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METHOD OF AND APPARATUS FOR CONCRETE CONSTRUCTION.
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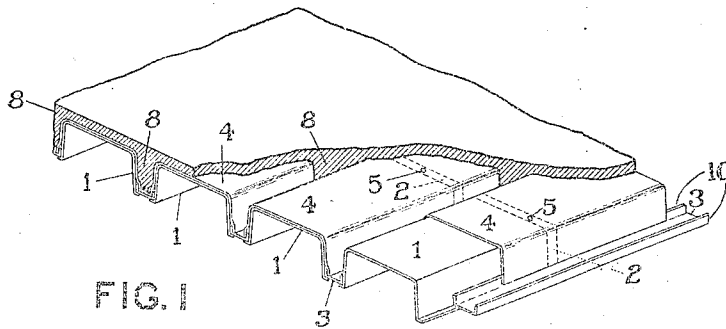


FIG. 1

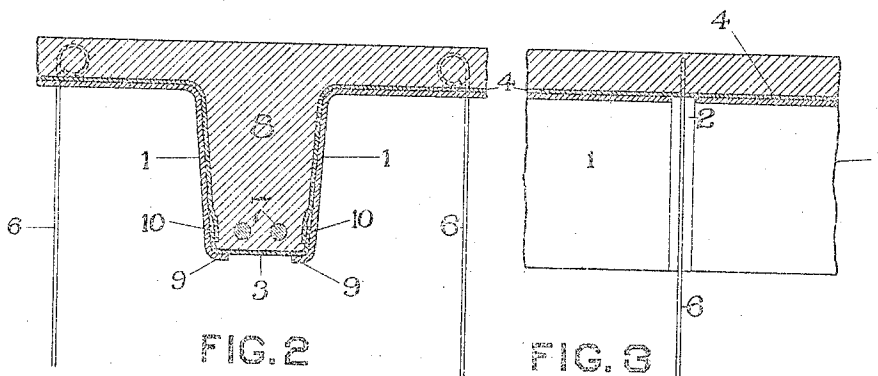


FIG. 2

FIG. 3

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METHOD OF AND APPARATUS FOR CONCRETE CONSTRUCTION

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To all whom it may concern:

Be it known that we, KARL H. MIDDENDORF and JOHN M. DAVIS, both residing in the city of Omaha, in the county of Douglas and State of Nebraska, and OLIVER G. BOWEN, residing in Kansas City, in Jackson county, in the State of Missouri, all being citizens of the United States of America, have invented certain new and useful Improvements in Methods of and Apparatus for Concrete Construction, and have described the same in the following specification, illustrated by the accompanying drawings.

Our invention relates generally to the construction of that class of flooring, beams, columns, and other architectural members, which are commonly incorporated in concrete buildings, and particularly to the so-called joist type of such flooring.

It relates not only to the method used in producing such flooring including roofs of the same type, but also to the class of apparatus used in that method.

It is the main object of the invention to facilitate, in this type of construction, the use of steel forms, or other metallic formers, between the flooring joists, and especially the removal of these forms after the hardening of the concrete; to reduce to a minimum the necessary weight and thickness of these forms individually, as well as their aggregate extent necessary for a specified floor space; to use collectively for a continuous flooring a plurality of these forms spaced from each other in the direction of their length; to provide means whereby hangers of wire, dependent between the forms for the support of a ceiling, may be anchored in the concrete floor spanning the flooring joists; to locate these hangers wherever they may be needed, without puncturing the forms; and in general to produce a construction of the specified class by a superior method. To accomplish this object we interpose between the concrete member which is in process of formation, and the forms which are used in this process, a plurality of flexible, nonmetallic sheets covering the forms and separating them from the concrete.

