May 10, 1938. K. P. BILLNER 2,116,557

METHOD OF AND APPARATUS FOR THE CONSTRUCTION OF WALLS AND SIMILAR FORMS

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Fig. 1

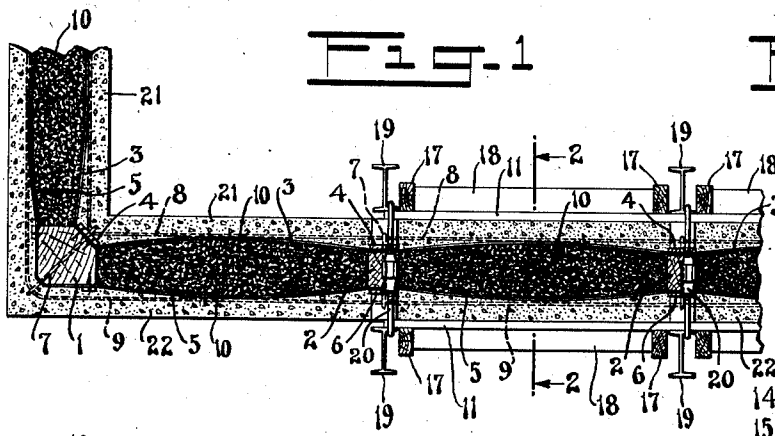


Fig. 2

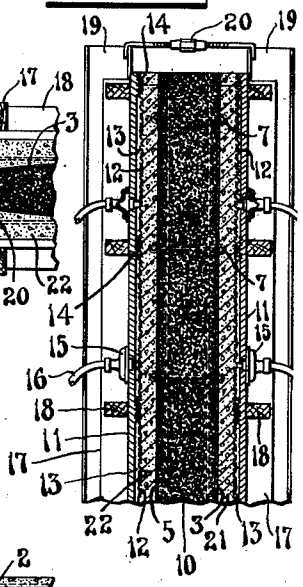


Fig. 4

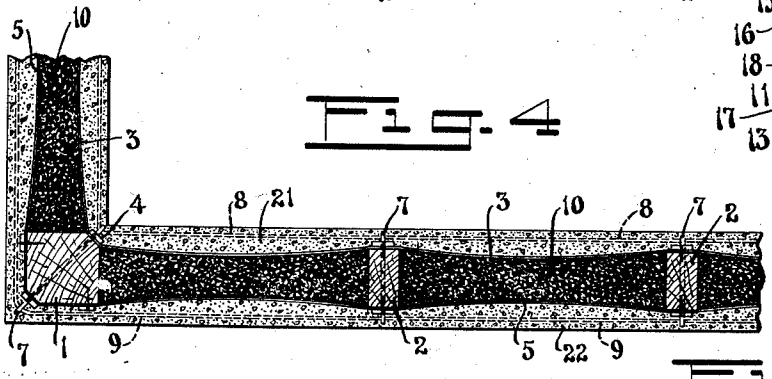
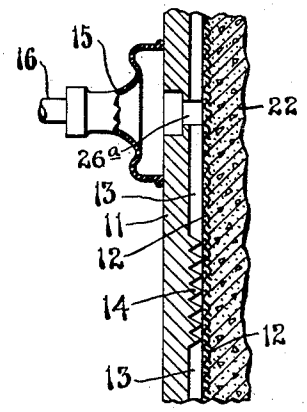


Fig. 3.



