Feb. 7, 1967 SVEN-ERIK BJERKING 3,302,360
METHOD OF REINFORCING CONCRETE FLOORS AND THE LIKE, AND A REINFORCING ELEMENT THEREFOR
Filed Dec. 23, 1963 4 Sheets-Sheet 1

Fig.1

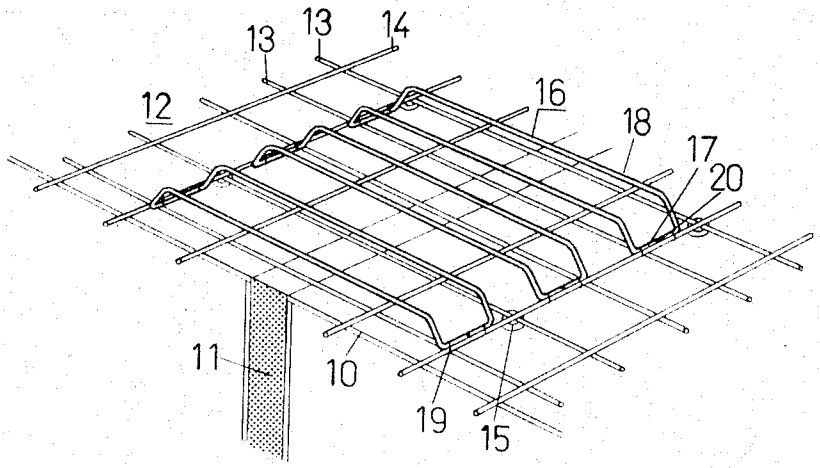

Fig.2

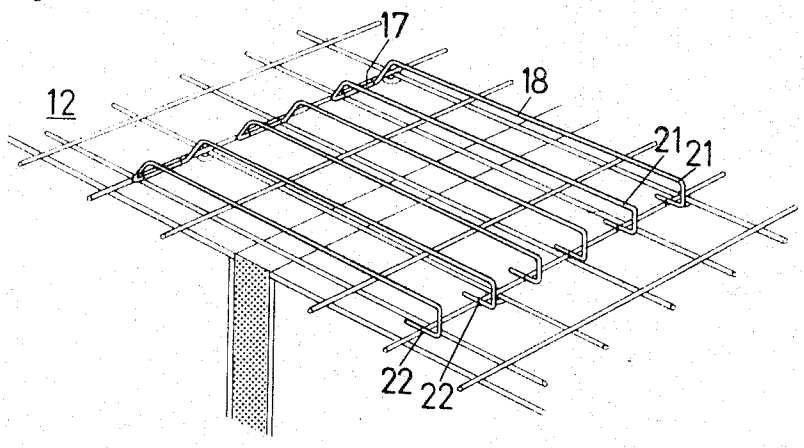

Fig. 3

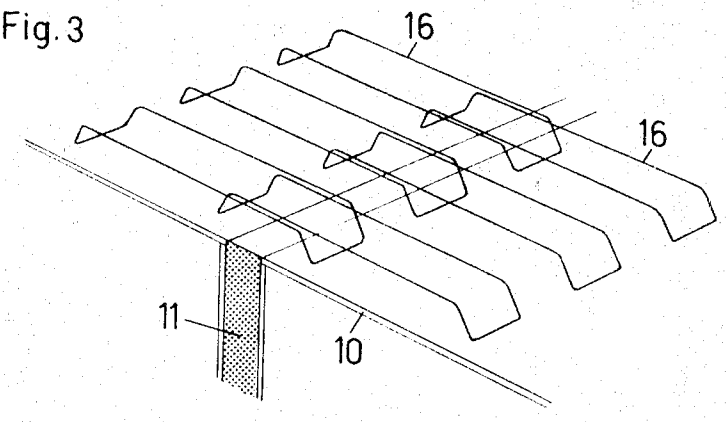

Fig. 4

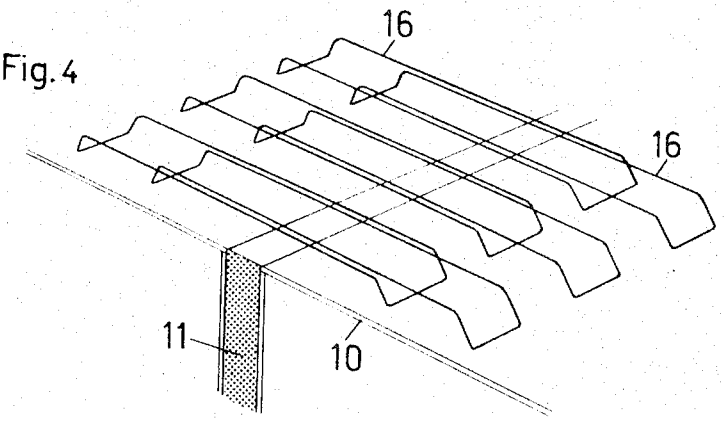

