April 7, 1931. H. A. MOODY 1,799,697

METHOD OF ERECTING CELLULAR CONCRETE STRUCTURES

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Fig. 1.

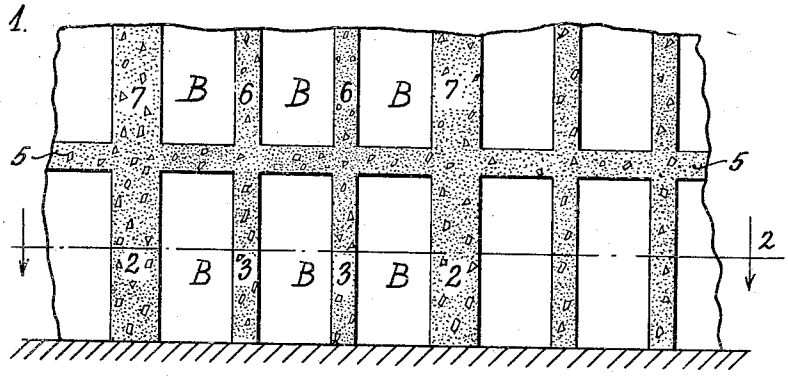


Fig. 2.

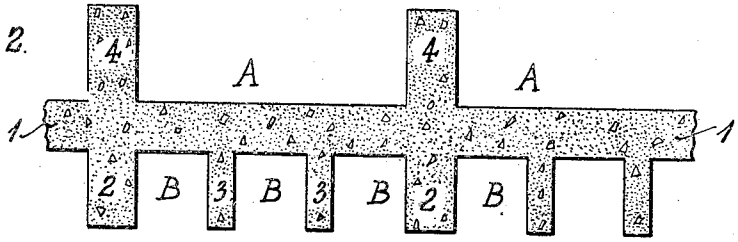


Fig. 3.

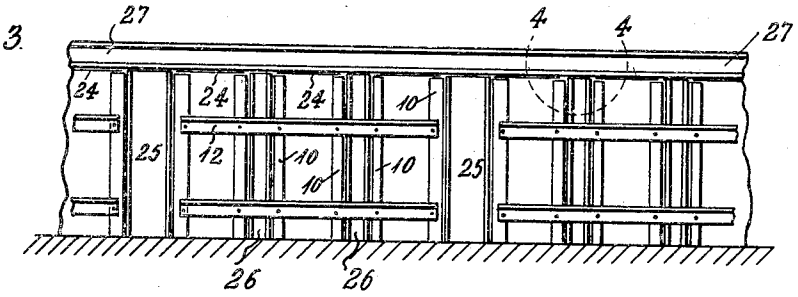


Fig. 4a.

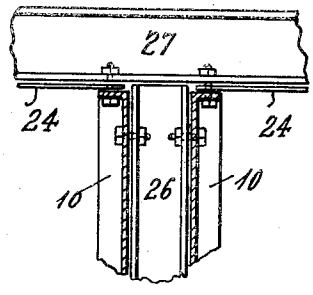


Fig. 4b.



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Fig. 5.

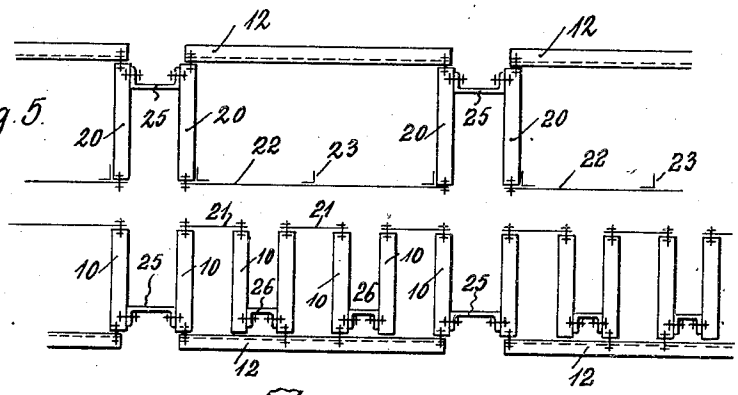


Fig. 6.

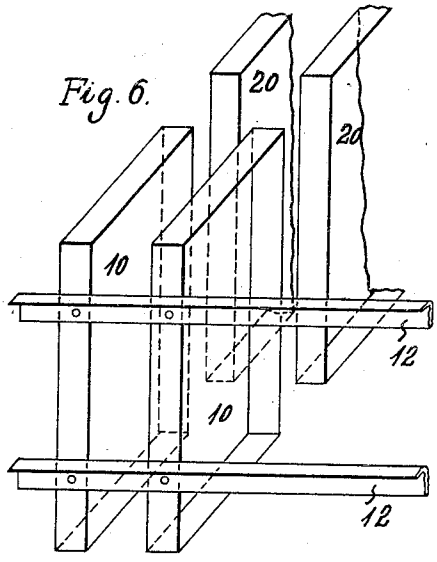


Fig. 7.

