

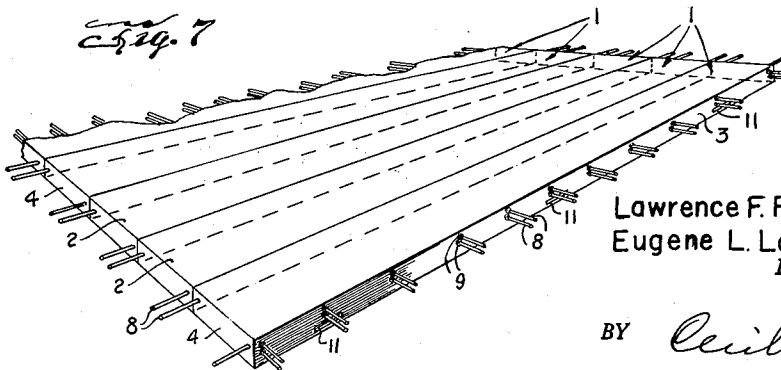
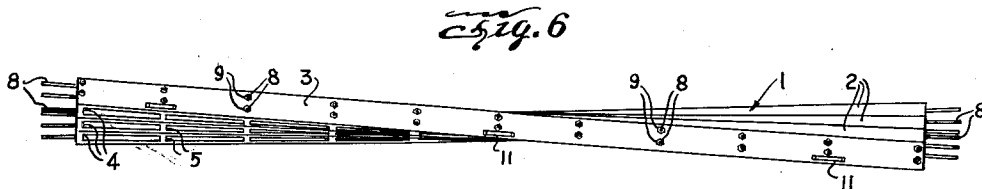
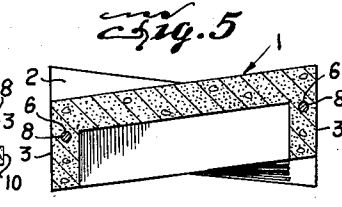
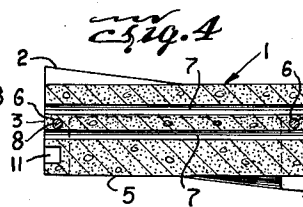
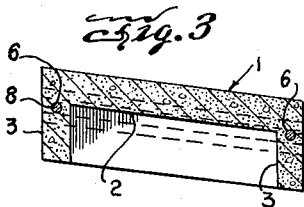
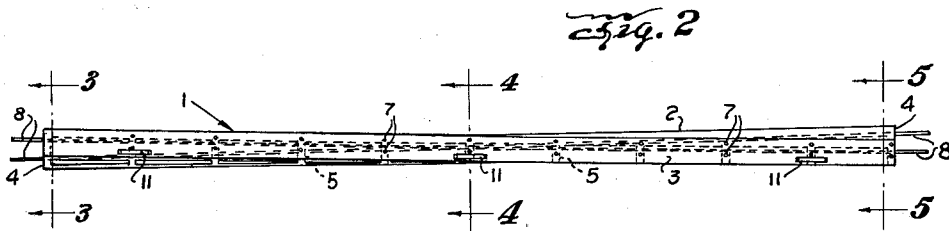
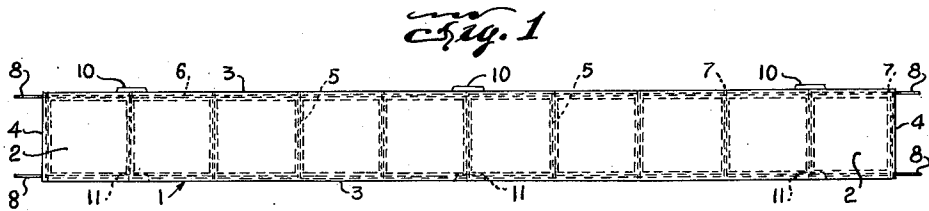
June 25, 1963

