PUBLISHED G. BARCHFELD Serial No.

MAY 11, 1943. STRUCTURAL PARTS FOR COACHWORK AND THE LIKE 243,598

BY A. P. C. Filed Dec. 2, 1938 8 Sheets-Sheet 1

Fig. 1.

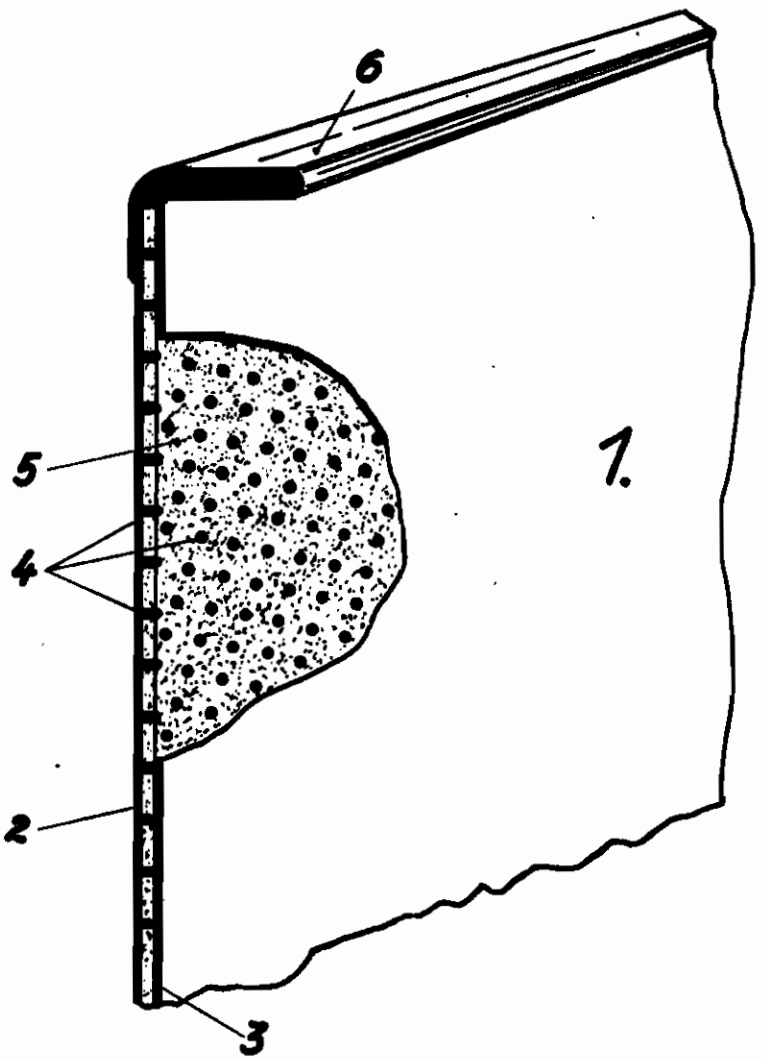

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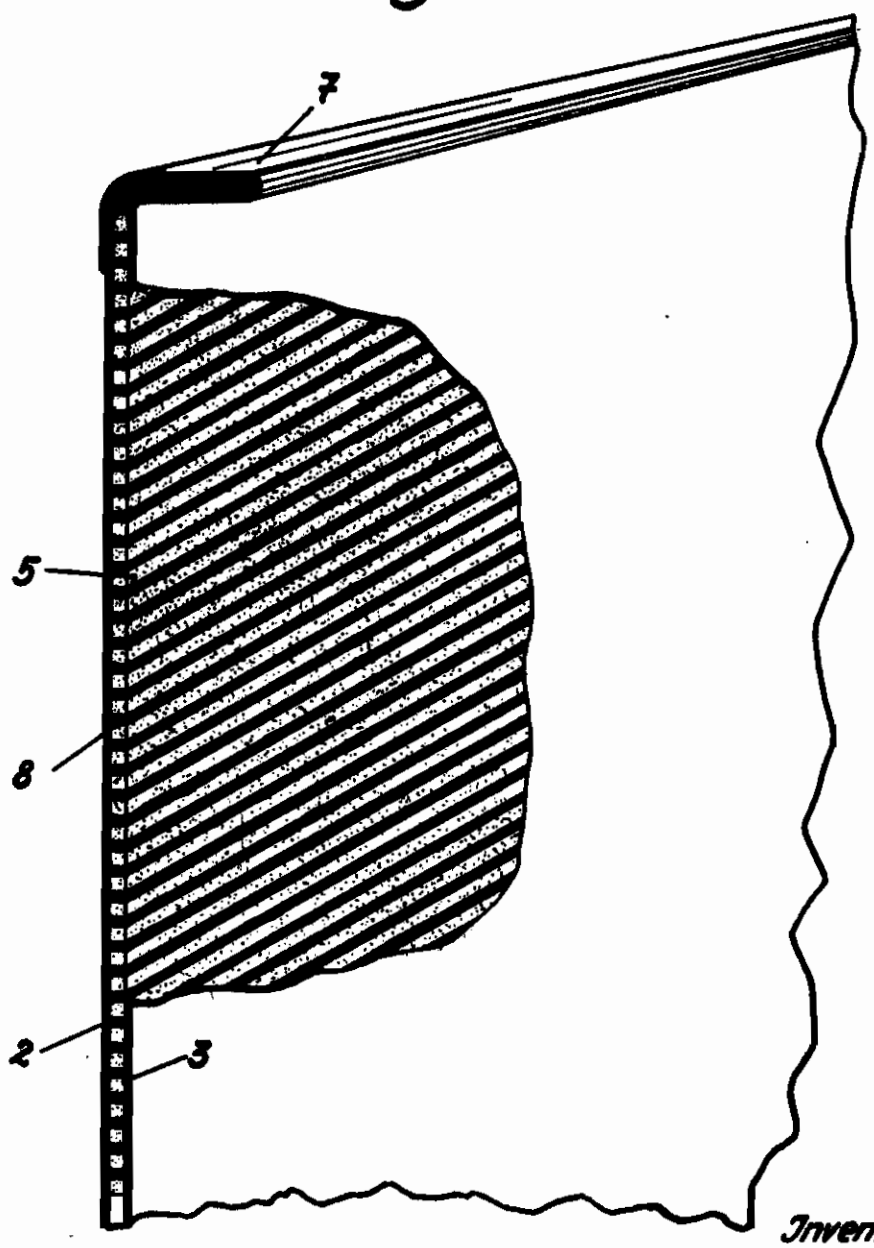
Fig. 2.