Fig. 5

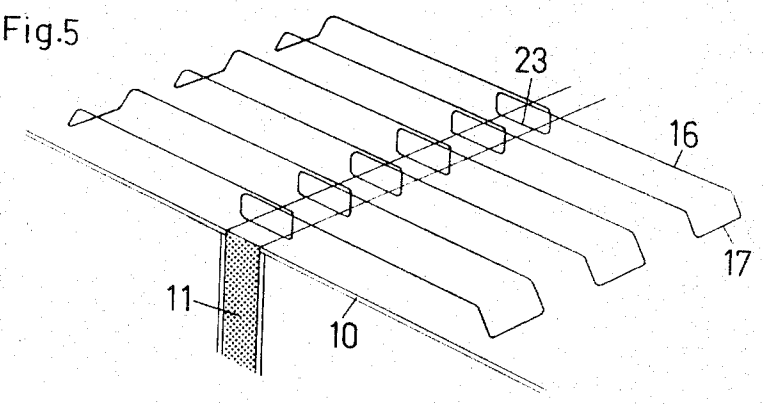

Fig. 6

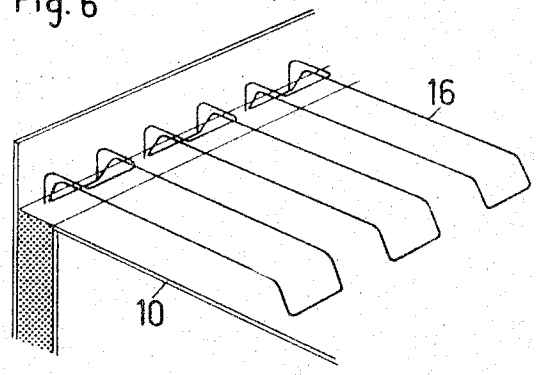

Fig. 7

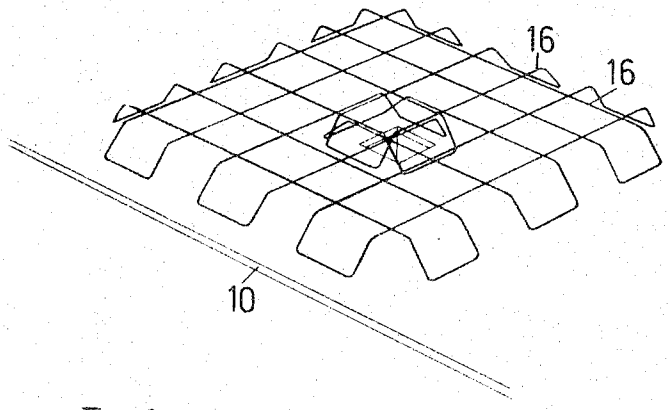

Fig. 8

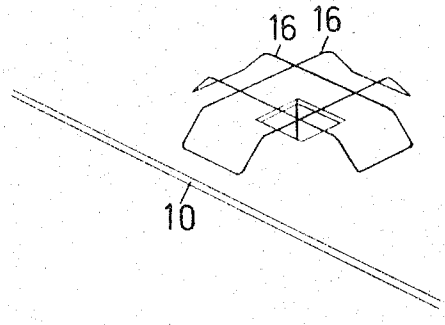

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Fig. 9

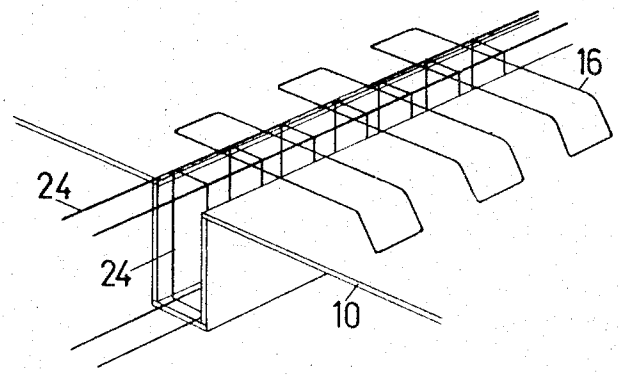
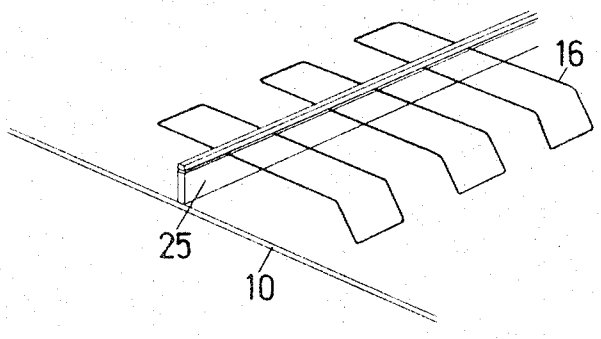