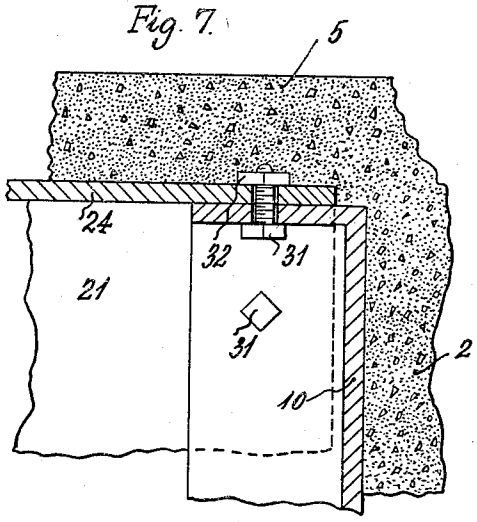


Fig. 8a.

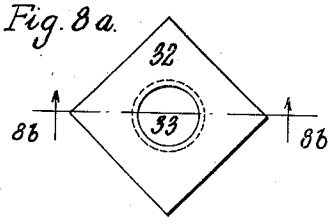


Fig. 8b.

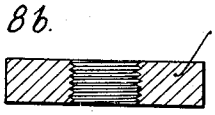
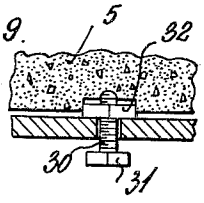


Fig. 9.



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UNITED STATES PATENT OFFICE

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METHOD OF ERECTING CELLULAR CONCRETE STRUCTURES

Application filed November 4, 1929. Serial No. 404,660.

This invention relates to an improved method of erecting cellular concrete structures characterized by recurrent forms of compartments or cells and particularly to the erecting of such structures for the accommodation of electric switching apparatus in central-, transformer-, converter-, switching-stations and the like.

The electric switching and similar stations fall especially in the class of constructions with recurrent types of partitions since the modern stations contain numerous banks of the same or similar apparatus which, for several reasons, are usually separated from each other by partition walls such as concrete walls. There are not only a great number of like partitions or cells to be found in one and the same station, but, due to the modern standardization of electrical apparatus and switching gear, also different stations if operated at the same or at nearly the same voltage have usually a great many shapes in common.

There are, nowadays, two modes in vogue of building such cells, the one using some sort of masonry work and the other concrete structure. Only the latter method forms the subject matter of this invention. The repetition of the types quite naturally calls for the use of permanent molds and attempts to use steel molds instead of wooden molds have, for this reason, repeatedly been made. They have, however, up to the present time, not been successful. Steel molds are much more expensive than wooden molds. On the other hand, wooden molds are of too perishable a nature to be used repeatedly, their combination in various ways for different cell dimensions is seldom possible, and concrete walls formed by such molds show an inferior finish. With repeatedly used iron forms, the distributed cost of investment may be considerably lower than the price for wooden forms. If, in spite of these obvious disadvantages of the wooden forms, their application is still widely practiced, the explanation is to be found in certain deficiencies of the metal molds or, rather, of the customary way of assembling and dismantling them. From my experience, I have found that the main difficulty encountered in the use of metal forms is due to troubles resulting from a sort of freezing-in of certain types of mold sections in the hardened concrete walls. The plastic concrete has a tendency to creep around the margins of the molds and to form overlapping fringes which render the work of removing such frozen-in sections extremely difficult. Frequently, unevennesses in the edges of the molds are perfectly sufficient to make the mold stick to the wall. Not only does the cost of removing such entrapped forms unduly increase the cost of labor, but very often the mold itself is deformed in the effort of withdrawing it so that the advantage of repeated use is lost. The dimensions of the cells are too small for a suitable application of effective tools.

The object of this invention is to provide a means in connection with the molds themselves which makes an easy and quick removal of such entrapped molds possible without the use of any other tool but an ordinary wrench of comparatively small dimensions and without requiring any unusual force in its application. Still other objects will appear in the subsequent description.

In order to give a clear apprehension of the manner in which I proceed to secure an easy removal of the molds, I shall, first, with reference to the drawings describe how such molds are assembled. The difficulties of their disassembling and the ways and means to overcome these difficulties according to this invention will then more easily be understood. The arrangement and use of the molds will be described with particular reference to the formation of a cellular structure for use in electric stations. This type of structure has been chosen as an illustrative example as it illustrates to the best advantage both the difficulties inherent in the use of metal molds and the manner in which my invention overcomes these difficulties.