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MAY 11, 1943. STRUCTURAL PARTS FOR COACHWORK AND THE LIKE 243,598

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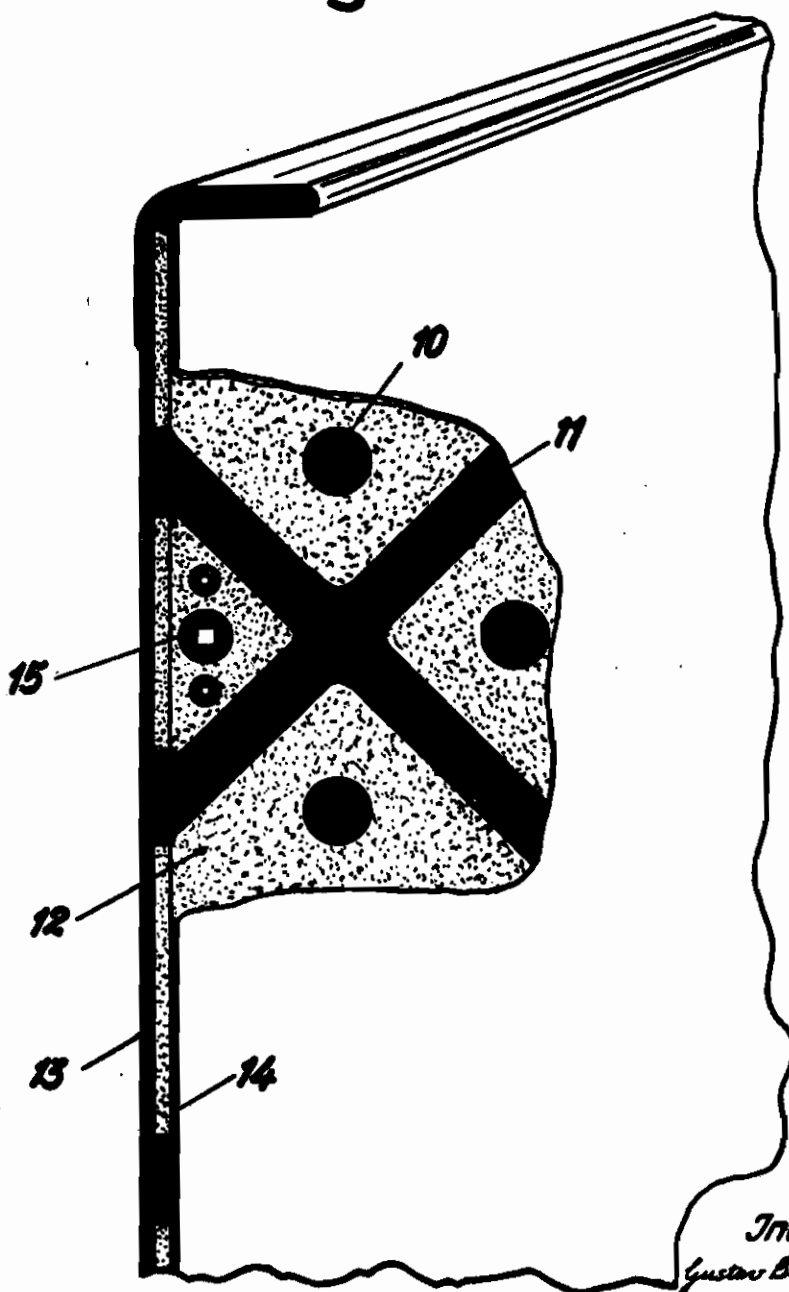
Fig. 3.