Fig. 10



United States Patent Office

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METHOD OF REINFORCING CONCRETE FLOORS AND THE LIKE, AND A REINFORCING ELEMENT THEREFOR

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12 Claims. (Cl. 52—600)

As is well known, concrete floors and other substantially horizontally extending, self-supporting concrete structures are provided both with a bottom reinforcement which, in the case of floors, is constituted, as a rule, by a grid of crossing reinforcing bars extending throughout the free length and width, respectively, of the floor and spaced slightly above the bottom surface of the slab, and with a so-called top reinforcement disposed adjacent and above supporting walls, supporting columns or other supporting points and consisting of comparatively short reinforcing bars which are embedded in the concrete a few centimeters beneath its free top surface. The bottom reinforcement is usually placed on thin concrete spacer blocks which rest on the mould bottom and support the reinforcement bars at a desired level above the same. It is the usual practice to place the top reinforcement on a plurality of cross-wise extending, relatively thick reinforcement irons, so-called mounting irons, which are supported, in turn, by spacer members of the required rather considerable height placed on the bottom reinforcement and usually consisting of reinforcement irons bent into a suitable shape.

The mounting irons and the appertaining spacer members have for their sole purpose to maintain the top reinforcement in proper position during the casting operation, and they do not increase the load-carrying capacity of the finished concrete slab or the like. It has long been felt to involve a waste of reinforcing steel to use heavy, transversely extending mounting-steel members supported on separate, relatively high supports for the single purpose of keeping the top reinforcement in position during the casting operation. Further, it has been experienced that the mounting irons supported at a substantial height above the mould bottom are in the way of the worker who may readily stumble over the irons as he must pass over the same. Therefore, it has long been desired to find another, more practical and economical solution to the problem of keeping the top reinforcement in place during the concrete-casting operation.

In accordance with the invention this problem has been solved by providing special top reinforcement members by bending lengths of reinforcement steel at their ends, and possibly also intermediate their ends, so as to form a kind of feet which, supported on the bottom reinforcement or on low supporting blocks of concrete or the like placed on the mould bottom, maintain said reinforcement members at a desired level above the mould bottom. According to the invention, these feet are provided by bending a reinforcement steel into the shape of a preferably closed and substantially rectangular, elongate stirrup, or loop, and by bending off one end portion, at least, of this loop through a suitable angle from the plane common to the two longitudinally extending portions thereof, and in a manner to cause the supporting surfaces on the bent-off portions to be disposed at such a distance from the plane common to the two longitudinally extending portions that, within the concrete structure to be cast, the latter will be disposed at a desired depth beneath the free top surface of this construction.

It has been found by accurate testing that the bent-off end portions of the reinforcement-steel members are adapted to ensure an excellent anchorage of these steel

members at their ends within the concrete, making it unnecessary to extend the steel members lengthwise in order to ensure sufficient gripping action. In other words, the bent-off end or foot portions will not, or will only unnoticeably, increase the required weight of the reinforcing members of the top or top-edge reinforcement, and in certain cases it would even be possible to count upon a reduction of the required steel weight. The elimination of mounting iron and the high supports therefor involve a corresponding direct saving in steel weight, since, as mentioned hereinbefore, these elements do not contribute to the strength of the finished concrete slab or the like. It has been found that, by applying the invention to the top reinforcement of concrete floors, it is possible to reduce the weight of steel for the top reinforcement by no less than up to 30% to 40%. In addition, the elimination of the obstructive mounting irons and high supports will render the mounting of the top reinforcement more convenient and less dangerous, because the workers can now walk unobstructedly on the bottom reinforcement. Further there will be no exposed sharp ends of concrete steel projecting upwards to a dangerous height above the mould bottom likely to cause injury to the worker or damage to his clothes.