L. F. PEELER ET AL  
PRECAST UNIT FOR FORMING A HYPERBOLIC  
PARABOLOIDAL ROOF STRUCTURE

3,094,812

Filed June 22, 1959

3 Sheets-Sheet 1



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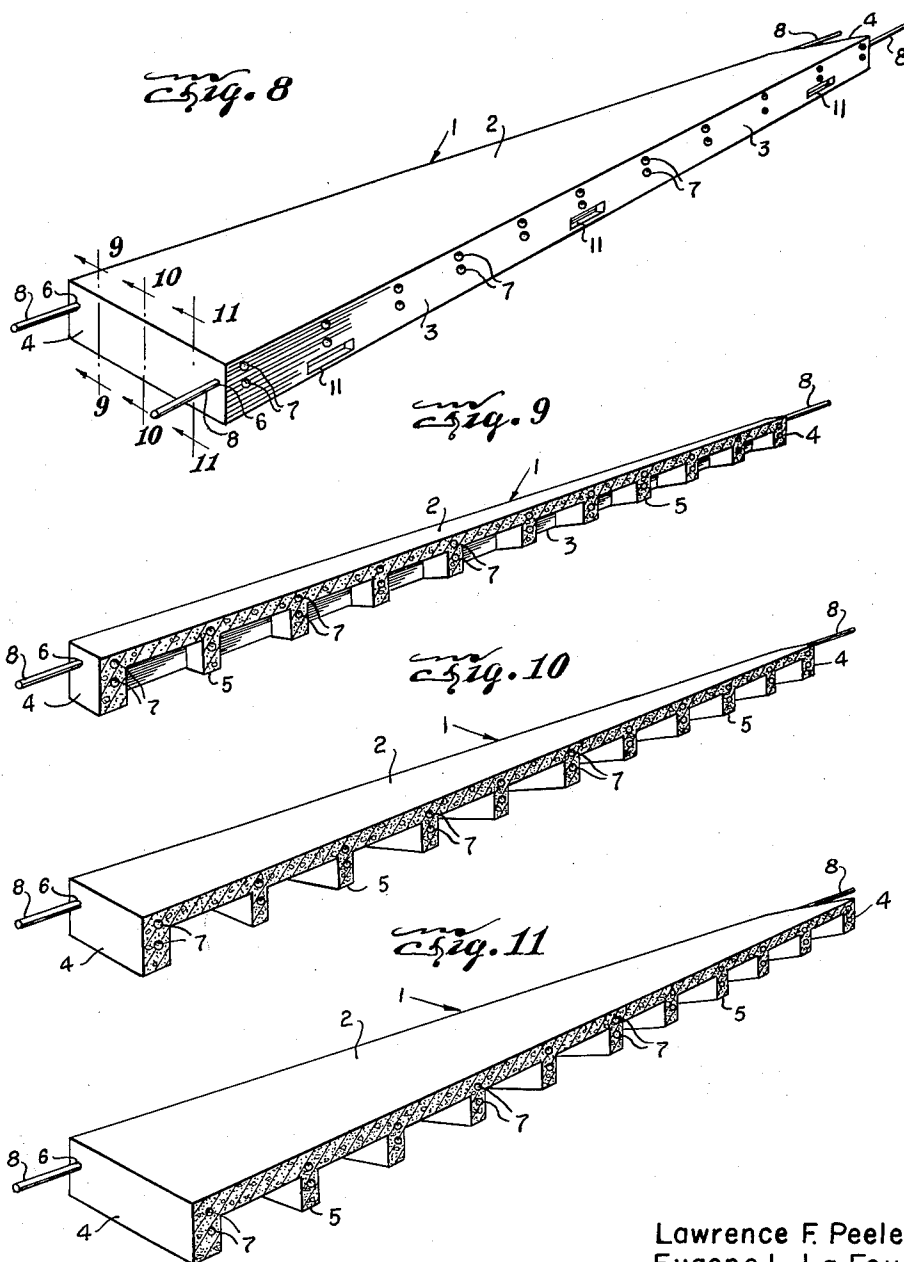