In the accompanying drawings, illustrating the best manner in which we have contemplated applying the principles of our invention, Figure 1 is an isometric view of a piece

of flooring of the specified class, which is constructed in accordance with these principles, together with a plurality of metallic forms and nonmetallic form covers, positioned relatively to the flooring as during the pouring of the concrete. Fig. 2 is a transverse vertical section of a portion of Fig. 1, including one of the floor joists. Fig. 3 is a longitudinal vertical section of a portion of Fig. 1, taken midway between two of the joists.

In these views the metallic forms, denoted by the numerals 1, are severally composed of a single rectangular sheet of steel, bent into the general vaulted form of an inverted flat-bottomed flaring trough having the outwardly extending side flanges, or feet, 9, in which it may stand horizontal in its inverted position as shown. To construct a flooring in accordance with the principles referred to, we provide a horizontal wooden open-work platform, not shown in the drawings, or some other equivalent and removable centering, suitably positioned relatively to the steel or concrete frame of the building. On this platform we distribute and arrange, in the positions shown, a suitable number of the described forms, alined in rows a predetermined distance apart in the usual manner, and terminally separated from each other by the space 2, which is at least sufficient to accommodate between the forms the hanger wires which are hereinafter mentioned. The separation of the alining forms by the spaces 2, as compared with the usual overlapping or telescoping of such forms, results in reducing very considerably the aggregate length of the forms necessary to be employed—a saving which is represented by the length of the overlapping portions plus the width of these spaces. It results also in saving the labor of fitting the forms together before the pouring of the concrete, and of getting them apart from each other after the concrete has hardened. As a covering for these forms we use sheets of cloth, strong paper, asbestos, fiber, or other tough, flexible and porous material, permeable to water, and preferably nonmetallic. Strips 3 of this material are laid in channel shape between the forms, so as to cover the feet 9 and all the platform space between them. Continuous or overlapping bent sheets 4 of the same material are laid over and upon each of the described rows of forms, and are

shaped contactingly thereto and to the up-
standing overlapped flanges 10 of the chan-
nel strips 3, so as to cover the forms them-
selves as well as all the intermediate vacant
spaces 2.

To hold the covering-sheets 3 and 4 in the
described positions during the progress of
the work, they are preferably stuck to the
forms, as well as to each other, by means of
a suitable adhesive agent. As such means
common flour paste may be used, being a
substance which may be softened or dis-
solved and rendered less adhesive, by the ac-
tion of water, after holding the covering
sheets in place as long as may be necessary.
This adhesive agent must be able to hold
the covers in place during the progress of
the work in windy weather, and must be of
such quality that, when soaked with water
from the concrete, it will lose adhesiveness
and will no longer stick the covering-sheets
to the forms when the latter are ready to be
removed. With some suitable sharp-pointed
instrument the holes 5, shown in Fig. 1, are
next punched through the covering-sheets
at such points as may be desired. The usual
hanger wires, or rods, 6, instead of being
inserted in the usual wire-holes through the
forms, and in uniformly predetermined po-
sitions, are inserted through the holes 5 in
the covering-sheets, and are dependent be-
tween the forms, as shown in Figs. 2 and 3,
wherever it is most advantageous that these
suspension members should be placed. Be-
ing in this way spaced and located inde-
pendently of the spacing of the flooring
joists, they are adapted to suspend in an ad-
vantageous manner the standard sizes of
ceiling elements without waste by any trim-
ming or overlapping of these elements. The
steel rods 7 are placed in position to rein-
force the joists 8 in the usual manner. The
concrete mixture is then poured upon the
covering-sheets 3 and 4 without coming in
contact with the forms. While the concrete
is hardening, the adhesive agent between the
forms and the covering-sheets is dissolved
or kept soft by the water which soaks from
the concrete through these sheets. After
taking down the centering, the forms are
then removed with the greatest ease and con-
venience, while the covering-sheets are
either removed from the concrete or left
adherent thereto, as may be found most con-
venient. This method, therefore, not only
reduces the usual cost of removing steel
forms, but also reduces or saves the cost of
straightening and cleaning them for subse-
quent use. It saves the labor which is ordi-
narily expended in overcoming the natural
cohesion between the concrete and the metal-
lic forms, and in prying loose, or otherwise
separating, the forms from the concrete, a
labor which is often of considerable mag-
nitude by reason of the circumstance that, in

