Sept. 3, 1929. H. M. KNIGHT 1,726,903

KEY

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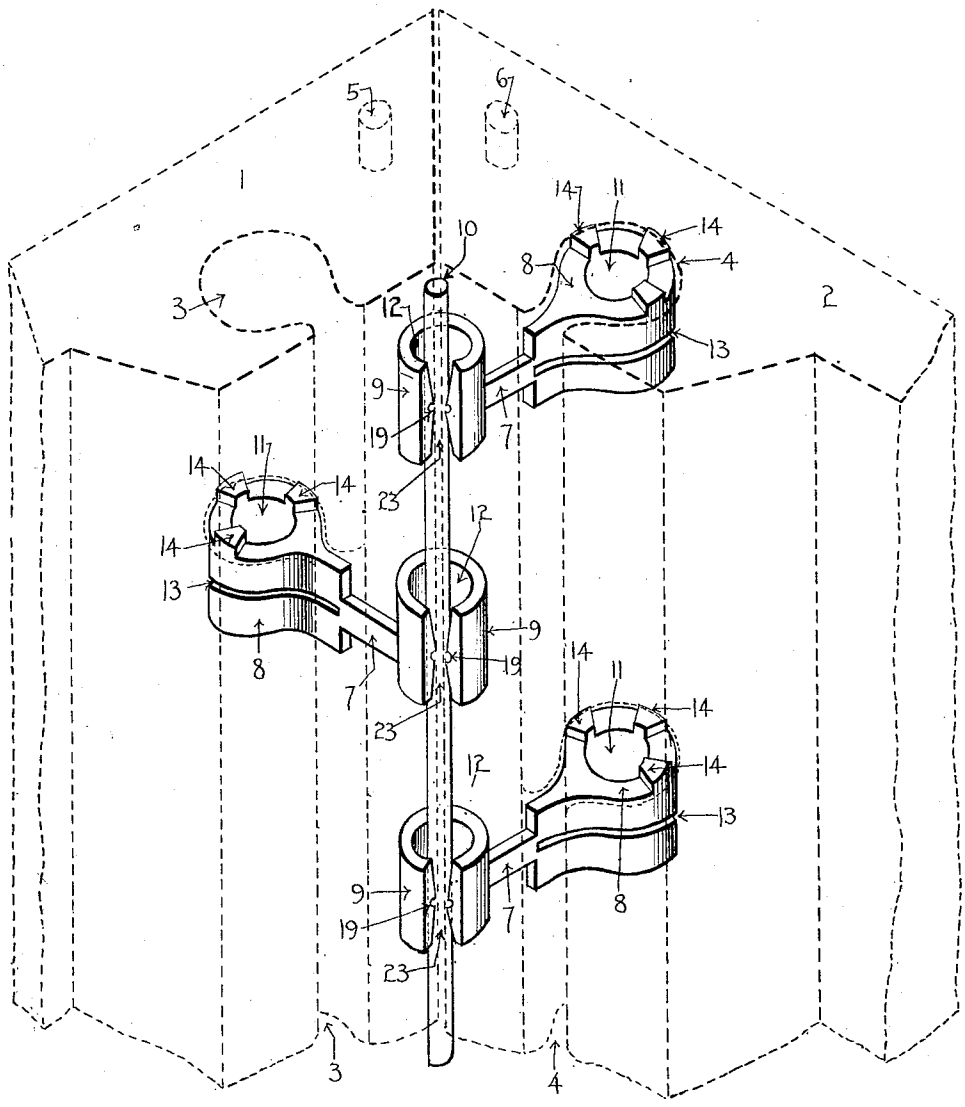


Fig. 1

Herbert M. Knight INVENTOR

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Fig. 5

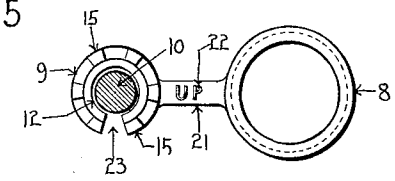
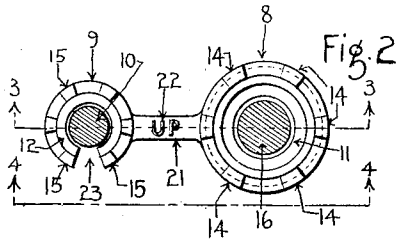


