PATENT SPECIFICATION (11) 1 593 432

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(21) Application No. 20100/77 (22) Filed 13 May 1977 (19)
(31) Convention Application No. 23550 (32) Filed 24 May 1976 in
(33) Italy (IT)
(44) Complete Specification Published 15 Jul. 1981
(51) INT. CL.[3] A47C 23/00
(52) Index at Acceptance
A4M 1C2H 2A

(54) BED FRAME

(71) We, FRAPO S.p.A., a Joint Stock Company, organized and existing under the laws of Italy, of Via Toscanini, 5 - Lecco (Province of Como) - Italy, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:-

This invention relates to a resilient wire mesh frame for a bed and the method for its manufacture .

Resilient wire mesh frames have now replaced the early resilient spring frames because their elastic deformation is more uniform and they have a longer life.

However two defects are still present in all types of wire mesh frame, namely a gradual loss of elasticity and the need to replace them after relatively short time, and there is a need to obviate such defects.

These defects arise from the fact that the stresses are widely different under distributed load conditions with an extended body, under concentrated load conditions with a person seated or standing on the bed, and under dynamic load conditions with a person jumping on the bed. If the wire mesh frame is calculated for these latter conditions, it would be too rigid for normal use. On the other hand, springs accommodate very large deformations without becoming permanently deformed themselves, but they are exposed to fatigue strain, and tend to yield in time, according to the work done. Conceptually, it would be necessary to provide shock absorbers for limiting the rate or deformation of the springs, as in motor car suspensions. Alternatively, more rigid springs could be provided to act upon and thus halt the deformation as soon as the normal springs have exceeded a predetermined deformation limit. However, these theoretical methods are given only to explain the problem because they would obviously be too complicated and costly.

The general object of the invention is to provide a structure which embodies the said theoretical concepts but avoids the constructional complications which appear to be connected with them.

The main practical object of the invention is a resilient mesh frame in which a much more rigid reaction follows an initial proportional deformation.

A further object of the invention is to provide a wire mesh frame in which a integral reaction of the entire structure accompanies the localised or concentrated stresses.

A particular object of the invention is to provide a mesh bed frame of particularly unlimited life but which offers comfortable resilience in normal use.

A further object of the invention is to obtain the required improvements in said mesh frame by a simple structure of easy construction.

All these and further objects which will be more evident hereinafter are attained by a wire mesh bed frame comprising a metal surround with two base longitudinal stringers, cross members bridging said basic stringers and of inverted U shape with their ends welded to the stringers, spaced-apart longitudinal members parallel to the stringers and joining all the cross members and welded thereunder, and selectively arched tie rods below and substantially coextensive with the cross members and arranged to arrest the bending above a certain limit of the vertical portions of the U shape of the cross members.

The characteristics and advantages of the invention will be more evident from the description of a preferred but not exclusive embodiment given by way of example with reference to the accompanying drawing, in which:

Figure 1 is a plan view of a flat metal mesh structure ready for folding in accordance with the invention;

Figure 2 is a perspective view of a finished resilient mesh frame according to the invention, and

Figure 3 is a cross-section through the mesh frame of Figure 2.

The mesh frame of Figure 1, indicated overall by the reference numeral 1, represents the mesh according to the invention before folding the lateral sides or feet, this folding being made about the two longitudinal lines AA and BB, and shown completed in Figure 2. Leaving aside the method of manufacture for the moment, the structure is supported by a surround 2 which in Figure 1 appears as a flat rectangle and in Figure 2 has taken the form of a saddle. Longitudinal members 3, of which there are six in the example, are welded to the two ends of the surround. As evident in Figure 3, the four central longitudinal members are welded under the surround, while the two most outer longitudinal members are butt welded to the surround, one on each side. Cross members 4 are welded to the outside of the surround perpendicularly to the longitudinal members 3 and above these latter, and are disposed uniformly distributed very close together over the entire length of the surround to make up the mesh frame support surface, for example to support a mattress. Statically, there is thus a flat reticulated surface supported by a number of vertical feet 4'. Such a structure is very flexible because the plurality of arches have their feet statically connected together but not to the base plane. It can be seen however that the entire flexible structure yields even for a weight acting on a single cross member, as the entire surround, and through this all the cross members, react to the load to follow the deformation.

To make the structure more rigid it would be sufficient to increase the diameters of the rods used for its construction. However this would give rise to the disadvantages stated initially.

In accordance with one object proposed and attained by the invention, a small number of tie rods 5, of which there are two in the example illustrated, are added at a chosen distance based upon effected measurements, to act as non-linear shock absorbers or attenuators for the deformation, their shape being arched to an extent based on experimental results. The tie rods 5 are also welded by the ends of their feet 5' to the surround 2 as in the case of the cross members 4 to which they are parallel (ignoring the curvature), but their transverse portion is decidedly lower than the cross members 4 so that they are not reached by the applied weight, even when the cross members 4 bend under the effect of the weight. The tie rods 5 are bent above the lateral longitudinal members 3, which are disposed at approximately half the height of the feet 4', in contact with the longitudinal members themselves so as to transmit to the contacting longitudinal member a traction force. The described structure, of which the elastic properties will be described hereinafter, may be utilised in various ways. It may be used by directly resting on the floor in the manner of a camp bed, or it may be transformed into a normal bed on four legs very simply by inserting a support leg into each of the hooks 6 at the four vertical corners of the structure, shown by a dashed line in Figure 2. Alternatively and preferably, the ideal method is to insert it into any normal bed surround, as in the case of a normal wire mesh frame.