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STRUCTURAL PARTS FOR COACHWORK AND THE LIKE

Filed Dec. 2, 1938

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Fig. 4

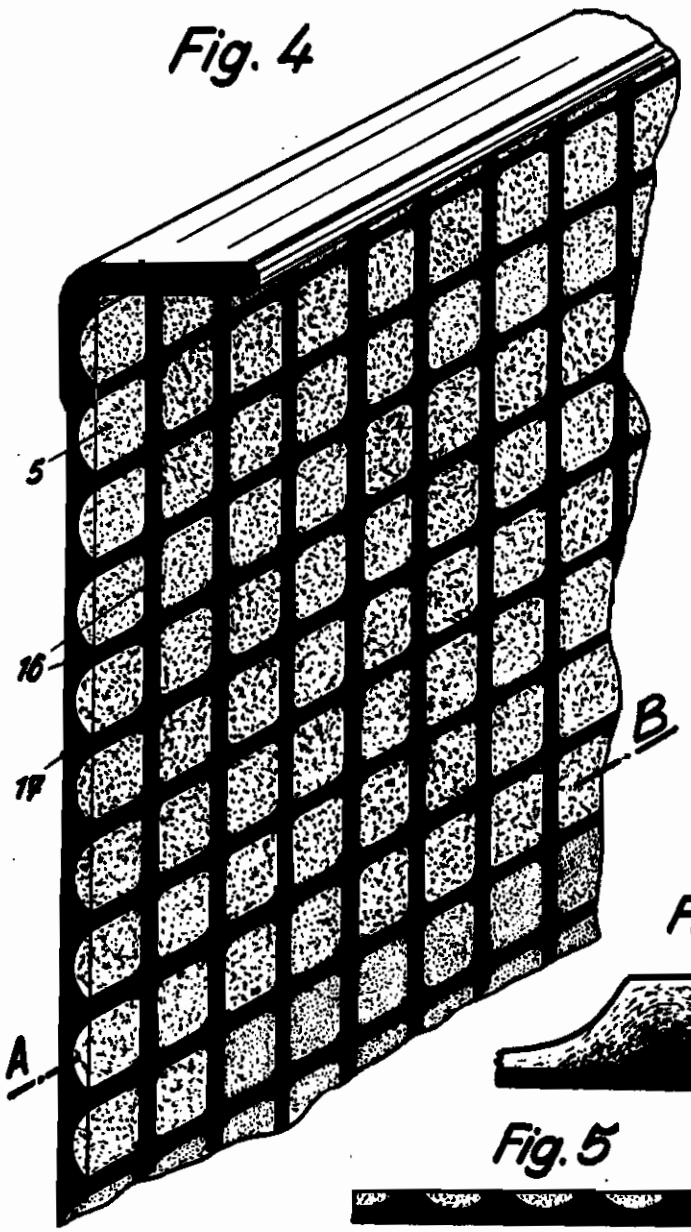

Fig. 6

Fig. 5

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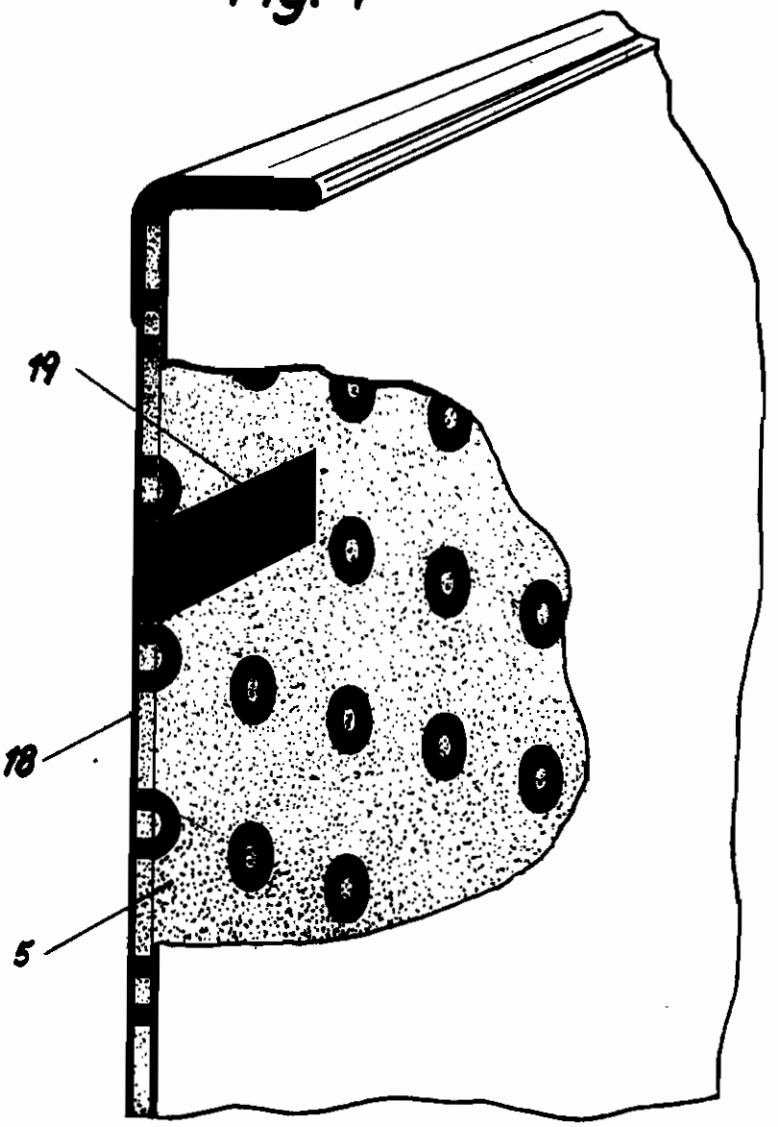
Fig. 7