Fig. 2



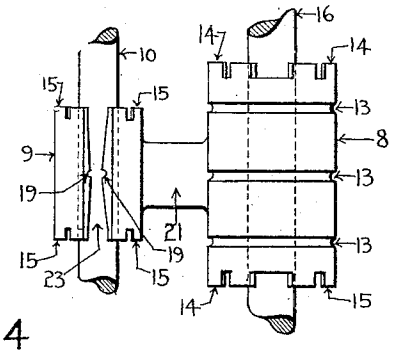


Fig. 4

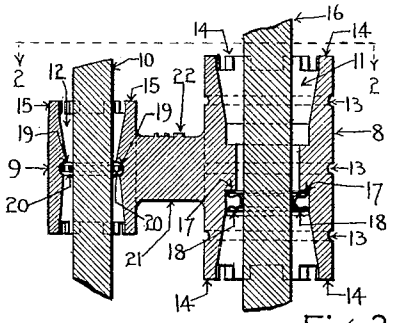


Fig. 3

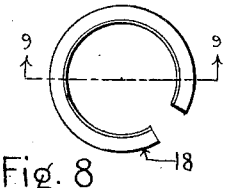


Fig. 8

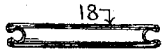


Fig. 9

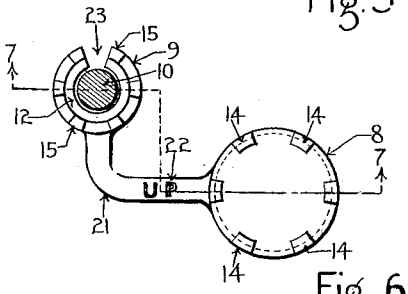


Fig. 6

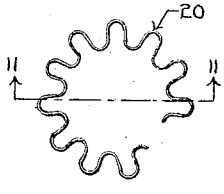


Fig. 10

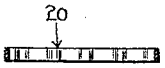


Fig. 11

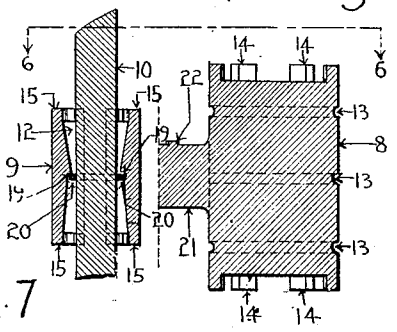


Fig. 7

INVENTOR

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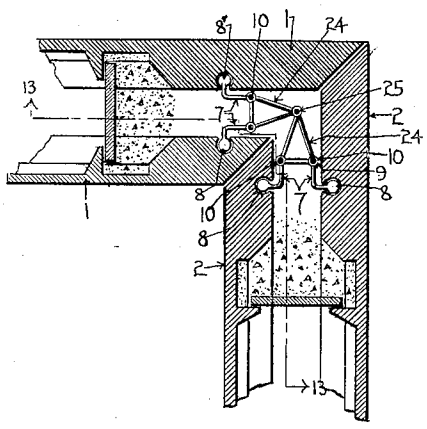


