United States Patent [19]

Bastgen

[11] **3,849,957**

[45] **Nov. 26, 1974**

[54] **REINFORCED CONCRETE RIBBED CEILING**

[76] Inventor: **Aloys Bastgen,** Eifelstr. 8, 5561 Wengerohr, Germany

[22] Filed: **June 4, 1973**

[21] Appl. No.: **366,407**

Related U.S. Application Data

[63] Continuation of Ser. No. 141,582, May 10, 1971, abandoned.

[52] **U.S. Cl.** **52/327,** 52/250, 52/334, 52/336, 52/337

[51] **Int. Cl.** **E04b 1/16**

[58] **Field of Search** 52/334, 336, 337, 250–252

[56] **References Cited**

UNITED STATES PATENTS

775,927	11/1904	Kahn	52/336
1,073,542	9/1913	Stewart	52/452 X
1,636,163	7/1927	Bitney	52/652
1,821,355	9/1931	Murray	52/336
1,863,258	6/1932	Tashjian	52/337 X
1,995,496	3/1935	Burgess	52/336 X
2,405,116	8/1946	Cullen	52/329 X
2,926,518	3/1960	Finley et al.	52/452
3,113,402	12/1963	Butler	52/329 X
3,178,856	4/1965	Grebner	52/337
3,245,186	4/1966	Jentoft	52/334
3,389,521	6/1968	Gregori	52/251 X

FOREIGN PATENTS OR APPLICATIONS

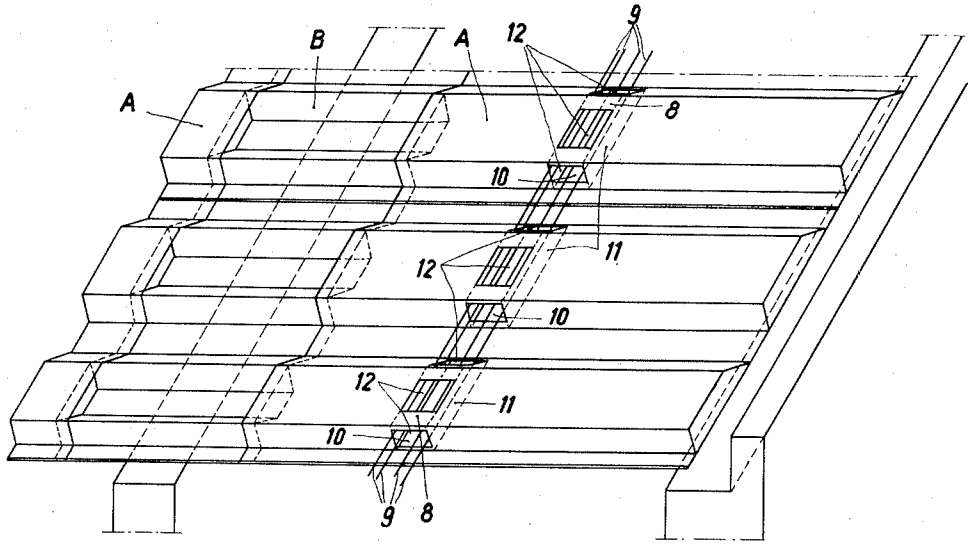
152,872	3/1938	Austria	52/336
712,932	9/1966	Italy	52/336
892,242	1/1944	France	52/334
1,008,501	2/1952	France	52/334
1,281,091	11/1961	France	52/337
332,331	7/1930	Great Britain	52/336

Primary Examiner—Alfred C. Perham
Attorney, Agent, or Firm—Robert W. Beach; R. M. Van Winkle

[57] **ABSTRACT**

A support structure for a reinforced concrete ribbed ceiling consists of a number of sections which each form a combined shuttering and support element and which are connected one to another. Each of the sections comprises a skin of thin steel sheet bent in zig-zag fashion such that its cross section includes at least one upwardly open trapezoidal portion, a continuous reinforcing mat spot welded onto the skin, a stirrup basket spot welded into each said trapezoidal section, and support reinforcement in each said basket.