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Fig. 5

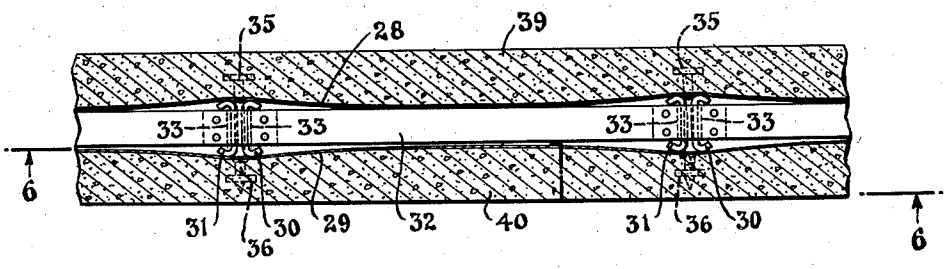



Fig. 6

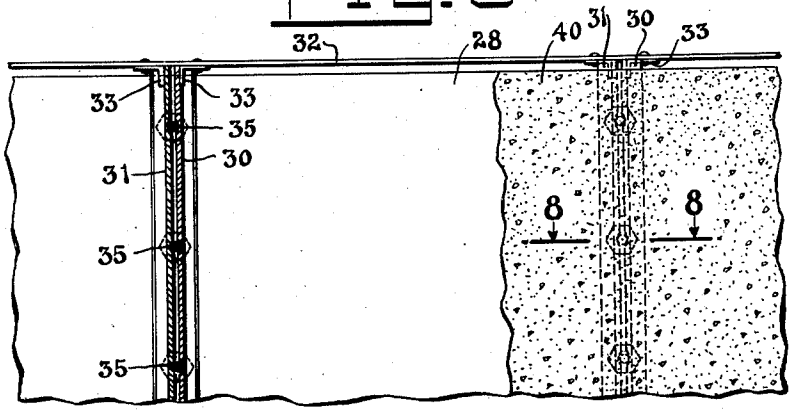



Fig. 7

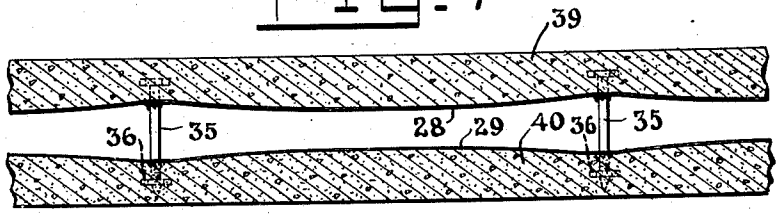



Fig. 8

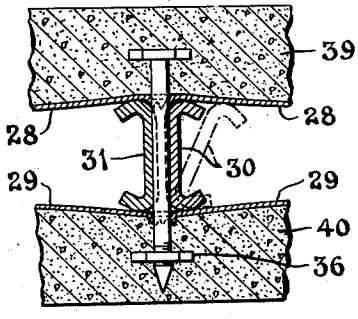
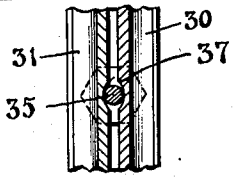