Fig. 12

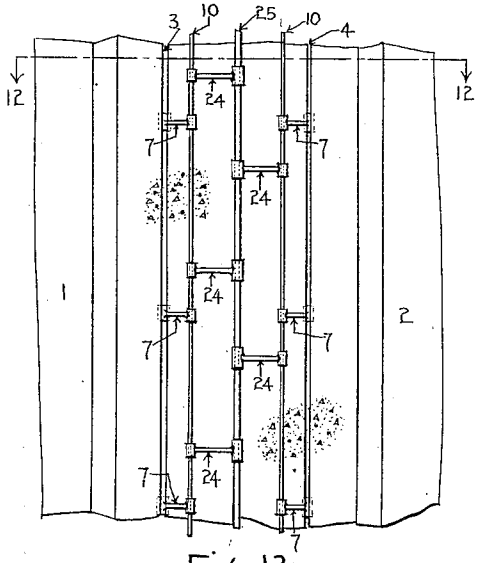


Fig. 13

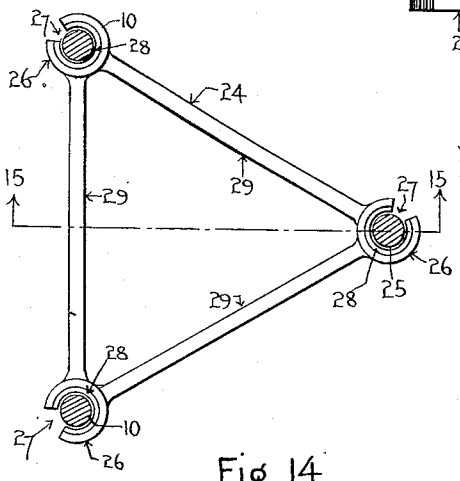


Fig. 14

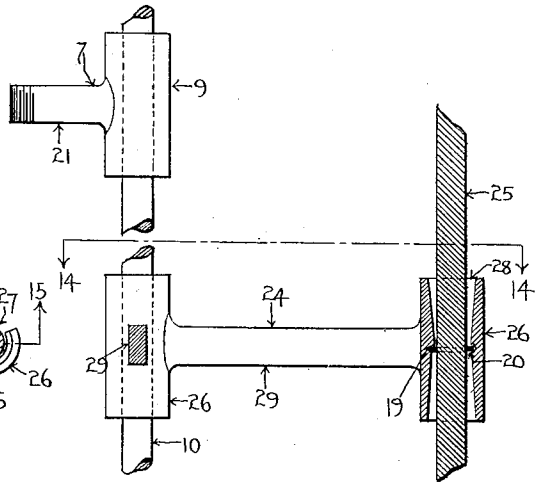


Fig. 15

Herbert M. Knight INVENTOR

Patented Sept. 3, 1929. 1,726,903

UNITED STATES PATENT OFFICE.

HERBERT M. KNIGHT, OF UPPER MONTCLAIR, NEW JERSEY.

KEY.

Application filed December 5, 1924. Serial No. 754,103.

This invention relates to improvements in keys for use in building construction, and particularly to construction wherein pre-cast slabs, or units, are employed.

One of the objects of this invention is to produce a key which shall interlock a pre-cast element with a reinforcing element. Another object of the invention is to produce a key which shall interlock two or more pre-cast elements with a reinforcing element. A further object of the invention is to produce a key, one portion of which is adapted to traverse a groove in a pre-cast element and another portion of which is adapted to engage a reinforcing element. Still a further object of the invention is to produce a key that is slidably in contact with one or more reinforcing elements. Another object of the invention is to produce a key of such form and arrangement of parts, that the key occupies, relatively, a small section only of the position in which keys are required for the proper interlocking of the pre-cast elements with the reinforcing elements, leaving a space between adjacent and successive keys for the mass concrete of a strengthening frame to surround said keys and firmly embed them on all sides within said mass concrete strengthening frame. Another object of the invention is to unite reinforcing elements with keys and slabs, or units, so as to secure a unified structure of maximum strength. Other objects of this invention will appear from the following description and from the accompanying drawings.

The accompanying drawings, Figs. 1 to 15, inclusive, illustrate the usual and preferred embodiment of the invention, but are not to be considered as inclusive of any and all forms in which the invention may be embodied, or as exclusive of forms other than those indicated.

I illustrate my invention by the accompanying drawings in which Fig. 1 is an isometric view of a bevelled joint or corner in which such keys are employed as a joining means; Fig. 2 is a plan view of such a key on the line 2—2 of Fig. 3; Fig. 3 is a section of a key on the line 3—3 of Fig. 2; Fig. 4 is a vertical elevation on the line 4—4 of Fig. 2. Fig. 5 is a plan view of a key in which one of the heads is solid; Fig. 6 is a plan view of a key having a bent shank on the line 6—6 of Fig. 7; Fig. 7 is a section of such a bent-shank-key on the line 7—7 of Fig. 6; Fig. 8 is a plan view of one form of a contact medium for engaging with a reinforcing element; Fig. 9 is a section of such a contact medium on the line 9—9 of Fig. 8; Fig. 10 is a plan view of another form of such contact medium; Fig. 11 is a cross-section of such a medium on the line 11—11 of Fig. 10; Fig. 12 is a cross-sectional view on the line 12—12 of Fig. 13, showing a double wall construction in which keys are employed supplemented by spiders; Fig. 13 is a vertical section of such a wall construction on the line 13—13 of Fig. 12; Fig. 14 is a horizontal view of a spider on the line 14—14 of Fig. 15, and Fig. 15 is a vertical section of such a spider on the line 15—15 of Fig. 14.