1 Claim, 7 Drawing Figures



PATENTED NOV 26 1974

3,849,957

SHEET 1 OF 4

Fig.1

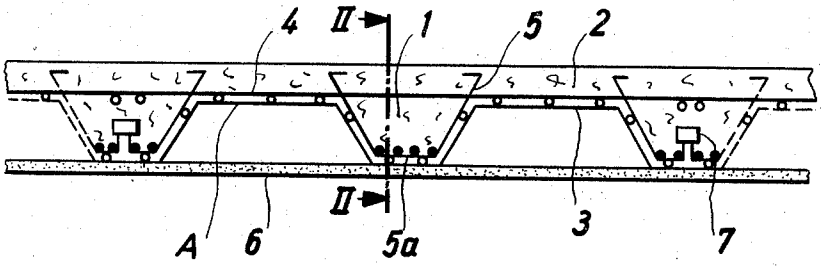


Fig.2

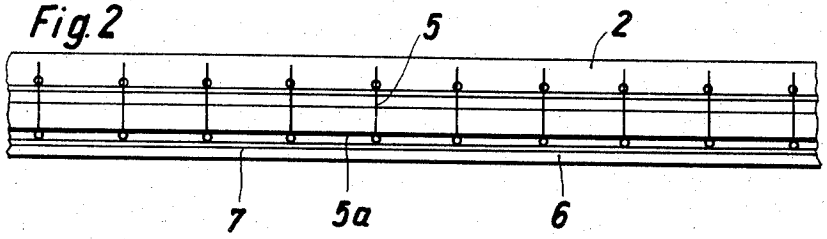


Fig.3

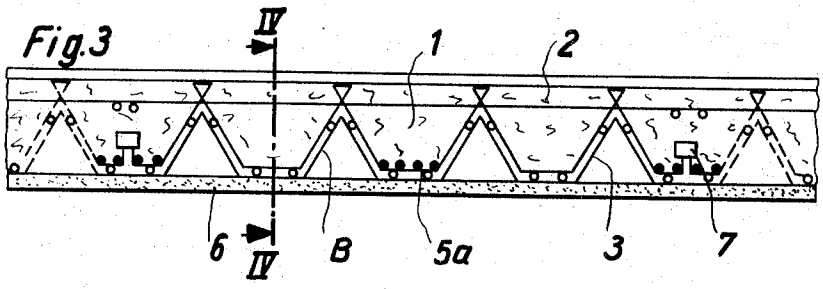
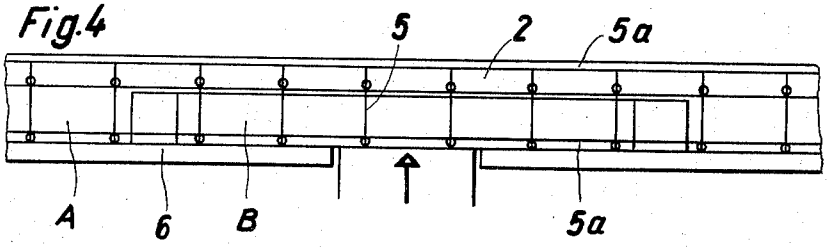