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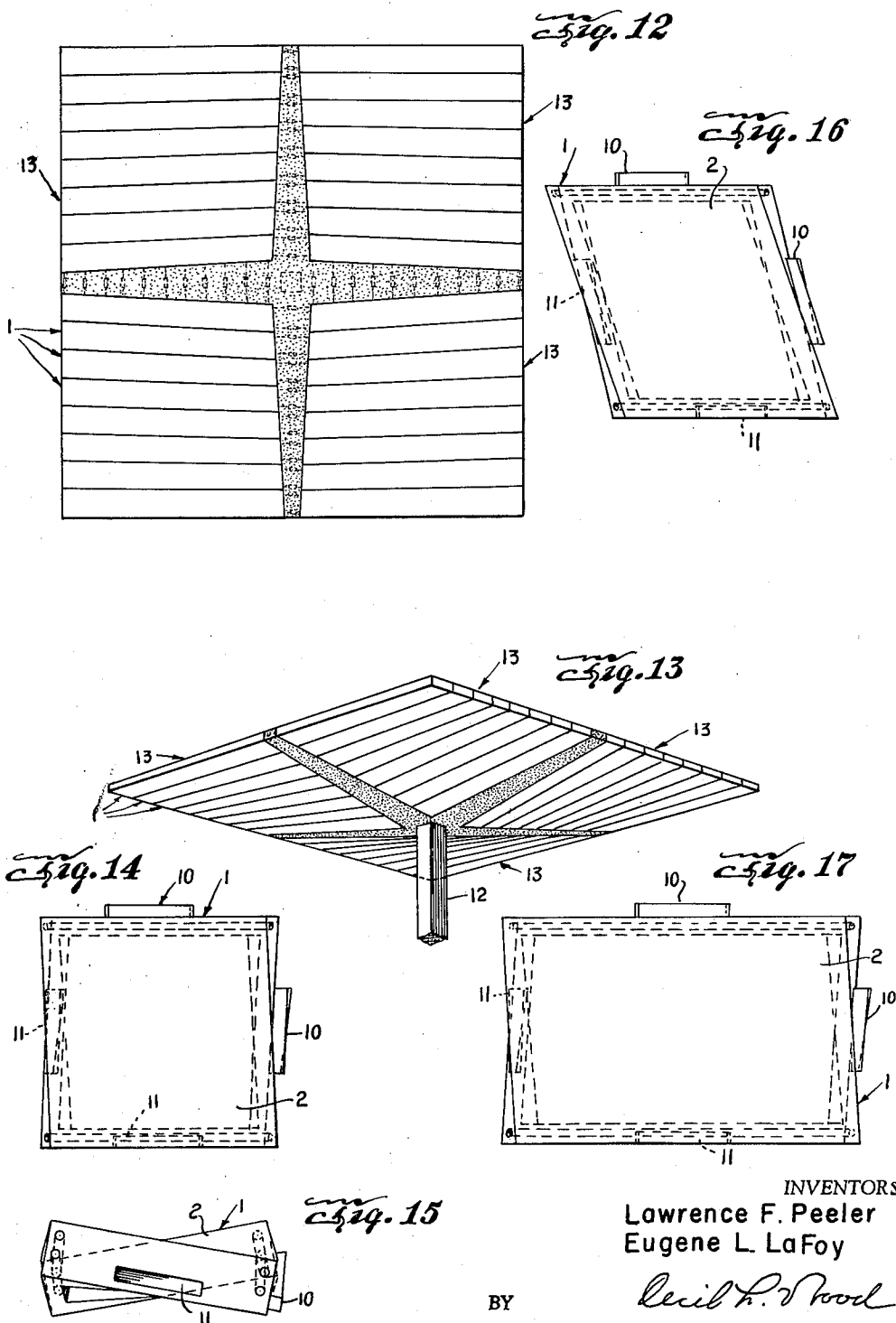
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## PRECAST UNIT FOR FORMING A HYPERBOLIC PARABOLOIDAL ROOF STRUCTURE