Referring to the drawings in which similar numbers refer to similar parts:—

(1) and (2) are pre-cast units having grooves (3) and (4) therein and positioning means (5) and (6) as parts thereof. Keys (7) with heads (8) adapted to traverse said grooves and with other heads (9) adapted to engage a reinforcing element (10) are so stationed as to be intermittently positioned upon said reinforcing element. Holes (11) pass through said heads (8) while other holes (12) pass through said heads (9). Grooves (13) are scored upon the exterior of said heads (8) and knurls (14) are formed upon the upper and lower surfaces of said heads (8) and other knurls (15) upon the upper and lower surfaces of said heads (9). A reinforcing element (16) is adapted to pass through said heads (8). Shoulders (17) within said head (8) act as an abutment for a contact element (18) adapted to slidably engage the reinforcing element (16). A shoulder (19) within the head (9) acts as an abutment for the contact medium (20), adapted to slidably engage the reinforcing element (10). A shank (21) connects said heads (8) and (9), and positioning indices (22) are part of said keys (7). A slit (23) is made in the side of said head (9). A spider (24) serves to connect a multiple of reinforcing elements, as (10), to one or more of which keys, as (7), are connected. Other reinforcing elements, (25) are engaged by said spiders. Heads (26) with slots (27) therein are parts of said spiders. Holes (28) pass through said

heads which are connected together by arms (29).

Reference is here made in this application to petitioner's co-pending application, Serial Number 491,228, "building construction", filed August 10, 1921, as illustrating the use of a key of this type in building construction.

When two pre-cast units, usually of concrete, have been assembled and temporarily held in place by positioning means, and in a type of construction in which a strengthening frame is to be installed, it becomes necessary to unite the said units or slabs, to the said strengthening frame in such manner as will insure that the said slabs and the said strengthening frame act as single structure. This is secured by the use of a key of the "dumb-bell" variety, usually of relatively short length, one of the heads of which said key, either solid or tubular, is adapted to be inserted into and to traverse a groove in the said pre-cast unit. The other of the heads is likewise of tubular form and is adapted to surround or partially surround and travel upon one of the reinforcing members of the strengthening frame. The heads are connected by a shank which is usually of less length than the length of the heads. Knurls or protuberances serve to make a positive connection between the heads and the concrete which is subsequently poured around them during the placing of the strengthening frame, and grooves, or other roughening means further add to the adhesive factor as between the keys and the concrete of the frame.

The perforations or holes through the said heads are not of uniform diameter but vary in diameter, and for the following reasons. In order that there shall be a comparatively large play as between the reinforcing element and the inner surface of the perforation through the head and admit of an adjustment of the two elements, preventing binding, the outer ends of the perforations through the heads are of greater diameter than that of the said perforations at the middle of said heads. This enlarged diameter of perforation at the outer ends permits concrete from the strengthening frame entering the said perforations and adhering both to the reinforcing element and to the inner surface of the head. Also the inner diameters decrease from a medial point outwardly in order to permit of the introduction of a contact means that shall elastically bind the key to the reinforcing member. A shoulder is formed in conjunction with this varying diameter, against which this contact member abuts.

One of the major objects sought in the use of a system of pre-cast exterior slabs in conjunction with an enclosed mass concrete strengthening frame, is to bind the two bodies together so that they shall act as one. A single key of the length of the joint would not successfully accomplish this as it would introduce a line of cleavage through the mass concrete frame and thereby become an element of weakness rather than of strength. Again a key of such character would not serve to bind or interlock a multiple of such pre-cast units to each other and to the said mass concrete frame. The above desired object is secured in this invention by making the keys relatively short and by so threading them upon the reinforcing elements as that alternate keys are connected to opposite or adjacent pre-cast units, and by leaving a substantial distance between adjacent keys, permitting the poured concrete of the frame to surround and adhere to the reinforcing element which is employed in connection with the keys. This concrete also passes in to the perforations through the play-space at the outer ends of said perforations still further assisting in the union of the several parts going into the making of the joint, and, in addition, concrete enters the unoccupied spaces of the grooves of the pre-cast slabs. As a further means by which to assure the maximum of contact between the concrete and the reinforcing elements which work, or are directly utilized in connection with the keys, a slit is made in that head which engages the said reinforcing element, through which said slit concrete enters, filling the void between the reinforcement and the inner surface of the said head.