To understand the method of operation of the structure under different loads, reference must be made to the study of deformed resilient structures, which notably constitutes one of the most difficult parts of construction theory and requiring the most complicated calculations of the whole of this subject. Fortunately, the mechanism of the invention may be understood by a qualitative simplified explanation of the deformation of the structure. For this purpose a cross member 4 in Figure 3 will be considered, and it will be assumed that it is firstly free and vertical, and then loaded by a vertical weight P.

In construction theory such an elementary structure is defined as a resting arch, and it can be shown that the effect of a vertical load is to make the resting points indicated by 7 and 8 withdraw from each other, with deformations which generally are very large relative to the load and to the tensile strength of the profile.

The most simple method of stiffening any free arch is to close the arch at the supports by a tie rod, known as an arch chain. The principle of the inventive concept is thus evident, i.e. to allow the structure to deform for a certain portion as if it were a free arch, then subsequently make a tie rod act to arrest the widening of the arch legs so that the deformation process passes to a second stage in which the structure becomes more rigid.

Having thus explained the basic concept, all the technical details on which the concept has been realised can now be explained in steps.

Using a curved tie rod instead of a straight one, with initial sliding and abutment stoppage, produces much more gradual passage from the initial yieldable structure to the more rigid subsequent structure, after the first stage of lowering and straightening of the arch 5.

Constraining the traction action of the tie rod to the two outer longitudinal members 3 instead of to the longitudinal stringers of the surround 2 gives a greater residue of deformability or resilient yielding even after the intervention of the straightened tie rod, as the feet 4' can rotate resiliently about the outer longitudinal members 3.

The differences between the actual behaviour and the diagrammatic explanation given, due to the fact that the cross members 4 or arches are not free but are connected to the surround, and that there are only a few tie rods to several cross members, lead only to small quantitative modifications and do not modify the concept of the structure deformation in any way. In fact, the actual structure is a straight tubular vault structure overall, and the behaviour of any of its sections is fairly well represented by the behaviour of a single arch formed by a cross member, with its equivalent tie rod, obviously dividing the effective force of one tie rod by the number of cross members which it covers in order to give the load of the equivalent tie rod.

It is evident from this latter consideration that although the structure is composed of a plurality of resilient parallel elements, it acts as a single resilient unit even for concentrated loads, because of its multiple connected modular form, more similar to an indefinite cylindrical form than to a flat foil or reticule, as in the case of the usual resilient mesh frames for beds.

One particular advantage of the invention is the ease and economy with which a resilient mesh frame for beds as described may be constructed.

A surround with longitudinal members and cross members welded to it and together as shown in Figure 1 may be very rapidly constructed by electric welding, using the same method as used for electrically welded meshes. The structure of Figure 1 is then placed under a press and bent along the lines AA and BB, preferably on a single jig, to give a frame as shown in Figure 2, but still without the tie rods 5 which are added and welded to the surround in the last manufacturing stage.

The quantitative resilient characteristics of the described structure obviously depend essentially on the size of the various elements and the material quality. As an example, it may be stated that excellent qualities have been obtained with a metal bed frame of normal size (approximately 90 cm by 195 cm surface and 10 cm height) constructed of normal steel of $\sigma_R \geqslant 60$ kg/mm^2, using rod of the following diameters: for the surround $D_2 = 10$ mm, for the longitudinal members $D_3 = 7$ mm, for the cross members $D_4 = 6$ mm and for the tie rods $D_5 = 7$ mm.

These values are obviously not limiting and neither are the described constructional details, only the concept and the explained principles being binding.

WHAT WE CLAIM IS:-

1. A wire mesh bed frame comprising a metal surround with two base longitudinal stringers, cross members bridging said base stringers and of inverted U shape with their ends welded to the stringers, spaced-apart longitudinal members parallel to the stringers and joining all the cross members and welded thereunder, and selectively arched tie rods below and substantially coextensive with the cross members arranged to arrest the bending above a certain limit of the vertical portions of the U shape of the cross members.

2. A frame as claimed in claim 1, wherein the heads or minor sides of the metal surround at the ends of the base stringers are turned to form two inverted U stirrups between said stringers, the stirrups being substantially equal and parallel to the cross members to which the ends of the longitudinal members are welded.

3. A frame as claimed in claim 2, wherein two lateral longitudinal members extend at half the height of the vertical portions of the cross members, and said tie rods are connected to said two lateral longitudinal members and engage with the vertical portions of the cross members by way of said two lateral longitudinal members.