Fig. 9




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Fig. 10

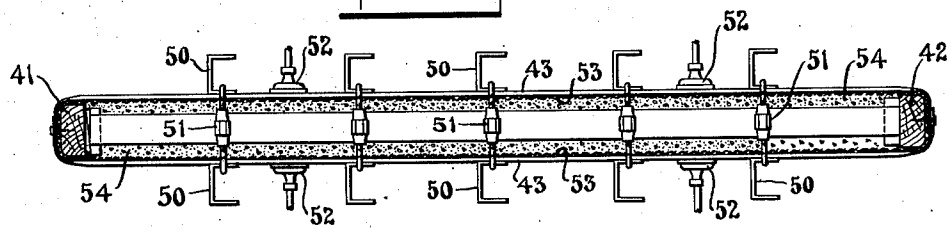



Fig. 11

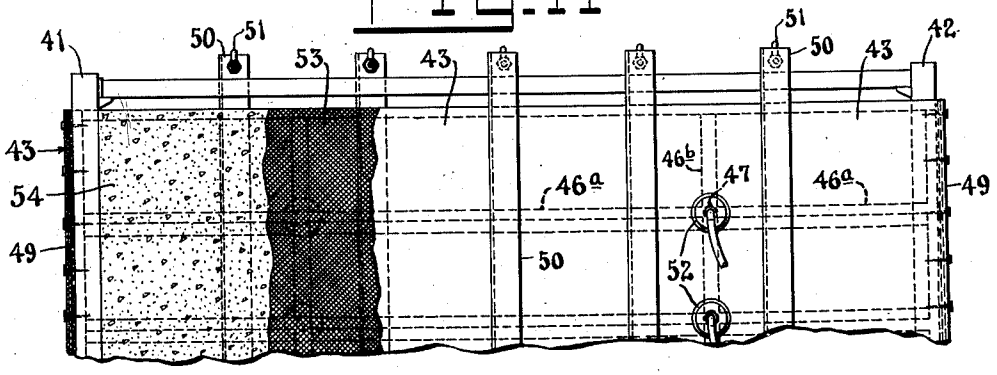



Fig. 12

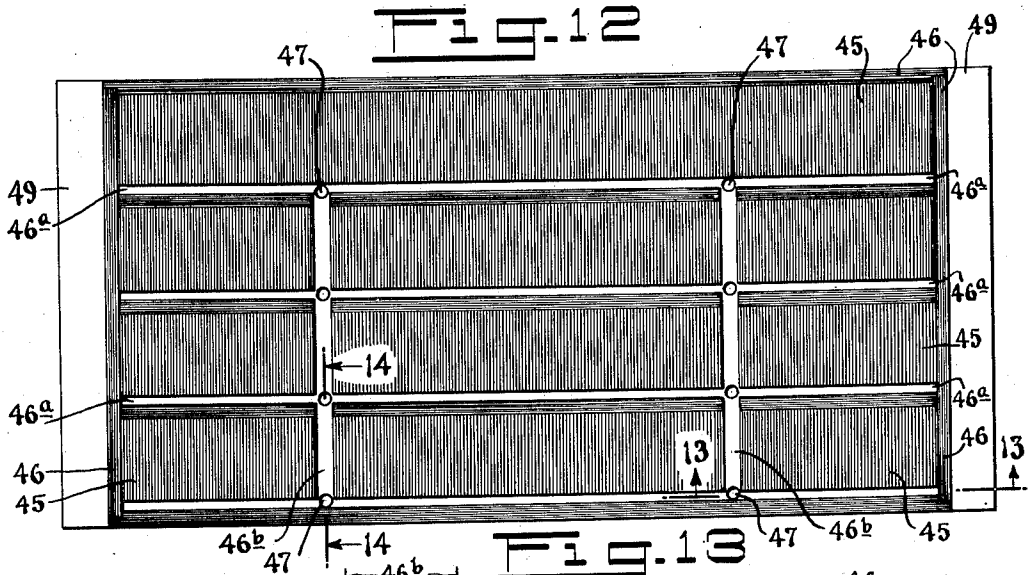



Fig. 13

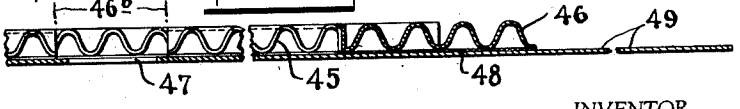



Fig. 14




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Patented May 10, 1938 2,116,557

# UNITED STATES PATENT OFFICE

2,116,557

## METHOD OF AND APPARATUS FOR THE CONSTRUCTION OF WALLS AND SIMILAR FORMS

Karl P. Billner, New York, N. Y.

Application July 2, 1936, Serial No. 88,665

4 Claims. (Cl. 25—131)

My invention relates to method of and apparatus for the construction of walls and similar forms of concrete or the like by the utilization of suction for the removal of excess water as disclosed in Letters Patent granted to me on July 7, 1936, No. 2,046,867.