Fig. 1 is a vertical section through an arrangement of cells as frequently met with in electric station practice;

Fig. 2 is a horizontal section on line 2—2 of Fig. 1;

Fig. 3 is a front elevation showing the as-

sembling of the molds for the formation of the lower series of cells and the ceiling above them, as illustrated in Figs. 1 and 2;

Fig. 4*a* and Fig. 4*b* are detached views of the portion circumscribed by the dashed line 4—4 in Fig. 3;

Fig. 5 is a top plan view of the mold assembling of Fig. 3 with the top channel iron removed;

Fig. 6 is a perspective view illustrating the set-up of some of the mold sections;

Fig. 7 is a detail view on much larger scale of the corner portions of assembled mold sections and the adjacent concrete portions, also showing the bolt and nut arrangement for the removal of the molds;

Fig. 8*a* and Fig. 8*b* show the preferred form of nut for lifting the molds from the concrete walls; and

Fig. 9 illustrates how the top plate of Fig. 7 is urged out of contact with the concrete by the bolt and nut device.

Figs. 1 and 2 show in vertical and horizontal cross-section a typical finished structure of electric station practice. The main wall 1 separates the front and back side of the cell arrangement. The larger rear compartments A, A formed by the side walls 4, 4 usually accommodate a bank of three oil-circuit breakers each, and the smaller front compartments B, B formed by the side walls 2, 3 may receive auxiliary apparatus such as instrument transformers, relays, and the like. Cells for bus bars differ from those shown in having a different ratio of length to height; in every other respect they are of the same nature. In the illustrations, the structure of the first floor comprising the side walls 6, 7 is assumed to be the same as that of the basement, a condition which is frequently met with in practice.

In the erection of the structure, the mold sections for the basement are properly assembled and then filled. After the concrete has sufficiently hardened, the mold sections for the first floor are assembled and filled on the ceiling 5 formed together with the lower cell structure. The forms of the lower structure may or may not be used in the formation of the upper structure, the choice depending on such factors as hardening time, time of removing the used molds, etc.

Fig. 3 shows in elevation a number of assembled molds for the lower front structure; and Fig. 5 is a top plan view of the same assembling. The types of mold sections as required for the erection of such and similar assemblings are trays, cover plates and channels. Fig. 6 is a perspective view of two trays 10 with the flat backs facing each other and leaving between them the space for the formation of a side wall such as the walls 2 or 3 in Fig. 2. Usually, these trays on their hollow sides are provided with reinforcing angle irons to prevent a bulging of the forming wall under the weight of the concrete. A number of such pairs of trays is set up and spaced apart according to the desired width of the cells. Horizontal angle irons 12 (see Fig. 6) bolted to the front side walls of the trays form stringers to secure an accurate spacing and a first rigidity for a series or row of pairs. A similar series of trays 20 is set up with similar stringers for the side walls 4 of the rear portion of the structure.

The forming space for the main wall 1, which represents a longitudinal separating wall between the two rows of trays, is now obtained by connecting always a right-hand tray of a pair with a left-hand tray of the next pair by means of cover plates 21 and 22 respectively (see Fig. 5) which span the entire rear side of each cell and also overlap, to an extent sufficient for bolt attachment to the trays, the rear side walls of the trays spanned over by them. In like manner, overlapping top plates 24 (see Figs. 3 and 4) are stretched over the upper side walls of the trays to form the support for the ceiling 5 extending between the basement cells and the first floor cells. The basement cells and the ceiling are made in one and the same pouring shift. The larger cover plates 22 for the rear cells are usually provided with reinforcement irons such as 23.

All that remains to be done now is the arrangement of stops in the wall interspaces between the trays, to prevent the lateral outflow of the concrete, and, furthermore, to provide border walls for the formation of the ceiling. For both purposes, channel irons are preferably used such as designated by the numerals 25 and 26 in Fig. 5 for the side walls and 27 in Figs. 3, 4*a* and 4*b* for the ceiling. These channels are also fastened to the trays by bolts.

For the joining together of the trays and the cover plates, I employ the type of bolt and nut as depicted in Figs. 7 and 8. The same type may be employed throughout that is also used for the attachment of the channels. The bolt 30 has a square head 31, and, over most of its length, is provided with threads of not too coarse a pitch. The mating nut 32, as illustrated in Figs. 8*a* and 8*b*, consists preferably of a plain square steel disk with a central threaded opening 33 for the bolt. In order to obtain in all places a good contact between the head of the bolt and the underlying sheet, a number of bolts of somewhat different lengths is preferably kept at hand on the building site.