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4 Claims. (Cl. 50—52)

This invention relates to reinforced concrete shell roof construction, and it concerns more particularly relatively thin reinforced concrete roofs of the hyperbolic paraboloidal shell type having structural shapes which are obtained by association of warped parallelograms.

By use of various types of reinforced concrete shell roofs, which are well known, it is possible to construct buildings which are characterized by comparatively large amounts of unobstructed space, free of supporting columns and beams, the roof structure being supported by a relatively small number of columns. Such roof structures ordinarily are maintained by reinforcing under tension throughout, and the concrete may be compressed or prestressed, by means of tie rods or cables, the imposed stress being sufficient to compensate for the dead weight of the structure and the loads superimposed thereon.

The principal object of this invention is to provide a shell roof structure comprising a plurality of shaped elements, of hollow, ribbed construction, each of such elements having a top and substantially parallel side and end walls, the several elements being twisted or warped so that when arranged side by side they collectively form a structural shape corresponding to the shape of the roof, such elements having bores formed therein parallel to the side and end walls for engagement by rods or cables whereby the elements are connected to form the roof.

Another object of the invention is to provide a prefabricated roofing element of the type described which advantageously may be formed of reinforced concrete, metal, plastic materials, or other suitable moldable materials capable of being produced in mass, or an assembly line basis, and which is capable of being employed, in combination with like elements to produce roofs of various sizes and shapes.

Another object of the invention is to provide a roof structure of the type described which is capable of being manufactured and erected economically, and which at the same time is entirely practical and serviceable as well as safe and dependable, and which is characterized by its light weight, strength and durability whereby it may be used indefinitely without need for repairs or replacement.

The invention will be readily understood by referring to the following description and the accompanying drawing, which:

FIGURE 1 is a top plan view of a roofing element embodying the invention;

FIGURE 2 is a side elevational view of the roofing element shown in FIGURE 1;

FIGURE 3 is a sectional elevational view taken on the lines 3—3 of FIGURE 2;

FIGURE 4 is a sectional elevational view taken on the lines 4—4 of FIGURE 2;

FIGURE 5 is a sectional elevational view taken on the lines 5—5 of FIGURE 2;

FIGURE 6 is an elevational view of a plurality of roofing elements, as shown in FIGURES 1 to 5, connected in side by side relation to each other to form a roof structure;

FIGURE 7 is a fragmentary perspective view of a roof structure as shown in FIGURE 6;

FIGURE 8 is a perspective view of the roofing element shown in FIGURES 1 to 5;

FIGURE 9 is a sectional elevational view taken on the lines 9—9 of FIGURE 8;

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FIGURE 10 is a sectional elevational view taken on the lines 10—10 of FIGURE 8;

FIGURE 11 is a sectional elevational view taken on the lines 11—11 of FIGURE 8;

FIGURE 12 is a top plan view of an umbrella type roof structure having incorporated therein roofing elements as shown in FIGURES 1 to 11;

FIGURE 13 is a perspective view of the roof structure shown in FIGURE 12;

FIGURE 14 is a top plan view of a roofing element or tile similar to that shown in FIGURES 1 to 11 which is substantially square;

FIGURE 15 is a side view of the roofing element or tile shown in FIGURE 14; and

FIGURES 16 and 17 are top plan views of roofing elements or tiles each having two parallel sides which are longer than the other two sides but which are substantially shorter, relative to the other two sides, than the corresponding sides of the element shown in FIGURES 1 to 11.

Referring to FIGURES 1 to 11 of the drawing, the numeral 1 designates generally a roofing element or tile which may be formed of reinforced concrete, for example. The roofing element 1 is of hollow, ribbed construction, and has a top 2 and substantially parallel side walls 3 and end walls 4. As shown best in FIGURES 6 and 7, the several elements 1 which comprise a roof structure are twisted or warped so that when arranged side by side they collectively form a structural shape corresponding to the shape of the roof.

The elements 1 are reinforced by a plurality of longitudinally spaced transverse ribs 5, and have bores 6 and 7 formed therein parallel to the side walls 3 and the end walls 4, respectively, for engagement by rods or cables 8 having nuts 9 applied to the ends thereof whereby the elements 1 are connected to form a roof structure. The bores 6 preferably extend through the side walls 3, while the bores 7 extend through the end walls 4 and the transverse ribs 5.