the absence of our invention, projecting
edges and flanges of the forms become em-
bedded in the concrete. As our forms are
completely covered, the concrete does not
come into contact with them, nor adhere
thereto; so that no pickling of the forms in
an acid bath, nor any other shop-work, is
necessary in order to clean and fit them for
subsequent use. By avoiding this shop-work
the deterioration of the forms by repeated
use, is retarded, and their life and useful-
ness indefinitely prolonged. For the same
reason, and because our forms are not sub-
jected to the hard usage above referred to,
they may advantageously and safely be
made of thinner and lighter sheet metal
than has heretofore been commonly used in
manufacturing forms of the same general
class.

The material composing the covering-
sheets 3 and 4, need not be of uniform po-
rosity or permeability in all instances, but
may differ in different instances and in dif-
fering climatic conditions. In some in-
stances it must be subjected to waterproofing
treatment, while in other instances all such
treatment may be dispensed with, in view of
atmospheric conditions and the grade of the
material. Operatively it must in all cases
be sufficiently permeable to permit the pas-
sage of sufficient moisture therethrough, and
sufficiently impervious to prevent the pas-
sage of cementitious material from the con-
crete poured thereon. It must be pliable, in
order that the covering-sheets may be made
to conform to the shape of the forms by a
minimum expenditure of labor and without
injurious cracking of the sheets. It must be
of considerable toughness in order that it
may not be torn or ruptured when perfor-
ated by the described wire-holes, nor when
subjected to ordinary loads while spanning
the spaces between the ends of adjacent
forms without intermediate support, dur-
ing the construction of the floor. The extent
of each of these spaces is advantageously
made as great as the strength of this ma-
terial will allow.

The described construction, though illus-
trated with special reference to flooring, is
equally applicable, without essential modi-
fication, to other architectural members
which are shaped by the use of removable
forms of the same general type.

Such being our method of concrete con-
struction and our apparatus therefor, our
invention accomplishes its specified object
in each and all of the particulars above enu-
merated.

We claim—

1. That improvement in the art of con-
structing concrete flooring of the joist type
which consists in supporting a plurality of
vaulted sheet-metal forms on centering, af-
fixing with an adhesive agent soluble in

water a plurality of porous covering-sheets to the outside of the forms so supported, pouring the concrete on the covering-sheets so affixed, permitting water from the concrete so poured to soak through the covering-sheets and soften the adhesive agent during the hardening of the concrete, and then removing the forms.

2. That improvement in the art of constructing concrete flooring of the joist type which consists in mounting on horizontal centering a plurality of spaced and vaulted sheet-metal forms, fitting over and between the forms a plurality of pliable covering-sheets permeable to water, sticking the covering-sheets to the outside of the forms with an adhesive agent subject to deterioration by wetting, pouring the concrete on the covering-sheets so stuck, permitting water from the poured concrete to soak through the sheets and wet the adhesive agent, and then removing the centering and the forms.

3. That improvement in the art of constructing concrete flooring of the joist type which consists in supporting on horizontal centering a plurality of forms longitudinally alined in parallel rows and separated by void spaces, covering the alined forms of each row with flexible sheets spanning the spaces between them, securing the sheets to the forms, pouring concrete on the sheets, permitting the same to harden thereon, and then removing the centering and the forms.

4. That improvement in the art of constructing concrete flooring of the joist type which consists in mounting on temporary supports a plurality of vaulted sheet-metal forms arranged lengthwise in rows and longitudinally spaced apart, covering the forms in each row with sheets spanning the gaps between them, inserting hangers through the sheets at the gaps, pouring concrete on the sheets, permitting the concrete to harden on the sheets, and afterward removing the forms.