Fig.4



Inventor:
ALOYS BASTGEN

BY
Robert W. Beach

ATTORNEY

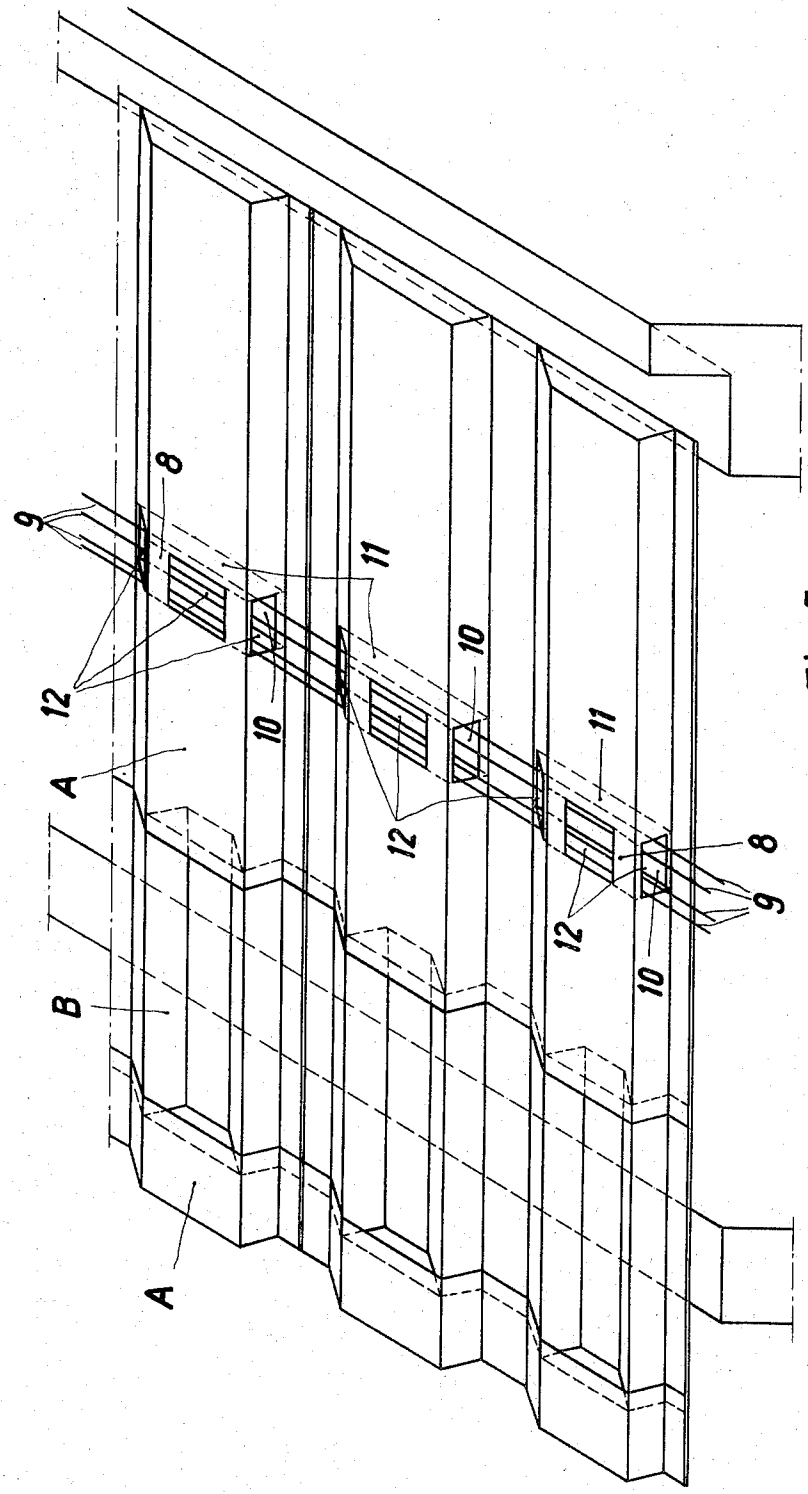


Fig. 5

Inventor:
ALOYS BASTGEN

BY
Robert W. Beach
ATTORNEY

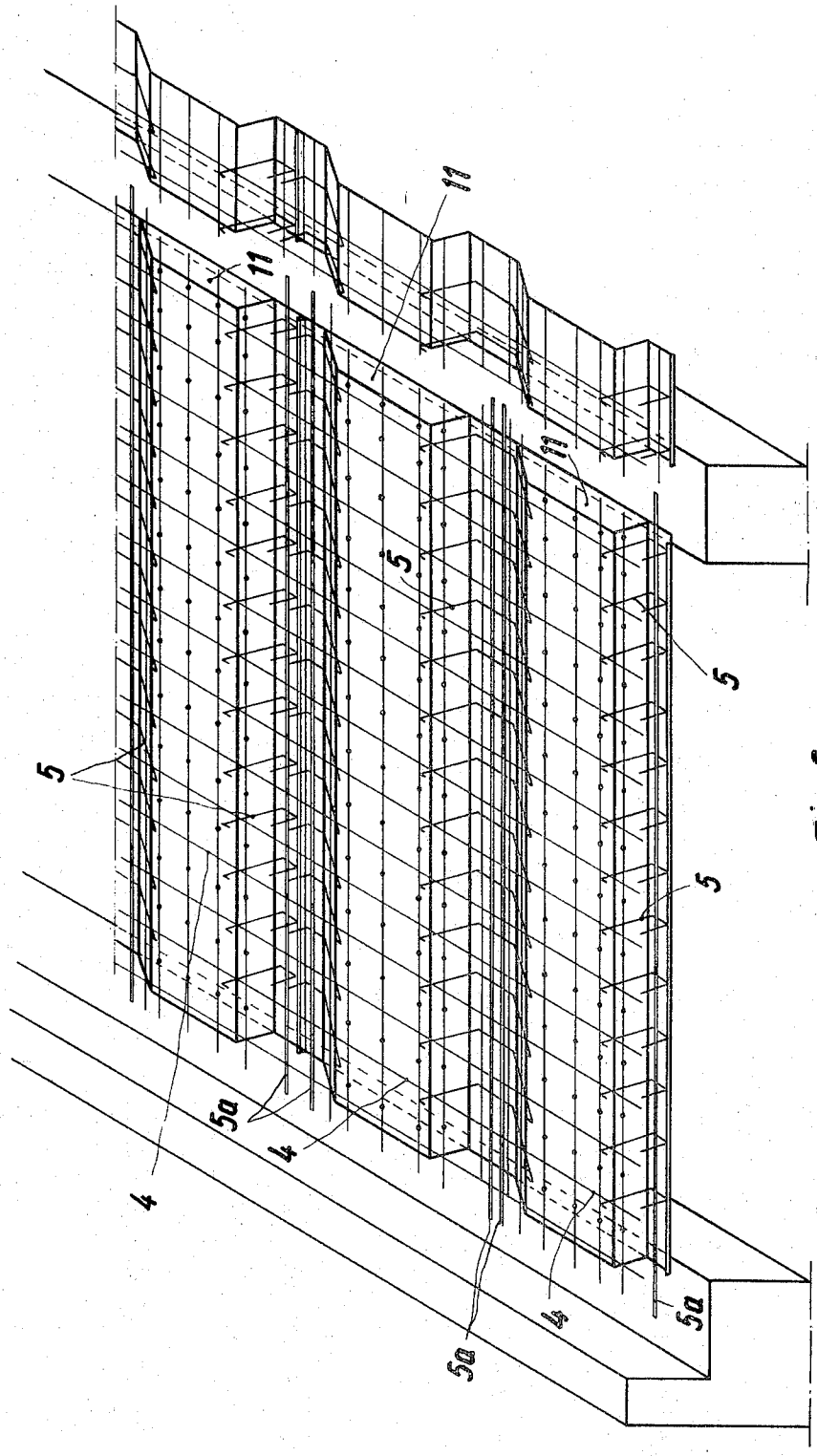


Fig. 6

Inventor:
ALOYS BASTGEN

BY
Robert W. Beach
ATTORNEY

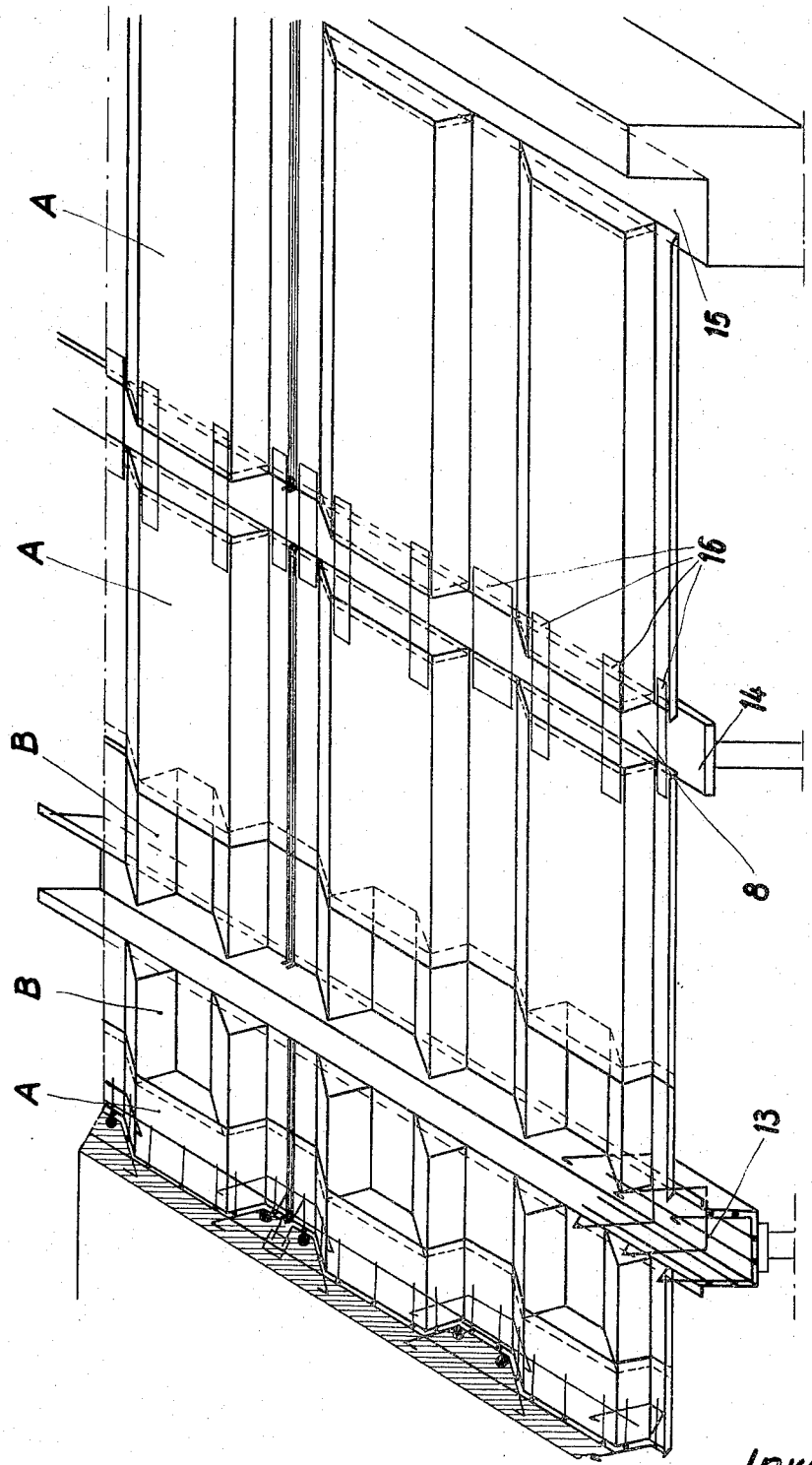


Fig. 7

Inventor:
ALOYS BASTGEN

BY
Robert W. Beach
ATTORNEY

REINFORCED CONCRETE RIBBED CEILING

This is a continuation of application Ser. No. 141,582, filed May 10, 1971 and now abandoned.

This invention relates to a reinforcedconcrete ribbed ceiling.

Reinforced-concrete ribbed ceilings are known in which ribs are arranged to extend parallel one to another at spaced intervals, the entire ceiling being reinforced by steel inserts. Such reinforced-concrete ribbed ceilings were hitherto either constructed on a special scaffolding having shuttering or were assembled from reinforced-concrete finished parts. In each case, scaffolding or shuttering has to be erected and, after the concreting, has to be removed again. When erecting such supporting structures on site, the shuttering is comparatively complicated and expensive. Moreover, it is difficult to achieve consistently accurate dimensions of the finished ribs.

The object of the invention is to provide a reinforced-concrete ceiling which can be produced without the need for a special scaffolding and shuttering,. whereby the costs of construction can be lowered and the previously occurring defects can be avoided.

With this object in view, a reinforced-concrete ribbed ceiling is proposed which is characterised in that arranged on the underside is a skin, made of thin steel sheet which is designed as shuttering and support element and which consists of several sections which are connected to one another and each of which overlaps at least one support rib of the neighbouring ceiling sections and is bent in zig-zag fashion in such a way that it has in cross section at least one upwardly open trapezoidal section. The skin is strengthened by a continuous reinforcing mat spot welded to its upper surface; and each upwardly open trapezoidal section of the skin receines a stirrup basket spot welded to the skin into which basket support reinforcement is inserted.