It is contemplated that the elements 1, shown in FIGURES 3 to 5 and 8 to 10 be formed, if desired, either in a solid unit without recesses between the transverse 5, or with one or more longitudinal cells or passages extending the full length of these members, and such cells or passages may be round or angular as desired. Such an arrangement will lessen the weight of the element and minimize the amount of material required in their formation.

The elements 1 each have a plurality of longitudinally spaced keys 10 formed on one of the sides 3 thereof for engagement with corresponding recesses 11 which are formed in the adjacent side 3 of an adjoining element 1 whereby the elements 1 are capable of being readily aligned with each other in assembling them to form a roof structure. The keys 10 are designed to withstand the stress applied thereto, and their form, as well as that of the recesses 11, may be varied as desired.

The umbrella type roof structure shown in FIGURES 12 and 13, which is supported upon a central post 12, comprises four corner sections, indicated generally by the numerals 13, each comprising a plurality of elements 1 which are connected in side by side relation to each other. The several elements 1 comprising the respective corner sections 13 collectively form a roof structure which is curved inwardly and downwardly toward the center. Each of the corner sections 13 is connected to the adjoining corner sections 13 by the rods or cables 8.

Referring to FIGURES 14 to 17, roofing elements 1 are shown which differ from the elements 1 shown in FIGURES 1 to 13 primarily in dimension. In the elements 1 shown in FIGURES 14 to 17 the transverse ribs

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5 have been omitted, and keys 10 and recesses 11 have been provided on the ends thereof as well as on the sides. These members are square or rectangular in shape but having the distorted form of the longer elements illustrated in FIGURES 8 to 11.

The invention may be modified in various ways without departing from the spirit and scope thereof.

What is claimed is:

1. A structural unit adapted for multiple installation to form a hyperbolic paraboloidal roof structure, comprising, a precast elongated concrete slab having longitudinal ribs formed on its underside and along each edge and depending therefrom in parallel planes, lateral ribs formed at spaced intervals between said longitudinal ribs, reinforcing rods arranged coextensively of each of said longitudinal ribs, the said slab having a plurality of bores formed transversely of said slab through each of said lateral ribs adapted to receive rods therethrough to connect a plurality of said slab in juxtaposition in a unitary roof structure, the said slab having a longitudinal twist whereby, when joined with similarly formed slabs, a hyperbolic paraboloidal roof structure is formed.

2. In a hyperbolic paraboloidal roof structure, comprising, a plurality of precast reinforced concrete units, each having greater length than width and warped longitudinally whereby the planar surfaces of each assume a gradual twist, each of said units having a rib formed on each longitudinal edge and depending therefrom in parallel planes, spaced transverse ribs connecting said longitudinal ribs and having bores therethrough traversing said unit, rods arranged through the said bores joining and supporting a plurality of said units in an integral roof structure, and interlocking means formed in the edges of each of said units cooperating with said rods in supporting said joined units.

3. A structural unit adapted for multiple installation to form a hyperbolic paraboloidal roof structure, com-

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prising, a precast concrete slab of substantially greater length than width and having parallel longitudinal edges and planar surfaces, the said slab having a longitudinal twist along its planar surfaces, ribs formed along each longitudinal edge of said slab and depending therefrom in parallel planes, a reinforcing rod arranged coextensively through each of said longitudinal ribs, a series of spaced lateral ribs formed on the underside of said slab and connecting said longitudinal ribs, each having a plurality of bores formed longitudinally thereof and opening through said longitudinal ribs adapted to receive rods for connecting a plurality of said slabs in longitudinal juxtaposition in a roof structure.

4. A precast concrete unit for forming a hyperbolic paraboloidal roof structure, comprising, a slab having greater length than width and formed with ribs depending in parallel planes from the longitudinal edges thereof, a reinforcing rod embedded longitudinally in each of said ribs and extending beyond the ends thereof, a plurality of spaced ribs formed transversely of said slab between said longitudinal ribs, each having a plurality of bores therethrough adapted to receive a cable for connecting a plurality of said slab in juxtaposed relation in a roof structure, the said slab being twisted along its longitudinal axis.

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