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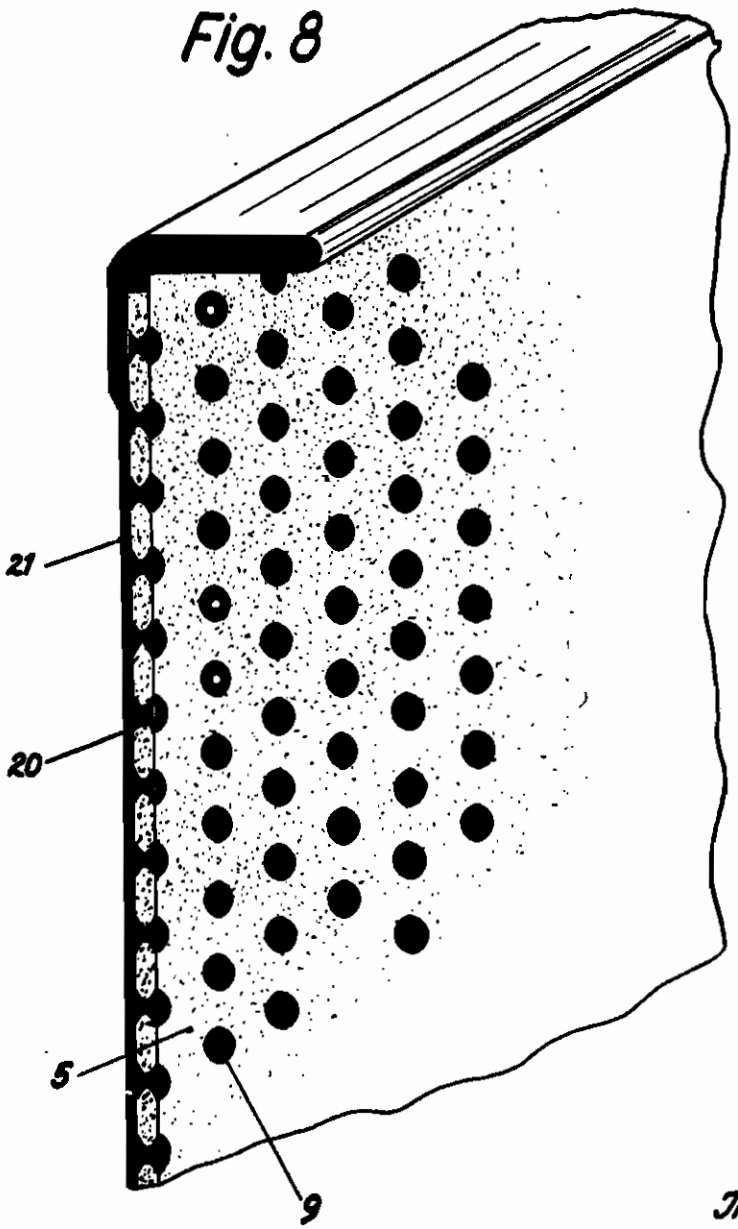
MAY 11, 1943. STRUCTURAL PARTS FOR COACHWORK AND THE LIKE 243,598