Advantageously the upwardly open trapezoidal sections of the skin are arranged at a spacing one from another a distance equal to the open trapezoidal side. More especially when mounted above supports, the open trapezoidal sections of the skin are arranged directly adjacent.

The size of the upwardly open trapezoidal sections arranged at a spacing is equal to the size of the directly adjacent upwardly open trapezoidal sections. In the case of the directly adjacent upwardly open trapezoidal sections, a head sheet is arranged at the end of every second trapezoid. At the edge of supports the downwardly open trapezoidal sections or triangular sections are likewise provided with head sheets.

The invention will now be described further, by way of example, with reference to the accompanying drawings, in which:

FIG. 1 is a cross section through a reinforced-concrete ribbed ceiling section utilizing a support structure according to the invention;

FIG. 2 shows a longitudinal section on the line II—II of FIG. 1;

FIG. 3 is a cross section through a reinforced concrete ribbed ceiling section utilizing a modified support structure according to the invention;

FIG. 4 shows a longitudinal section on the line IV—IV of FIG. 3;

FIG. 5 shows a perspective representation of two structural elements, butting against each other, corresponding to the embodiment in accordance with FIG. 1 and the embodiment in accordance with FIG. 3 in the case of a continuous supporting structure having a transverse rib;

FIG. 6 shows a perspective representation of structural elements of the embodiment in accordance with FIG. 1 for the formation of single-panel supporting structures having reinforcements; and

FIG. 7 shows a perspective representation of structural elements of the embodiment in accordance with FIG. 1 in conjunction with structural elements of the embodiment in accordance with FIG. 3 with a transverse rib and formation of a reinforcedconcrete beam support for a continuous supporting structure.

A reinforced-concrete ribbed ceiling comprises several concrete ribs 1, arranged parallel one to another at spaced intervals, and a ceiling plate 2 lying thereover and connecting the concrete ribs 1 one to another. In accordance with the invention, arranged on the underside of the ribbed ceiling is a support structure made of thin steel sheet, formed by a number of interconnected sections each of which is designed as a combined shuttering and support element.

In the embodiment A of FIG. 1 and 2, a skin 3 of each section is made of thin steel sheet bent in zig-zag fashion in such a way that it has a widthwise cross section which includes at least one upwardly open trapezoidal section. This part of the skin covers a concrete rib 1 from below, while the parts adjoining onto both sides give rise to the lower covering for the ceiling plate 2 laying between the concrete ribs.

Spot welded onto the skin 3 is a continuous reinforcing mat 4. Inserted into each of the open trapezoidal portions of the skin is a stirrup basket 5 having a support reinforcement 5*a*, which basket is spot welded onto the base and sides of the trapezoidal portions of the skin 3 in order to strengthen the supporting structure. The concrete ribs 1 of the skin 3 surrounding them supports a suspended ceiling 6.

The individual sections of the support structure are connected one to another end-to-end by connecting rings 7.

In the embodiment B shown in FIGS. 3 and 4, the concrete ribs 1 and consequently the upwardly open trapezoidal sections of the skin are arranged closely adjacent so that downwardly open triangles are formed between the trapezoidal sections, instead of the downwardly open trapezoidal sections which occur in the case of the embodiment A in accordance with FIG. 1 and 2. The embodiment shown in FIG. 3 and 4 is most advantageously used as a continuous structure across supports, while in the panels the embodiment A in accordance with FIG. 1 and 2 is used.

In its construction, the embodiment B resembles that of FIG. 1 and 2, but with the difference that, according to the embodiment B of FIG. 3 and 4, twice the number of ribs 1 and consequently also upwardly open trapezoidal sections are present. The size of the open trapezoidal sections is, however, in the case of FIGS. 1 and 3 equal, so that it is possible, for example, to place a structural element of the embodiment A in accordance with FIG. 1 and a structural element B in accordance with FIG. 3 directly in end-to-end juxtaposition and also in end-to-end overlapping relationship as is represented in FIG. 5. Advantageously, at the end of each of the alternate upwardly open trapezoidal sections of the structural element B which is spanned by the horizontal connecting structural elements of the embodiment A,

a head plate is provided to close the end of the rib and thereby confine the poured concrete therein. Likewise, the downwardly open trapezoidal sections and triangular sections of the structural elements of the embodiments A and B can be sealed on the supports by means of head plates **11.**