The invention will now be described more in detail with reference to the accompanying drawings, in which:

FIGURE 1 shows a plurality of concrete-reinforcing elements according to the invention in the form of closed elongate loops bent-off or angularly off-set at both ends, and supported upon the bottom reinforcement for a concrete floor above an intermediate supporting or spine wall;

FIGURE 2, in a similar manner, shows the disposition of reinforcing elements in the form of open loops;

FIGURES 3 and 4 illustrate two different ways of forming a top reinforcement comprising reinforcing elements disposed in pairs of elements overlapping each other endwise;

FIGURE 5 shows reinforcing elements formed with intermediate supports or feet and disposed in place in the casting mould;

FIGURES 6 to 10 show further applications of the invention.

Referring now to FIGURE 1, numeral 10 designates the mould for casting a concrete floor, numeral 11 denotes a supporting or spine wall which has just been cast and is intended to support the concrete floor, and 12 designates the bottom reinforcement. The latter, conventionally, comprises longitudinally extending reinforcing-steel bars 13 and transversely extending reinforcing-steel bars 14 crossing the bars 13. The bottom reinforcement is supported on low concrete spacers 15 which are disposed on the mould bottom, whereby a predetermined clearance is maintained between the bottom reinforcement and the mould bottom.

The top reinforcement comprises a plurality of reinforcing elements 16 formed in accordance with the present invention and disposed in side-by-side relation upon the bottom reinforcement 12. Each reinforcing element consists of a reinforcing-steel bar which is bent into the shape of a closed elongate rectangular loop which, in its turn, is bent off at its ends whereby the short transverse end portions 17 of the rectangle will form feet for carrying the long portions 18 extending longitudinally. The reinforcing elements are placed on the bottom reinforcement with its foot portions 17 supported on corresponding ones of the transversely extending reinforcing bars 14. The feet 17 are tied to the reinforcing bars with tie wires or lashings 19 whereby the reinforcing elements are securely maintained in predetermined positions relative to the bottom reinforcement. The distance of the bent-off foot portions 17 from the common plane of the longitudinally extend-

ing portions **18** is so chosen in relation to the thickness of the concrete floor to be cast as to cause the longitudinally extending portions to be disposed at a desired depth beneath the top surface of the finally cast floor.

The bent-off end portions will afford for the reinforcing elements according to the invention an extraordinarily satisfactory anchorage within the concrete, and this renders it unnecessary to extend the longitudinal portions—which will have to carry the tensile and compressive loads concerned—further in order to ensure the required gripping action at their ends. This means that, to obtain a given reinforcing effect, the straight longitudinal portions can be made of a length which is so much shorter than that of conventional straight reinforcing bars that the overall weight of the reinforcing element will scarely be higher, and in certain cases even lower, than the weight of two straight reinforcing bars of the same cross-sectional area. In addition, the omission of high supports and mounting members, therefore, as a rule, will involve a direct saving in overall steel-weight.

In the embodiment of FIGURE 1 the butt ends of the reinforcing steel bar bent into a rectangular loop are assumed to be joined together, such as by a butt weld **20**, whereby each reinforcing element will form a substantially rigid unit with no pointed portions which could cause injury to the worker. However, the ends directed towards each other need not necessarily be joined together, and, in fact, need not actually meet either.

The spaced parallel parts of the bent-off end portions suitably form obtuse angles with the longitudinal sides of the reinforcing element, these angles being preferably about 120°. When forming the elements in this way, it is possible to tie together a plurality of reinforcing elements into bundles which are easily handle which is a great advantage when manufacturing the elements in quantities. This configuration, in addition, will increase the resiliency of the reinforcing element, whereby it will be capable of reverting to its initial shape after subjecting the straight sides to moderate loading forces.

FIGURE 2 illustrates a modified configuration of the reinforcing element according to the invention. In this case, the element has the shape of an open loop bent off at its closed end into a transverse foot **17**, while the free ends of the loop are bent downwards and backwards to form two separate feet **21** extending in spaced parallel relation to the longitudinal sides **18** of the reinforcing element. The feet **17** and **21** are tied to the bottom reinforcement.

The feet at the free ends of the loop, of course, can be formed otherwise than as shown in FIGURE 2, in that they may be bent away from each other, for example.

FIGURE 3 illustrates the possibility, in top-edge reinforcing a concrete slab above an intermediate supporting or spine wall, of using pairs of relatively overlapping, comparatively short reinforcing elements **16**. FIGURE 4 illustrates a similar arrangement with reinforcing elements overlapping in pairs over a longer portion of the length of the longitudinally extending sides.