BY A. P. C. Filed Dec. 2, 1938 8 Sheets-Sheet 6

Fig. 8



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STRUCTURAL PARTS FOR COACHWORK AND THE LIKE

Filed Dec. 2, 1938

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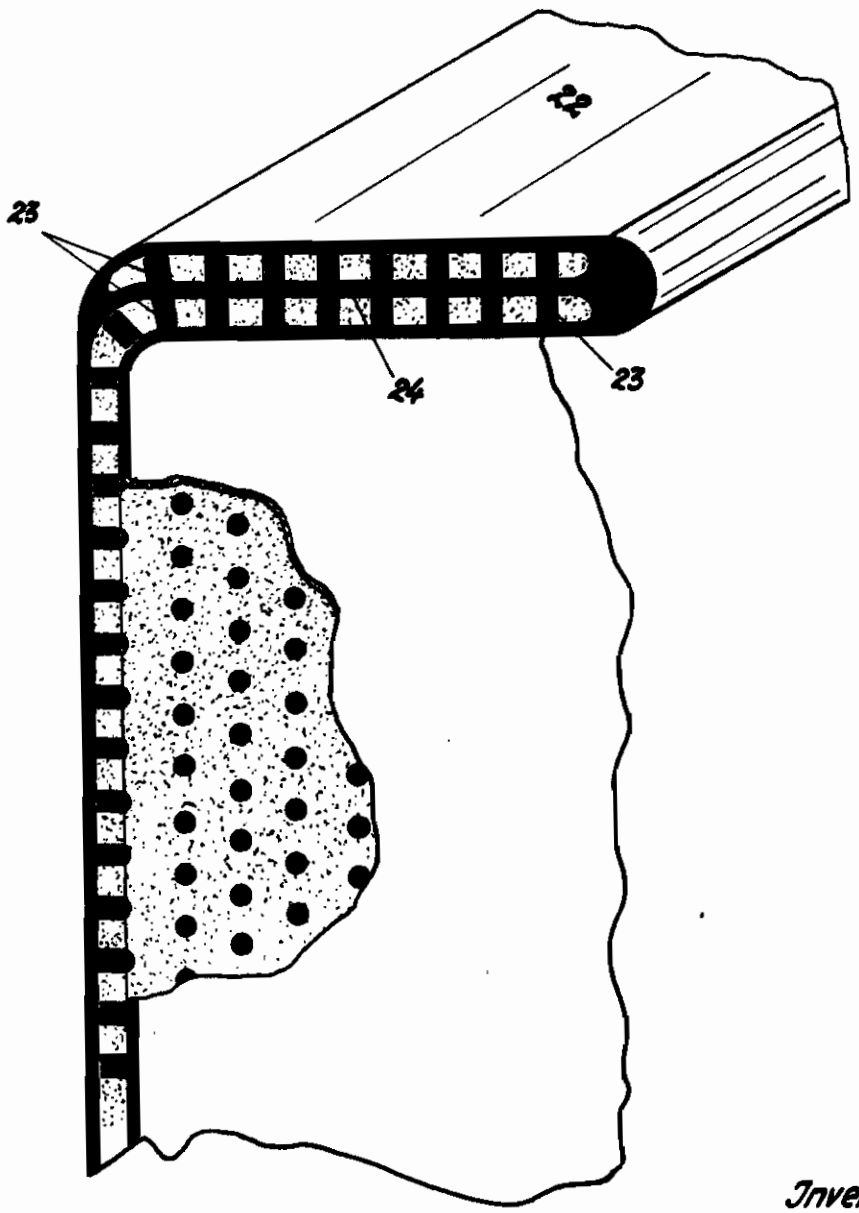
Fig. 9



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STRUCTURAL PARTS FOR COACHWORK AND THE LIKE

Filed Dec. 2, 1938

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Fig. 10

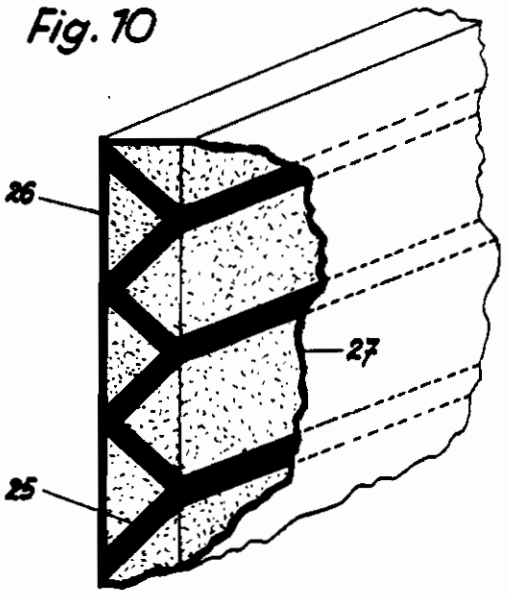


Fig. 11

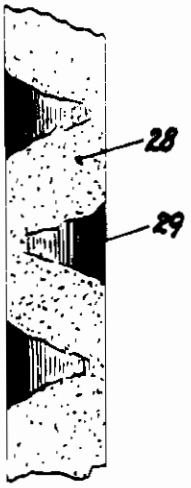


Fig. 12

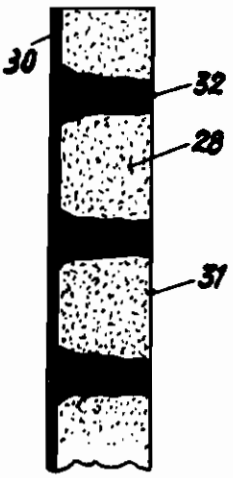


Fig. 13

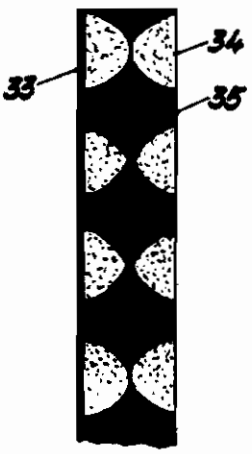
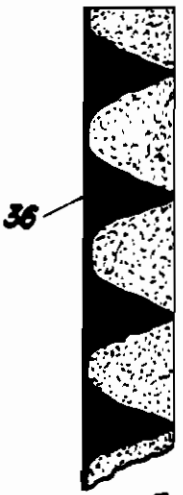


Fig. 14



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ALIEN PROPERTY CUSTODIAN

STRUCTURAL PARTS FOR COACHWORK AND THE LIKE

Gustav Barchfeld, Troisdorf, Cologne, Germany; vested in the Alien Property Custodian

Application filed December 2, 1938

The invention relates to constructional parts for vehicles of all kinds in particular to coachwork parts of motor vehicles, which are made from fibres, fibrous fabrics or fibrous shaped bodies, with a binder.

