process consisting for
example in painting one or more single slabs of
vener with viscous adhesive preparations, com-
bining the coated slabs and subjecting them to
high mechanical pressure, if desired while heat-
ing. When employing common glue the process
is rather tedious due to the long period of time
required by the glue for obtaining its maximum
of adhesiveness. Preparations from casein can
be applied in the form of the so-called cold glues,
in contrast to common glue which is usually ap-
plied in the form of a hot viscous solution. The
employment of cold glues from casein is, how-
ever, met with several disadvantages and neutral
solutions of condensation products from urea and
formaldehyde have been suggested as substitutes
for the adhesives from casein. These prepara-
tions from the said condensation products are
quite satisfactory for combining paper, leather
or other soft materials but for the production of
plywood and other joined wooden articles these
preparations have not proved entirely satisfac-
tory.

We have now found that plywood and other
joined wooden articles with a particularly high
strength can be obtained when the single parts,
for example slabs of veneer, are coated with a
solution of a water-soluble condensation prod-
uct of a urea and formaldehyde to which solu-
tion a small amount of an acid reacting agent
has been added shortly before coating the sur-
faces to be joined. By the said addition the sin-
gle parts of wood are firmly joined in a short time
on pressing the combined layers in a mechanical
press, the quantity of acid reacting agent being
usually from about 0.4 to 2 per cent by weight
of the urea-formaldehyde condensation product.
The said upper limit should not be exceeded since
otherwise the glue may be rendered too viscous
for easily coating the slabs and solidifies too
quickly. The said acid reacting agents may be
chosen from acids such as hydrochloric, sulphu-
ric, phosphoric, acetic, oxalic, lactic acids, acid
reacting salts such as acid sodium sulphate, mono-
ammonium phosphate or aluminium chloride, and
agents which split off acids when incorporated
with the mixture, such as ammonium chloride,
ammonium sulphate, copper sulphate or copper

chloride. In order to improve the uniform dis-
persion of the glue onto the wood and the de-
sired degree of viscosity, starch, potato flour,
ground potato flakes or other pulverized fillers of
most different nature may be added.

The aforesaid water-soluble condensation
products from urea and formaldehyde may be
obtained for example by condensing a urea and
formaldehyde in the presence of water and/or
of an organic solvent with the aid of an acid
condensing agent, such as the acid agents men-
tioned above or the so-called buffer compounds
or buffer mixtures as for example monosodium
phosphate or a mixture thereof with di-sodium
phosphate, or the urea and formaldehyde may be
first condensed in the presence of a small quan-
tity of alkali whereby methylol derivatives of the
urea employed are formed and these methylol
compounds, such as mono- or di-methylol urea,
mono- or di-methylolthiourea and the like, may
be then further condensed with the aid of acid
condensing agents, care being taken, however,
that the condensation is not carried so far that
water-insoluble products are obtained. When
the condensation has been carried out in the pres-
ence of such quantities of water that the con-
densation products are obtained in the form of
their aqueous solutions of such concentration that
they may be directly employed for the purpose
of the present invention, no dilution with water
or, on the other hand, evaporation of water will
be required, the strength of the solutions em-
ployed for the present process being usually be-
tween 20 and 50 per cent of condensation product
of the solutions. These solutions usually possess
a rather low viscosity, especially those with a low
content of condensation products and their vis-
cosity may be easily increased by the before-
mentioned addition of carbohydrates or flour,
which are usually employed in quantities of from
5 to 40 per cent by weight of the solutions and
do not impair the adhesive power of the glue. If
desired up to 10 per cent of an animal glue such
as common bone-glue or casein may be added.

The plywood and other joined wooden articles
obtained in the aforesaid manner show a par-
ticularly high strength which is higher than that
of joining with the aid of glue from a urea-for-
maldehyde condensation product free from acid
reacting agent, the joints being moreover highly
resistant to water. In any case the single orig-
inal parts of wood cannot be torn off from each
other as such along the joint but the wood breaks
within the fibres.

The following examples will further illustrate

how the present process may be carried out in practice but the invention is not restricted thereto.

Example 1

200 kilograms of 30 per cent aqueous formaldehyde are incorporated with 100 grams of monosodium phosphate and heated to 95° C. A solution, heated to 70° C., of 60 kilograms of urea in 30 kilograms of water is then introduced into the solution of formaldehyde and 150 grams of trisodium phosphate are added whereupon the mixture is evaporated in vacuo and below 50° C. until it has a content of 35 per cent of condensation product.

1000 parts of the 35 per cent aqueous solution are stirred with 200 parts of potato starch, whereupon 10 parts of 2 N-sulphuric acid are added. The glue obtained remains in the liquid condition for from 8 to 12 hours within which time slabs of beech wood of 1.5 millimetres thickness are coated with the preparation and then the whole is pressed for 5 minutes at 100° C. and at a pressure of 20 kilograms per square centimetre. When the veneers have been joined while crossing the grain the strength of the product is from 25 to 27 kgs. per square centimetre, whereas when the slabs have been joined in parallel direction of the grain a strength of from 60 to 80 kilograms per square centimetre is obtained.

Example 2

1000 parts of an aqueous 45 per cent solution of the condensation product prepared according to Example 1 are incorporated with 10 per cent of wheat flour and 30 parts of 5 per cent aqueous ammonium chloride. Slabs of beech wood which are 2 centimetres wide and 0.4 centimetre thick are coated with the glue and then pressed at 100°

C. for 8 minutes at a pressure of 20 kilograms per square centimetre. The strength of the finished product is from 90 to 140 kilograms per square centimetre when the slabs have been joined in parallel direction of the fibres in the single slabs, whereas the strength is from 40 to 50 kilograms per square centimetre only when no ammonium chloride has been added.

What we claim is:—

1. The process of joining wooden surfaces which comprises applying to said surfaces a solution of a water soluble condensation product of a urea and formaldehyde to which condensation product an acid reacting agent inert to formaldehyde has been added shortly before the solution applying step is effected and pressing the surfaces together at an elevated temperature.

2. The process according to claim 1 in which the pressure is about 20 kilograms per square centimeter and the temperature is about 100° C.

3. The process according to claim 1 in which the acid reacting substance is added in an amount ranging from .4 to 2 per cent of the weight of the condensation product.

4. The process according to claim 1 in which the solution of condensation product employed is a water solution to which a thickening agent has been added.

5. The process of joining wooden surfaces which comprises applying to said surfaces a solution of a water soluble condensation product of a urea and formaldehyde to which condensation product an acid reacting agent inert to formaldehyde has been added shortly before the solution applying step is effected and pressing the surfaces together.

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