The object of my present invention is to very materially expedite the operation of constructing a wall owing to the fact that the forms or molds may be taken down in very much less time than is now possible. At present it is necessary to keep the molds or forms in place for several days before the concrete has hardened sufficiently to permit such removal, the time depending upon the thickness of the walls, atmospheric conditions and other factors. With my improvements the forms or molds may be taken down with entire safety in two or three hours or less after the vacuum treatment.

Not only is the construction of walls or the like greatly facilitated by the practice of my invention but the resulting concrete is of increased strength, due to the fact that in the treatment the mass is subjected to heavy consolidating atmospheric pressure, depending in value upon the degree of vacuum employed.

In my patent above identified I point out that in the molding or casting of concrete a large excess of water is required in order to make the mass sufficiently plastic. Heretofore the excess of water, not required for hydration, slowly passes out of the mass by evaporation leaving behind minute voids which are a source of weakness in the concrete. Also the evaporation of the excess water frequently results in setting up internal stresses causing objectionable cracking.

With my improved vacuum treatment disclosed in said patent I apply a powerful suction to the surface of the concrete, whereby excess water is drawn out from the interior of the mass and at the same time a complementary atmospheric pressure is applied to consolidate the mass and thereby close any voids left by the removed water.

Thus, if a vacuum of twenty inches of mercury is applied the resulting pressure imposed upon the mass will be more than 1400 pounds per square foot.

I will describe my present improvements in connection with the construction of vertical walls or the like of three types, first a double wall with a filling of a cheap insulating material like ashes, second, a solid wall, and third, a light double wall with an interior air space, and I will also explain how molds or forms of a cheap material like paper may be used. In order that my invention may be better understood attention is directed to the accompanying drawings forming a part of this specification and in which

Figure 1 is a top view of a vertical double wall, illustrating a construction wherein ashes or other cheap material is introduced into the space within the wall before the pouring of the concrete and showing one complete suction outfit for each wall section.

Figure 2 is a sectional view on the line 2—2 of Figure 1.

Figure 3 is a partial vertical section of a portion of Figure 2 showing the suction mat, filter cloth, water channels, sealing grooves and one of the suction cups.

Figure 4 is a top view of a double wall similar to that shown in Figure 1 except that the ashes or other material is introduced within the wall after the concrete has been poured, before or after the suction treatment.

Figure 5 is a horizontal section of an improved double wall with an air interspace showing the same before the completion of the constructional operations.

Figure 6 a section on the line 6—6 of Figure 5.

Figure 7 a horizontal section of the completed double wall.

Figure 8 an enlarged sectional view on the line 8—8 of Figure 6 illustrating in dotted lines the manner of removing the spacing channels.

Figure 9 a sectional view on the same scale as Figure 8 taken vertically on the midsection of the spacing channels.

Figure 10 a top view illustrating the construction of a solid vertical wall by means of molds of corrugated paper or paper board.

Figure 11 a side view of the same partly in section.

Figure 12 a bottom view of the corrugated paper suction mat employed for processing one of the faces of the wall of Figure 10.

Figure 13 is a section on the line 13—13 of Figure 12 looking in the direction of the arrows, and

Figure 14 is a section on the line 14—14 of Figure 12 looking in the direction of the arrows.

In the above views corresponding parts are indicated by the same numerals, unless otherwise indicated.

Referring first to Figures 1, 2 and 3, I show at 1 a vertical standard or post, preferably of wood at the corner of the wall and intermediate wooden uprights 2—2. A vertical sheet of paper or other cheap material 3 is stretched as shown with respect to the corner 1 and uprights 2, being secured thereto by wooden strips 4 nailed in place.