It has already been proposed to make constructional parts for vehicles of synthetic resins containing fillers, by pressing such materials in moulds, or by wrapping or planking with sheet synthetic resinous materials as for instance fabric lacquered with synthetic resin. All the coachwork and constructional parts made in the hitherto known ways have as common features a uniform distribution of filler and synthetic resin over the whole cross section, and a high resin content which affords the mass which usually comprises in addition fibres of various kinds and forms, the necessary hardness or strength for the finished part. The large fraction hitherto necessary of brittle synthetic resin and its distribution in all zones brought with it a fault, however, which has made the use of synthetic resin masses for the purposes mentioned practically impossible hitherto, namely an extreme brittleness which under high stresses, such as arise for example in the case of accidents or collisions and are unavoidable, leads to complete destruction which is extremely dangerous to the passengers, and which does not occur for example with sheet metal coachwork. The other properties of the synthetic resins which are of advantage as compared with metal could not therefore be practically utilized in this field.

It has now been found that thoroughly satisfactory products can be obtained in a highly economical manner with synthetic resin materials, in the production of coachwork and constructional parts for vehicles of all kinds, if the cross section of the part is formed in a special manner and if new methods are used not hitherto met with in the working synthetic resins and the possibilities and effects of which were not known.

The problem of the invention is therefore to construct shaped parts of fibres and binder, or in other words to distribute the binder within the fibrous body, in such a way and in such quantity, that zones of the greatest tenacity and resistance to fracture are obtained along with zones of the greatest hardness and strength, so that a form is obtained which is statically particularly efficient for the loads arising.

This problem is solved in essence by the shaped fibrous parts being provided according to the laws of static with stiffening corresponding with the forces arising, these stiffenings consisting of embedded portions and/or surface layers containing more or less binder. These stiffenings extending through the shaped part form in a certain measure the struts and ties of a static structure akin to a bridge girder, the fibrous material filling the intermediate spaces substantially strengthening the framework of binder by its tenacity.

In a more specific aspect of the invention the outer surface layers, preferably of resistent, hard and dense material, are secured spaced apart by cross stiffenings and the hollow space bounded thereby is filled with material of less stiffness but of greater tenacity. In this embodiment of the shaped parts, both surface layers are hard and therefore relatively brittle. They are therefore better adapted to resist compressive and buckling stresses than tension.

So far therefore as the shaped parts only have to take their main stresses in one direction, according to the invention the one surface layer will be made as a compression and buckling resisting plate with high binder content, and the other surface layer as a soft tenaciously-elastic plate with a correspondingly low binder content. In this case the tenacious plate takes the tensile stresses and the hard plate the compression stresses, when the load bears on the pressure resisting plate.

A further strengthening of the shaped part constructed according to the laws of statics, can be obtained according to the invention by filling the intermediate spaces between the stiffenings or surface layers, with felted fibrous materials, which to increase their cohesion can be lightly sized by the methods usual in the paper industry; or the binder can also extend from the hard, binder-rich zones into the fibrous filling in gradually decreasing proportion.

The stiffenings can according to the invention be of two different forms, the synthetic resin being provided either over locally bounded spaces of circular section or over longitudinal strips, in such quantity that it penetrates the whole cross-section, whereby in the former case rod form stiffeners or stays are produced and in the latter case synthetic resin ribs, which bind the surface layers firmly together. With local enrichments of the synthetic resin, it is possible to arrange the stiffeners in desired form and number in the cross section.

In a further advantageous embodiment of the invention these synthetic resin ribs can run through the shaped part pairwise diagonally or in the form of curves as for example as orthogonal trajectories, by which arrangement particular

stiffness and resistance to pressure of the body are obtained. Naturally all the above described measures can be used together, in that both synthetic resin ribs which can be compared to a plate web in structural steelwork, and synthetic resin stays distributed between the former, are used, both kinds of supporting elements being continuous with or so to say welded to, the surface layer or layers.

In many cases it is further necessary to provide regions on the shaped body especially resistent to pressure for the reception of connecting or fastening members, which can be done according to the invention by providing an enrichment or synthetic resin extending right through the cross section at locally limited places.

These enrichments in synthetic resin can in a further form of the invention, advantageously be used for connecting together adjacent or different shaped parts, for example by screws and rails. For many purposes one surface layer of the shaped part can be dispensed with, so that the part consists of but one resistent surface layer of a hard and dense synthetic resin fibre mixture, on which synthetic-resin-containing rivets or ribs or rails are produced by corresponding application of synthetic resin, in the fibrous mass arranged on the hard surface layer. If now a layer or plate of highly elastic material, advantageously a synthetic material, is applied to the uncovered surface of such a shaped body, an additional reinforcement is provided for cases of loading which put the highly elastic layer under tension. For the highly elastic materials thermoplastic synthetic materials are preferably used, as for example polymers and mixed polymers of unsaturated organic compounds such as those of styrol, isobutylene, vinyl chloride, vinyl alcohol, acryl acid ester, and the derivatives and homologues of these compounds; further, natural and synthetic rubber products can be used.