The employment of this kind of jointing means makes the disassembling of the mold sections almost as easy as their assembling. The stringers and channel irons are first removed. The latter come off almost as easily as the former since the side walls of the horizontal ceiling channels are entirely free and those of the vertical channels are in sliding

contact with a pair of trays. The withdrawal of the trays which is to follow now after the detachment of all bolts offers sometimes a greater resistance because the top cover plates 24 are being pressed on the upper side walls of the trays under the weight of the ceiling. This greater resistance can, however, comparatively easily be overcome by gripping the front end of the tray, which end, after the removal of the channels, protrudes freely from the concrete structure and by manually wrenching the tray loose.

For the withdrawal of the plates (back plates and top plates), the bolts are screwed down again in their nuts until their flat end face abuts against the now hardened concrete wall. Then, one after the other is further turned in a bit with the aid of a wrench. This will have the effect that the nut begins to rise on the bolt and lift the cover plates from the wall. In going around several times with the wrench over the provided number of bolts, the plate will gradually and uniformly be lifted from the wall without undue bending stresses. Therefore, not only the channels and trays but also the plates are disassembled in a manner which protects them against any deformation, a factor which is of greatest importance in the repeated use of the relatively expensive molds. It is easily seen that the removal of the cover plates by externally applied means of whatever kind must meet with great difficulties since these plates are not easily accessible.

The general appearance and the finish of the concrete structure made according to this method form a favorable contrast to the appearance of structures made with wooden molds or with steel molds not set up according to this invention. It is a known fact that wooden molds, even if extreme care for their preparation has been exercised, will never give that faultless, smooth finish which is characteristic of walls formed in a high grade steel mold. But it will furthermore be understood that structures made in steel molds according to this method will show a dimensional accuracy of the cell spaces and walls much greater than could be expected from methods employed in the art heretofore. Another advantage is that in the case of the formation of overlapping concrete fringes around the edges of the cover plates, such fringes will be taken off under a pure shearing action, thus leaving a good finish also in the corner portions of the cells.

Usually four sets of bolts and nuts, one in each corner, are sufficient for the joining of the molds and their safe withdrawal; with larger plates a greater number may be desirable. The depressions left from the nuts in the walls may or may not be filled with concrete. As a matter of fact, those depressions are hardly discernible for some one walking along the row of cells.

I have shown now that I have developed a new method of erecting cellular concrete structures, which is simple, inexpensive, and superior in its results.

What I claim is:

1. A method of casting concrete which comprises assembling permanent mold members, passing bolts through the mold members, threading nuts onto said bolts on the side of the mold to be occupied by the concrete, casting the concrete and permitting it to harden, removing the bolts, and then screwing threaded members into said nuts and against the hardened concrete to force the nuts away from their seats in the concrete and against the mold members to strip the latter from the concrete.

2. A method of casting concrete which comprises assembling multi-part permanent mold members by means of bolts passing through the mold members and nuts threaded onto said bolts on the side of the mold to be occupied by the concrete, casting the concrete and permitting it to harden, removing the bolts while leaving the nuts in the hardened concrete, removing all portions of the mold except those members directly bearing on the embedded nuts, and re-threading the bolts through the last named members and into the nuts to cause the bolts to impinge against the hardened concrete and thereby to force the nuts away from their seats in the concrete and against the mold members to strip the latter from the concrete.

3. A method of erecting cellular concrete structures which comprises assembling a permanent metal mold including a substantially flat plate defining the inner wall of the cell, passing bolts through said plate, threading nuts onto the bolts on the side of the plate to be occupied by the concrete, casting the concrete and permitting it to harden, and then screwing the bolts into the nuts and against the hardened concrete to force the nuts away from their seats in the concrete and against the plate to strip the latter from the concrete.

4. A method for erecting cellular concrete structures which comprises assembling a permanent metal mold including flanged members defining the sides of a cell and the edges of the walls bordering on the cells, and also including substantially flat plates defining the inner and top walls of the cellular cavity, securing the parts of the mold by bolts passing through said flanges and also through the plates and by nuts threaded onto the bolts and positioned on the side of said plates to be occupied by the concrete, casting the concrete and permitting it to harden, removing the bolts leaving the nuts embedded in the hardened concrete, removing the flanged mold members, passing the bolts through the plates and into the nuts, and screwing the

bolts into the nuts and against the hardened concrete to force the nuts away from their seats in the concrete and against the plates to strip the latter from the concrete.

In testimony whereof, I have affixed my signature.

HERBERT A. MOODY.