5. Apparatus of the specified class, comprising a removable support, a plurality of forms spaced apart thereon in the direction of their length, and a plurality of protective sheets of pliable material covering the forms and spanning the gaps between them, for the support of a plurality of hangers perforating the sheets and dependent therefrom between the forms and through the platform.

6. That improvement in the art of constructing concrete flooring of the joist type which consists in arranging on a centering platform a plurality of sheet-metal forms spaced apart, covering the forms with sheets of pliable material spanning the spaces between the forms, perforating the sheets at said spaces, suspending through the perforations a plurality of hanger wires dependent between the forms, pouring the concrete

on the sheets, permitting the same to harden thereon about the top of the hanger wires, and then removing the platform and the forms.

7. Apparatus of the specified class, comprising a removable platform, a plurality of removable sheet-metal forms supported on the platform and mutually spaced apart, and a plurality of covering-sheets fitted over the forms and spanning the spaces between them, perforated at said spaces and adapted to receive a plurality of hanger wires through the covering-sheets, and dependent therefrom between the forms.

8. Apparatus of the specified class, comprising a plurality of vaulted sheet-metal forms, spaced apart in the direction of their length, a plurality of perforated covering sheets fitted to the forms and spanning the spaces between them, and means for holding the sheets to the forms during the pouring of the concrete.

9. Apparatus of the specified class, comprising a plurality of forms spaced apart longitudinally on a horizontal openwork platform, and a plurality of sheets supported on the forms and spanning the gaps between them, for the support of a plurality of hangers extending through perforations in the sheets and dependent therefrom through the platform.

10. Apparatus of the specified class, comprising a plurality of forms, spaced apart in the direction of their length, a plurality of covering sheets spanning the gaps between the forms for the support of hangers at the gaps, and means for temporarily holding the sheets to the forms.

11. Apparatus of the specified class, comprising a plurality of spaced forms, a plurality of sheets spanning the spaces between them perforated to receive a plurality of hangers dependent from the sheets in these spaces, and means for holding the hanger-supporting sheets to the forms during the pouring of the floor.

12. Apparatus of the specified class, comprising a plurality of spaced forms, a plurality of covering sheets thereon permeable to water, and an adhesive agent subject to deterioration by wetting, for holding the sheets temporarily to the forms.

13. Apparatus of the specified class, comprising a plurality of vaulted steel forms spaced apart in the direction of their length, a plurality of sheets of nonmetallic fabric, resting on the forms and spanning the spaces between them, and an adhesive agent for holding the sheets to the forms.

14. Apparatus of the specified class, comprising a plurality of vaulted forms alined and spaced apart in the direction of their length, and means supported on the forms for suspending in the gaps between them a plurality of hangers.

15. Apparatus of the specified class, comprising a plurality of forms, and a plurality of sheets supported thereon which are permeable to water and stuck to the forms by an adhesive agent subject to deterioration by wetting.

16. Apparatus of the specified class, comprising a plurality of sheet-metal forms spaced apart and alined in the direction of their length, a plurality of permeable covering sheets spanning the spaces between the forms, and adapted to receive a plurality of hanger wires dependent from the sheets in the spaces, an adhesive agent for holding the sheets in position on the forms.

17. That improvement in the art of concrete construction which consists in supporting horizontally on centering a plurality of longitudinally spaced forms, placing thereon a plurality of covering sheets spanning the gaps between the forms, inserting through the sheets and supporting thereby

a plurality of hangers at the gaps, pouring the concrete on the sheets, permitting the same to harden thereon around the individual hangers, and then removing the centering and the forms.

18. That improvement in the art of concrete construction which consists in supporting on centering a plurality of spaced forms, placing thereon a plurality of covering sheets spanning the gaps between the forms, fastening the sheets to the forms, inserting through the sheets and holding thereby a plurality of hangers at the gaps, pouring the concrete on the sheets, permitting the same to harden thereon around the heads of the hangers, and then removing the centering and the forms.

Witness our signatures at Omaha, Nebraska, January 17th, 1916.

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O. G. BOWEN.