So far as the need arises to apply any desired surface or covering layer to a fibrous shaped body with cross stiffenings after the production of the latter, this may be done according to the invention by directly producing the stays or ribs in a fibrous shaped body by local provision of synthetic material. The statically stiffened body is completed only after the application of the surface layers of the desired material having the desired properties and their union with or welding to the synthetic resin rivets or ribs.

So far as surface layers of highly elastic synthetic or other materials are used, the provision of additional longitudinal stiffeners which may again consist of local synthetic resin enrichments within the cross section of the shaped body and by which the cross-stiffeners are connected together or bridged over, grid fashion, is of particular advantage because the elastic cover layers are in themselves not hard enough to take mechanical stresses alone. In this way a grid-like, stiff structure is obtained, of local synthetic resin enrichments within the cross section with elastic surface layers.

The stays or ribs can be solid walled, and to reduce the weight or increase the moment of resistance for the same weight can be constructed as hollow bodies, for instance in tubular, U or V form. In particular according to the invention the ribs can be so arranged within the shaped body that they form a grid support. All these measures serve to increase the stiffness of the shaped body, without the elasticity or tenacity being reduced on that account. Particular effects as regards compressive strength and elasticity are obtained by varying the cross-sectional dimensions of these stiffeners, these being increased or decreased along their longitudinal axes, so that for example in the vicinity of the outer walls the stay or rib is stouter than in the centre of the shaped body and vice versa. The stay thus becomes similar to a rivet in shape. So far as the rivet is stouter towards the outer surface, the neighbouring synthetic resin enrichments apprcach one another so that in the limiting case the rivet heads coalesce or weld together into a covering layer or run with large surfaces into the covering layers and thus ensure a very intimate connection with the covering layers.

According to the invention the coachwork parts can also be produced in such a way that the resin content in the hard covering layers, ribs or rivets decreases in desired directions in steps or gradually, to any desired lower value or to zero, and also in such a way that a limited quantity of resin partially penetrates the neighbouring tenacious elastic layers, whereby reliable anchoring of the carrying, binder-containing framework into the complete fibrous structure is ensured.

The further result is obtained by this measure, of a gradual change from zones of great hardness to zones of great tenacity, whereby in particular cracking and tearing effects are not only much reduced but are above all locally limited. Stresses leading to the breaking limit therefore only act in the immediate neighbourhood of the breaking load.

These good properties can in many cases even be improved by arranging the resin rivets or ribs to project only partially into the shaped body, these stiffening elements preferably being arranged relatively staggered. These measures are used particularly when, according to the invention, the shaped body is put together of several layers provided with rivets or ribs, the individual layers then being relatively staggered, in such a way that rivets or ribs are produced running inclined to the surface, because through the staggering of the layers, staggering of the rivets is also easily attained.

In further development of the invention, large regions of the shaped body, as for example frames, edge rails and the like, as well as places for screw threads and attachments, are made hard right through by the use of an enriching quantity of resin, so that only the boundary or bounded stiffened zones retain their stiff and tenacious character simultaneously.

A plurality of such shaped bodies provided with rivets and ribs, and, it may be, built up layer fashion, can advantageously be welded together into a shaped body of desired form and size, by utilizing the neighbouring resin enrichments.

To increase the strength of connection, advantageously the stays or ribs can be secured together by means of embedded inlays of other substances of great strength, as for example metals and suitable fastening elements.

According to the invention the shaped bodies are provided with constructional parts of desired form and material for the purpose of further stiffening or to make connections possible, as for example parts of wood, metal, fibres of other kinds and synthetic materials, ropes, netting or fabric of fibrous material or metal, and finally foils, tubes or sections of wood, metal, vulcanized fibre or synthetic materials, which are united with the shaped body during the production

thereof, either at particular places or right through it. Further according to the invention in the production of the shaped parts, other materials which influence the final product in various desired directions can find additional use, as for example fillers of all kinds, colouring agents, plasticizers, swelling agents, solvents, wetting agents, lubricants, impregnating agents or water repelling and fire resisting chemicals.

Just as the stay form enrichments make spot welding possible, naturally with rib-form synthetic resin enrichments a connection with neighbouring parts can be effected by seam welding using the known process for hardenable resins.

The above described invention shows for the first time a way of producing shaped bodies with enclosed tenacious materials in place of hollow spaces, which have the same properties as shaped bodies made according to the laws of statics with hollow spaces. The production of such hollow spaces in the shaped bodies in one working operation by the pressure process is impossible. It is therefore a particularly valuable feature of the invention, that it enables the same effects to be obtained practically by the normal pressure process. Accordingly these statically stiffened shaped bodies can be produced with very small wall thickness, so that the parts are light. Further owing to their non-homogeneity splintering is effectively hindered because the hollow spaces filled with fibrous material can take up considerable deformation energy when a breaking load occurs on account of their unreduced elasticity. The fractures thus remain locally limited in contradistinction to the known shaped bodies pressed from synthetic resin.