A similar paper or like sheet is stretched around outside of the corner 1 and uprights 2 as indicated by 5, being held in place by strips 6. At suitable points, as in Figure 2, I introduce through the sheets 3 and 5 a series of metal bolts 7 which are formed at one end with an eye as shown, the eye at the other end being formed after the bolts have been introduced in place. Through the eyes of the bolts at one end I pass continuous reinforcing rods 8, similar rods 9 being passed through the eyes of the bolts at the other end. These reinforcing rods are shown clearly in Figures 1 and 3. Thus far it will be seen that two vertical sheets of paper or similar material have been set up and between them is now introduced a mass 10 of ashes or similar material, thus causing the sheets to expand outwardly to a slight extent, as shown in Figure 1.

I now set up vertical forms outside the sheets 3 and 5 and a sufficient distance therefrom to provide the desired thickness of concerte for the wall sections. In Figures 1 and 2, I show mats 11 as in said patent, faced with filter cloth 12 and provided with vertical water channels 13 and sealing channels 14 at right angles thereto, all as I have described in detail in my said patent.

Any desired number of suction cups 15 may be applied to draw out the water from the mass, these suction cups connecting by a pipe 16 to a suitable vacuum tank in which water may accumulate and which in turn is connected to a suitable power driven air pump. The vacuum tank and pump are not here shown but are illustrated in my patent. The mat 11 is preferably strengthened by a suitable frame preferably of wood, comprising vertical and horizontal members 17 and 18, respectively, and the mats in turn are held in proper alignment and prevented from moving outwardly by light I-beams 19 temporarily held together by hooked members 20, here shown as turn buckles although this refinement is not necessary.

Having set up the suction mats and properly spaced them the required distance from the sheets 3 and 5 the concrete with the required excess water to give plasticity is poured into the space between the suction mats and sheets 3 and 5. After the concrete has been thus poured, the suction pump is started and the excess water is removed from within the mass. Such an operation may require an hour or less depending upon the thickness of the mass undergoing treatment and the degree of vacuum used.

If at least sufficient water has been removed to make the concrete mass self-sustaining the suction is stopped, the I-beams 19 lifted off and the suction cups removed. The suction mat will therefore be immediately available for further use, instead of being required to stand for several days as would be the case with concrete forms under old conditions.

It is desirable to apply a relatively powerful suction to remove a substantial part of the excess water because in this way the operation will not only be facilitated but a very heavy compacting pressure will be imposed upon the mass. If, for example, a vacuum equal to 20 inches of mercury is used the compacting pressure on the concrete will be more than 1400 pounds per square foot. It will be seen that an equal pressure will be imposed upon the inner faces of the concrete mass by the sheets 3 and 5.

My observation has been that it is desirable to remove excess water and complete the operation of pressing the concrete prior to actual setting, because if a heavy compression is applied after the concrete begins to set, it is likely to produce weakness instead of strength. Therefore, I prefer to employ a suction equal at least to one inch of mercury for each inch in thickness of the concrete. Beyond this minimum improved results are progressively secured as the degree of vacuum is increased.

Referring to Figure 4 here a wall is shown constructed as in Figure 1, except that the concrete mass is first poured causing the sheets 3 and 5 to curve inwardly as shown, after which the ashes or other material 10 is introduced.

Referring now to Figures 5 to 9 inclusive, I here show what I call a light wall construction, namely, a double vertical wall with an air interspace. Vertical sheets 28 and 29 are stretched over shallow channels 30 and 31, whose side flanges are bent slightly inwards to the form shown in Figure 8. In order to hold the spacing channels together, I employ a flat metal strip 32 having angles 33 straddling the upper ends of the spacing channels. In lieu of the eye bolts 7 of Figure 2, I employ pointed threaded bolts 35 punched through the paper sheets and each receiving a nut 36 over its pointed end. These act as rigid supports between the wall sections as shown in Figure 7. If desired the webs of the channels 30—31 may be formed with shallow grooves 37 to receive the shanks of the bolts 35. (See Figure 9.)