4. A frame as claimed in claim 3, wherein the tie rods also have their ends welded to the two opposing stringers of the surround and also form an inverted U stirrup, but with the U lower than that formed by the cross members and lying there-under, the bights of the U profile embracing the two lateral longitudinal members, that portion of the tie rod between the two longitudinal members being curved by a camber calculated to allow a determined deformation movement of the lateral longitudinal members and thus of the cross members as the arch straightens under tension so as to progressively oppose said movement.

5. A frame as claimed in claims 1 to 4, wherein the number of said tie rods is small and much less than the number of cross members, and in the limit the number being one only.

6. A frame as claimed in one of claims 1 to 5, constructed of mild steel, preferably in the form of rods having an ultimate tensile stress $\sigma_R \geqslant 60$ kg/mm^2 and of approximate diameters $D_2 = 10$ mm for the surround, $D_3 = 7$ mm for the longitudinal members, $D_4 = 6$ mm for the cross members and $D_5 = 7$ mm for the tie rods.

7. A method for constructing a bed frame as claimed in one of claims 1 to 6,

which method comprises: providing a substantially rectangular flat surround, forming thereon a reticule of longitudinal members and cross members welded together and to the surround, folding two opposite side portions of said surround and reticule welded thereto, which side portions extend along and include stringers, at 90° to form said cross members in said inverted U shape, and finally inserting and locating said selectively arched tie rods below and substantially coextensive with the cross members.

8. A wire mesh bed frame as hereinbefore described with reference to and as illustrated in the accompanying drawing.

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Printed for Her Majesty's Stationery Office,
by Croydon Printing Company Limited, Croydon, Surrey, 1981.
Published by The Patent Office, 25 Southampton Buildings,
London, WC2A 1AY, from which copies may be obtained.

1593432 COMPLETE SPECIFICATION

1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

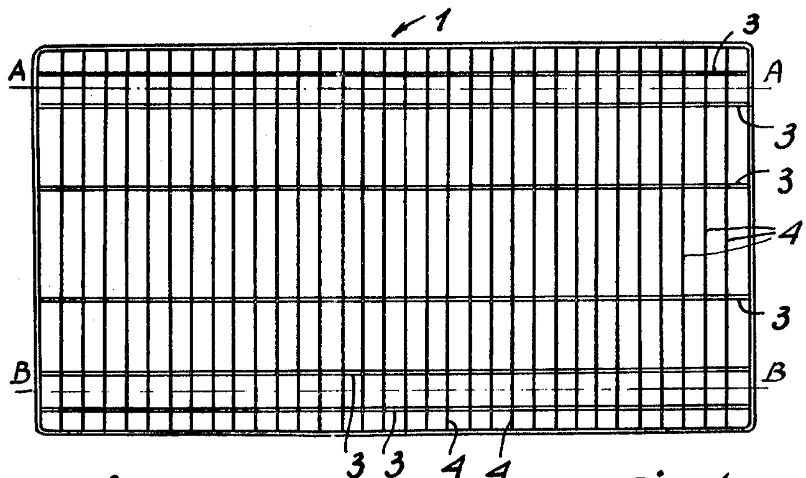

Fig. 1

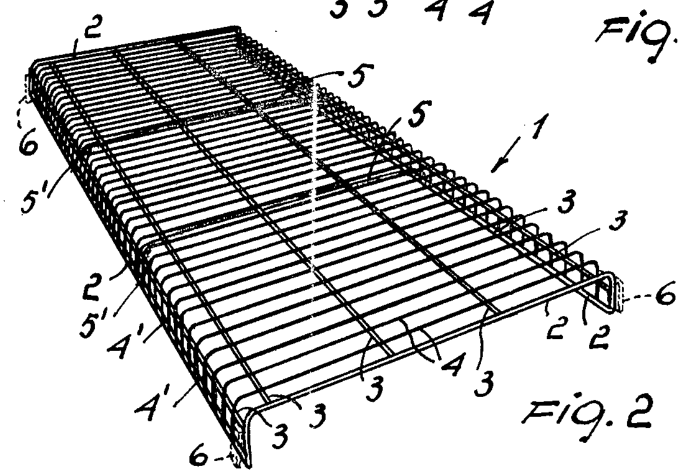

Fig. 2

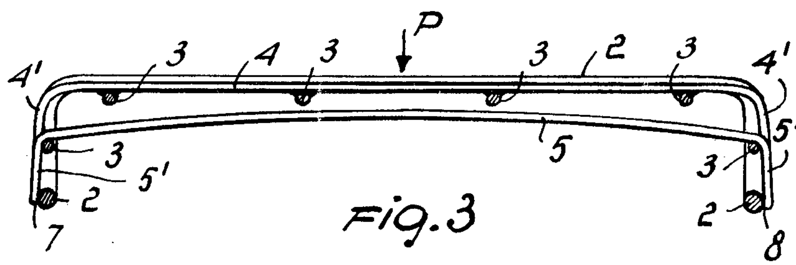

Fig. 3