Some examples embodying the invention are illustrated in the accompanying drawings.

Figure 1 is a perspective view with part broken away, of a motor vehicle door which is stiffened by synthetic resin rivets.

Figure 2 is a similar view of a similar door stiffened with synthetic resin ribs.

Figure 3 shows a motor vehicle door with synthetic resin ribs, synthetic resin stays and pressed in connecting members.

Figure 4 shows a motor vehicle door with grid-like stiffening.

Figure 5 is a section on the line A—B of Figure 4.

Figure 6 is a detail of a similar section, on a larger scale.

Figure 7 shows a motor vehicle door with tubular stays and local synthetic resin enrichments.

Figure 8 shows a motor vehicle door with synthetic resin stays having increasing and decreasing resin content,

Figure 9 shows a motor vehicle door in which the upper part consists of two shaped parts reinforced by stays and layered one on the other.

Figure 10 shows a piece cut out of a shaped body with synthetic resin ribs lying inclined to the surface,

Figure 11 is a section of a shaped body with staggered stays having decreasing resin content.

Figure 12 is a section of a shaped body in which one surface layer consists of a hard plate and the other of an elastic plate,

Figure 13 is a section of a shaped body in which both surface layers consist of hard plates and the cross section of the rivets uniting them increases towards the centre, and

Figure 14 is a section of a shaped body in which the stays are broadened at one outer surface in such a way as to constitute a continuous hard layer.

In Figure 1 the shaped part 1 consists of two hard cover layers 2 and 3 with high resin content, which are welded together by synthetic resin stays 4 distributed over the sectional surface. The stays are formed by local strong resin enrichments in the tenacious fibrous mass 5 lying between the outer surfaces. The upper rail 6 of the shaped part which is a motor vehicle door, is provided throughout with synthetic resin and is therefore very hard and stiff. The other parts 2, 3, 4 and 5 of the door wall are firmly attached to this hard part.

In the shaped parts shown in Figure 2 instead of rivets, synthetic resin ribs 8 are provided to unit the surface layers 2 and 3, the ribs being produced stripwise by strong enrichment of the tenacious fibrous mass 5 with synthetic resin. In the same way the upper hard rail 7 is characterised by a high resin content.

Figure 3 shows the simultaneous use of stays 10 and ribs 11 within the fibrous layer 12, which is externally so strongly provided with synthetic resin that hard surface layers 13 and 14 are produced. Further additional synthetic resin enrichments 15 are provided in the shaped part, which in this case serve for the mounting of the lock and if necessary of screws, bolts and the like connecting members.

In the example of Figure 4, rails 16 traverse the whole shaped part grid fashion, but are welded to the hard cover plate 17 on one side only.

In these rails or ribs as indicated by the shading in Figures 5 and 6, the synthetic resin content falls off continuously towards the opposite face so that the latter part of the shaped body is characterized by great elasticity.

As Figure 7 shows, the stays 18 can be of ring form so that their moment of resistance is correspondingly greater for the same weight. This door also illustrates the possibility of a resin enrichment 19 right through which serves for example for the attachment of a hinge.

The synthetic resin stays can also be constructed with varying cross-section; thus the stays 20 shown for example in Figure 8 are substantially thinner at mid cross than at the outer surfaces. There they run out at one end with broad sections into the hard covering layer 21 while at their opposite ends they terminate in rivet heads 9 bounded by the tenacious fibrous mass 5.

In Figure 9 the strengthened top stiffening rail 22 of the door is obtained by the provision within the thick section of an additional cross stiffening 24 extending between the stays 23.

In Figure 10 a grid like structure of the stiffening elements of the shaped fibrous body bounded by the plates 26 and 27 is formed by ribs 25 which are inclined to the surface so that the static resistance of the shaped body to forces acting in the plane of the plates is also increased. With the same advantage stays inclined to the surfaces could be used alone or together with ribs, the stays being formed by corresponding dimensioning of resin enrichments extending through the body.

In the shaped body according to Figure 11 separate hard or elastic surface layers are omitted, stays 29 being provided in the fibrous layer 28, relatively staggered and decreasing in resin content from the outside inwards. This

arrangement is particularly adapted for the subsequent application of stiff or hard coverings.

In the example according to Figure 12 the one outer surface layer 30 consisting of hard material and the other 31 consisting of tenacious elastic material, are held together by synthetic resin stays 32. The outer layer 30 here preferably consists of fibres provided with phenol-formaldehyde resins, and the other layer 31 of thermoplastic synthetic materials as for example polymers, mixed polymers or rubber like materials, with or without a plasticizer.

The example according to Figure 13 shows an arrangement in which the outer surface layers 33 and 34 consist of layers which are both hard but are of different thickness, while the section of the rivets connecting them increases towards the centre to such an extent that in the centre a grid-like continuous hard layer of very great strength is formed.

Such a strong layer can also be produced, as shown in Figure 14, by the stays 36 being broadened by resin enrichment towards one surface of the fibrous shaped body, to such a degree that they coalesce and thus form a continuous layer over one surface of the body.

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