In placing a key of such character, where a considerable distance is desired to be maintained between adjacent keys, some means of positively maintaining this distance is necessary. This means consists of an elastic medium surrounding, or partially surrounding the reinforcement bar, and housed within the perforation of the head and abutting against the shoulder therein. This contact means being elastic in character, admits of pushing the key downwardly over the reinforcing element until the key shall have attained the position desired, where it rests, the friction between the bar and the contact means being sufficient to prevent further movement of the key upon the said bar. The contact means usually employed is an open ended spring, such as is illustrated in Figs. (8) to (11), the elasticity of the spring giving that degree of sliding friction necessary to engage the reinforcing element, and yet permitting movement of the key upon the said reinforcing element when slight, but sufficient, force is exerted from without.

The above description is applicable largely when there is relatively only a small number of reinforcing elements in the strengthening frame. When these elements become more numerous, other and additional means are necessary in order to bind the slabs,

through the keys, to a sufficient number of the reinforcing elements. The additional means employed are spiders, so called, which consist of a multiple of perforated heads, similar to the heads of the keys, adapted to slide upon the several reinforcing elements which are designed to be engaged by each of the said spiders, one at least of which said reinforcing elements is engaged by the keys connecting with the aforesaid pre-cast concrete slabs. These spiders are introduced at separated intervals, as is the case with the keys, and the mass concrete surrounds and engages these spiders as it does the keys. The heads of the spiders being slotted as are the heads of the keys, concrete passes through the said slots and engages the reinforcing elements. Means slidable upon and engaging the reinforcing elements serve to retain the spiders in their pre-determined location upon the said reinforcing elements. The result of the employment of the spiders in conjunction with the keys is the tying together of all of the several parts in such manner as to secure a unity of action and a near approach to monolithic construction. The spiders do not act independently but both the spiders and the keys act in unison to produce a maximum of strength and a unity of structure.

What I claim is:—

1. A key, heads to said key, a shank connecting said heads, a perforation through one of said heads, a contact means within said perforation and abutting means within said perforation adapted to engage said contact means.

2. A key, heads to said key, a shank connecting said heads, perforations through said heads, contact means within said perforations and abutting means within said perforations adapted to engage said contact means.

3. In building construction, pre-cast slabs, grooves in said slabs, a key, heads to said key, means connecting said heads, and a reinforcing element, one of said heads being inserted within said groove and one of said heads being perforated and engaging said reinforcing element.

4. In building construction, the combination of pre-cast slabs, grooves in said slabs, a key, heads to said key, means connecting said heads, a reinforcing element, one of said heads being inserted within said groove and one of said heads being perforated and engaging said reinforcing element and a mass concrete frame surrounding said keys and said reinforcing element.

5. In building construction, the combination of pre-cast slabs, grooves in said slabs, a key, heads to said key, means connecting said heads, a reinforcing element, one of said heads being inserted within said groove and one of said heads being perforated and engaging said reinforcing element and a contact means engaging said reinforcing element and said key and slidable upon said reinforcing element.

6. In building construction, the combination of pre-cast slabs, grooves in said slabs, a key, heads to said key, means connecting said heads, a reinforcing element, one of said heads being inserted within said groove and one of said heads being perforated and engaging said reinforcing element, contact means engaging said reinforcing element and said key and mass concrete surrounding said key and said reinforcing element.

7. In building construction, the combination of pre-cast slabs, grooves in said slabs, a key, heads to said key, said heads being perforated, means connecting said heads, a bar in said groove, one of said heads being within said groove and enveloping said bar, a reinforcing element exterior to said slabs, one of said heads enveloping said reinforcing element and a contact means in contact with said key and said reinforcing element.

8. In building construction, the combination of pre-cast slabs, grooves in said slabs, a key, heads to said key, said heads being perforated, means connecting said heads, a bar in said groove, one of said heads being within said groove and enveloping said bar, a reinforcing element without said slab, one of said heads enveloping said reinforcing element, a contact means engaging said key and said reinforcing element and mass concrete surrounding said key and said reinforcing element.

9. In building construction, the combination of a key, heads to said key, means connecting said heads, a reinforcing element, one of said heads being perforated and engaging said reinforcing element and a spring as a contact means housed within said perforation.

Signed at New York in the county of New York and State of New York this fourteenth day of November A. D. 1924.

HERBERT M. KNIGHT.