As shown in FIG. **5,** to distribute the loads onto several ribs, more especially in the case of large span widths, it is necessary to arrange ribs **8** in accordance with FIGS. **5** or **7** with corresponding transverse reinforcement **9.** The transverse ribs **8** are formed in that the downwardly open trapzoidal sections are closed by a base **10** having a lateral, upright head plates **11.** In order to be able to insert the concrete and the lateral reinforcement **9** into the channel and in order to obtain a connection between the concrete of the rib and ceiling plate, rectangular apertures **12** corresponding to the width of the transverse rib **8** are hollowed out in the upper surface and in the lateral crosspieces of the trapezoidal plate of the embodiment A.

Represented in FIG. **6** is a structural element in accordance with the embodiment A having a reinforcing network **4,** stirrup baskets **5** and support reinforcements **5***a* for a statically intended supporting structure (single panel plate). The downwardly open trapezoidal sections are closed on the support by head plates, so that the concrete for the ribbed ceiling can be introduced.

Represented in FIG. **7** is the arrangement of the structural elements of the embodiments A and B of a continuous ribbed ceiling for the superposition onto a reinforced concrete transom **13** which acts as a support. The transom **13** is thus formed by an upwardly open sheet-metal channel, in which the sheet metal is strengthened by a spot welded stirrup basket made of reinforced mats. The transverse rib **8** is produced by a continuous channel above an auxiliary support **14.** The structural elements of the embodiment A are separated above the auxiliary supports, while the reinforcing mat **4,** the stirrup basket **5** and the support reinforcement **5***a* pass through from the transom **13** to the support **15.** So that the structural elements of the embodiment A and A/B can even be laid in position before the assembly of the auxiliary supports **14** in one piece from the support **15** to the transom **13,** the missing upper and lower chord is replaced by spot-welded strengthened skin cover plates **16** and consequently the missing supporting cross section is produced in conjunction with the reinforcing mat **4** and the stirrup basket **5.**

However, it is also possible to cut out only the upper surface and the sloping side surfaces out of the trapezoidal sections, so that then only the missing upper chord is to be replaced by strengthened skin cover plates. The downwardly open trapezoidal sections on the transverse rib and the wall support, as well as the triangles on the transom, are sealed by head plates. On the left edge of the representation the concrete cross section is indicated as being strengthened with reinforcement.

With the aid of the support structure in accordance with the invention, a reinforced-concrete ribbed ceiling can be produced in a simple manner quickly and true to size. In this connection the skin serves initially, during the installation with spot-welded reinforcing mat and stirrup basket, as a scaffolding and shuttering and, in the case of the finished ceiling, as an additional strengthening of the reinforcement. It is naturally also possible to manufacture the skin from another suitable material, for example plastics, instead of steel sheet.

I claim:

1. A reinforced concrete ribbed ceiling comprising supporting structure means for providing scaffolding, shuttering and integral load-carrying capacity including a lower thin steel skin bent to form a plurality of upwardly opening trapezoidal channels, said channels being spaced apart a distance equal to the width of a channel opening, downwardly opening trapezoidal channels being defined therebetween, a wire reinforcing network spot welded to the upper side of said skin and spanning its entire longitudinal and transverse extent, and stirrup means in said trapezoidal channels spot welded to the channel skin and having portions extending above said channels and spot welded to said reinforcing network, a bottom strip spanning transversely across the skin bottom, a plurality of upright head plates closing the downwardly opening channels at opposite sides of said bottom strip, the downwardly opening channels including apertures in their closed channel bottoms and inclined channel sides between head plates, concrete carried by said skin embedding said reinforcing network and said stirrup means, the channel skin, stirrup means, and concrete of the channels forming integral longitudinal ribs, and concrete filling the transverse rectangular channels between the bottom plate and the head plates integral with concrete in the upwardly opening trapezoidal channels forming a transverse rib.

* * * * *