FIGURE 5 shows reinforcing elements which, in addition to the bent-off foot-portions **17** at their ends, are provided intermediate their ends with supports formed by bending each longitudinally extending rod portion **16** into an elongated loop **23** having its overlapping portions in close proximity to each other.

FIGURE 6 illustrates a suitable disposition of the reinforcing elements according to the invention adjacent to an external supporting wall, and FIGURES 7 and 8 show suitable arrangements thereof above a supporting column.

FIGURE 9 shows a modified form of the reinforcing element of the invention. This element, being in the shape of a closed rectangle, is bent off into a foot at one end of the rectangle only. The figure illustrates a plurality of such reinforcing elements disposed across the top of a concrete joist to be cast integrally with the concrete floor. The reinforcement for this joist is indicated at **24**. The

reinforcing elements of the invention are supported at their bent-off ends on the bottom reinforcement (not shown) for the concrete-floor slab to be cast, whereas the elements are supported near their opposite ends on the reinforcement for the joist.

FIGURE 10 shows a suitable disposition of reinforcing elements of the same configuration as those of FIGURE 9 adjacent a construction joint in the floor to be cast. The reinforcing elements are supported at their straight ends on a mould board **25** temporarily placed on an edge on the mould bottom **10** and intended to be removed after the floor slab to the right of said board has been cast.

The invention is not limited to the embodiments illustrated in the drawings and described in detail herein, but modifications are conceivable without departing from its scope.

What I claim is:

1. A method of reinforcing concrete floors and other substantially horizontally-extending, self-supporting concrete structures, having an upper surface and a lower surface, comprising:

(a) disposing in the lower portion of said floor a plurality of elongated straight steel rods;

(b) supporting said steel rods in a first horizontal plane above the lower surface of said floor to form bottom reinforcing means;

(c) disposing in said floor at least one rectangular, continuous, steel loop, having at least one end thereof bent downwardly to provide vertically-disposed legs and a horizontal support foot of substantial length formed by the end of the rectangle; and

(d) supporting said foot in a horizontal plane above said lower surface of said floor with said support foot essentially the same distance above said lower surface of said floor as said bottom reinforcing means, and the sides of said rectangle in a second horizontal plane above said first horizontal plane and in the upper portion of said floor to form top reinforcing means.

2. A method in accordance with claim **1** wherein both ends of the loops are bent downwardly to form support feet.

3. A method in accordance with claim **1** wherein the foot of the loop is supported by and fastened to the rods.

4. In reinforced concrete floors and other substantially horizontally-extending, self-supporting concrete structures, having an upper surface and a lower surface, the improvement comprising:

(a) a plurality of elongated, straight steel rods disposed in a first horizontal plane above said lower surface of said floor to form bottom reinforcing means;

(b) at least one rectangular, continuous steel loop, having at least one end thereof bent downwardly to provide vertical legs and a horizontal support foot of substantial length formed by the end of the rectangle, disposed with said foot in a horizontal plane above said lower surface of said floor with said support foot essentially the same distance above said lower surface as said first horizontal plane and the sides of said rectangle in a second horizontal plane above said first horizontal plane and in the upper portion of said floor to form top reinforcing means; and

(c) spacer means in the bottom of said floor to temporarily support and space said bars and said foot above said lower surface of said floor.

5. A structure in accordance with claim **4** wherein both ends of the loop are bent downwardly to form support feet.

6. A structure in accordance with claim **4** wherein the foot of the loop is supported by and fastened to the rods.

7. A structure in accordance with claim 6 which additionally includes tie wires fastening the foot of the loop to the rods.

8. A reinforcing element for reinforcing the top of concrete floors and other substantially horizontally-extending, self-supporting concrete structure comprising: a rectangular, continuous steel loop of substantial width, having at least one end thereof bent downwardly to provide vertical legs and a support foot of substantial length formed by the end of the rectangle, said support foot being in a plane parallel to and spaced from the plane of the sides of said rectangle.

9. A reinforcing element in accordance with claim 8 wherein at least one secondary, vertically-disposed, rectangular loop is formed by a side of said main loop and has a vertical height equal to the spacing between the two parallel planes so that one side of the secondary loop is in one plane and the other side of the secondary loop is in the other plane.

10. A reinforcing element in accordance with claim 8 wherein both ends of the rectangle are bent downwardly to form support feet.

11. A reinforcing element in accordance with claim 10 wherein the angle is 120°.

12. A reinforcing element in accordance with claim 8 wherein legs form an obtuse angle with the sides of the loop.

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