Having set up suitable suction forms or mats spaced a proper distance from the sheets 28 and 29 as in Figure 2, the concrete wall sections 39 and 40 are poured and subjected to vacuum to remove the excess water therefrom. After the vacuum treatment, the outer forms or suction mats are removed, the plate 32 is lifted off and the channels 30, 31 are canted out as shown in dotted lines (Figure 8). The resulting completed wall is shown in section (Figure 9) and comprises the two wall sections rigidly connected together by the numerous bolts 35.

Obviously the sheets 28 and 29 will remain as part of the finished wall and these sheets can conveniently be made of water-proof paper to insure additional dryness. The interspace between the walls serves not only to improve insulation from heat and cold but also may accommodate piping and wiring.

Referring lastly to Figures 10 to 14 inclusive, I here show a solid wall construction and illustrate how heavy waterproof paper or sheets of some other kind of flexible material may be used as mats for carrying out the vacuum process. I here illustrate the wall as being formed of a section between uprights 41 and 42, which may be any desired distance apart.

In using the apparatus shown in Figures 10 to 14 inclusive the cement mixture is poured into the space between the two corrugated mats after which suction is applied to draw off the excess water. The corrugated paper or paper board mat 43 is secured at its ends to the posts 41 and 42 and comprises channels 44 for carrying off the water and sealing channels 45 and 46 extending at right angles thereto. As shown in Figure 12 the water channels 44 are arranged vertically while the sealing channels 45 are shown as being horizontal, but obviously the reverse arrangement may be employed.

The sealing channels 46 at each end, are shown as being parallel with the grooves 46 but these latter grooves act as sealing channels for the reason that they are not intercepted by or con-

nected to the conduits **46***a*. As shown in Figure 12 these larger conduits **46***a* are shown as being connected with vertical conduits **46***b* which are formed with suction holes **47** to which suction is applied.

The entire mat of corrugated paper or other flexible material is secured to a foundation sheet **48** having extensions **49** by means of which the mats are nailed or otherwise secured to the uprights **41** and **42**. In order to support the corrugated mats I make use of channels **50** held against outward strains by the connectors **51**, here shown as turnbuckles. In Figure 10 I show the suction cups **52** which engage over the suction holes **47**. A filter cloth **53**, as shown in Figure 11, engages the inner faces of the corrugated mats and prevents particles of cement from being carried off with the water. This cloth also acts to give to the finished wall a relatively smooth surface because without it the corrugations of the mat would impart a fluted surface to the wall.

Mats made of corrugated paper as I have described are extremely cheap and if carefully handled may be used more than once.

It will be understood of course that these paper mats may be used instead of the rigid forms referred to in connection with Figures 1 to 9 inclusive and that rigid mats as shown in Figure 2 may be employed for building the solid wall of Figure 10. It will also be understood that suction mats made of paper or paper board may be employed for the treatment of concrete generally, without limitation to the treatment of concrete walls or the like.

Having now described my invention what I claim as new therein and desire to secure by Letters Patent is as follows:

1. The method of making a hollow wall or the like, which consists in casting two parallel and separated wall sections with a concrete mix having an excess of water to secure plasticity, then in applying suction to the exposed wall faces to remove excess water from the interior of the mass and in sealing the inner faces of the wall sections against the entrance of air.

2. The method of making a hollow wall or the like, which consists in erecting spaced vertical uprights, then in stretching across such uprights two sheets of thin impervious material, then in erecting opposite and separated from the outer faces of said sheets vertical forms provided with suction surfaces, then in casting between each sheet and its associated form a mass of concrete having an excess of water to secure plasticity and finally in applying suction through the suction surfaces to each mass of concrete to remove excess water therefrom, whereby a heavy consolidating pressure will be imposed upon each mass.

3. Apparatus for forming hollow walls or the like comprising in combination, vertical uprights, sheets of thin impervious material stretched across such uprights in substantially parallel relationship, two forms spaced apart from the exposed faces of said sheets and means for applying a powerful suction to the inner surfaces of said forms.

4. Apparatus as recited in claim 3, wherein the sheets are sheets of impervious paper.

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