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MEANS FOR STRIPPING A CONCRETE SLAB CASTING FORM

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Fig. 3

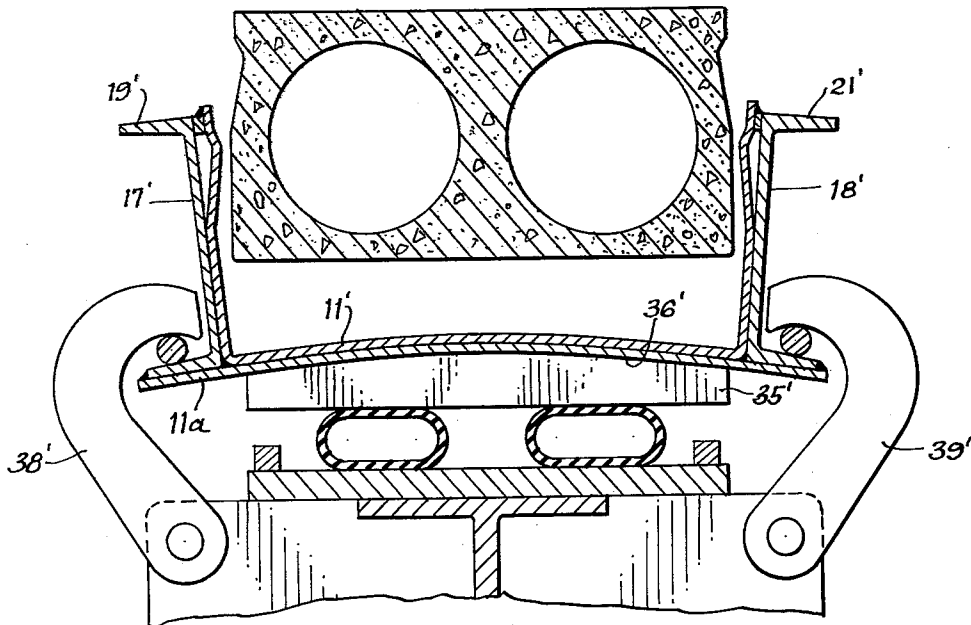
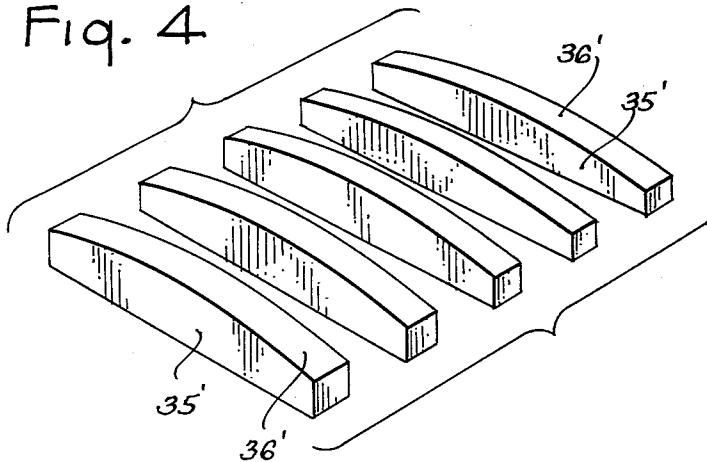


Fig. 4



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3,061,904 MEANS FOR STRIPPING A CONCRETE SLAB CASTING FORM

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This invention relates to a means for stripping a concrete slab casting form. In United States Patent No. 2,299,070 issued on October 20, 1942, there is disclosed an elongated concrete slab or beam which has since gone into wide use. In this patent, as well as in other patents, various means for casting such slabs are disclosed. In particular, in the copending applications of Warner B. Smith, Mark J. Wise and Robert E. Smith, filed October 2, 1959, Serial No. 844,012, now Patent No. 3,023,477, and Mark J. Wise, filed April 25, 1961, Serial No. 105,425, now Patent No. 3,023,476, there are disclosed U-shaped casting forms wherein the entire casting surface is of one piece construction.

As more fully disclosed and claimed in said copending applications, the necessity for grout keys along the sides of the slabs has imposed some limitations upon the design of casting forms.

The sides of the casting forms are reinforced by plates or channels or chanel-like members. It is desirable to open the form by changing a flat form bottom to provide a predetermined arch. By controlling the arching of the casting form the possibility of damaging the casting form is substantially eliminated.

In accordance with the present invention, means are provided for bending the bottom of a flexible casting form along a predetermined arched path. In a preferred embodiment of the invention, the means for creating the force for opening the form includes inflatable bags or tubes. Furthermore, the apparatus is so designed that the point of application of the force to the form sides provides a short lever arm for opening the casting form. In the arched position of the form, the lever arm becomes so short that the bending force, even if poorly regulated, cannot bend the form to excess. The form bottom is arched or bent over a suitably shaped contour plate which can support the full width of the form.

As is disclosed in the copending applications referred to above, the design of a form insofar as the steel characteristics are concerned involves certain formulas. These formulas indicate a close relation between the form dimension as width, depth, the radius of curvature of the form bottom when the form is opened to release a casting and characteristics of steel. In particular, the form and arch assumed by the form bottom are related. The formulas are as follows:

$$(1) \quad R = \frac{.95LV}{H+C}$$

$$(2) \quad R = \frac{L+C}{\sin\left(\frac{L}{R}\right)} + H \cot\left(\frac{L}{R}\right) - V$$

$$(3) \quad f = \frac{nEt}{KR}$$

In the above formulas, R is the radius of curvature of the arch assumed by the form bottom, L is one-half the form width, C is the clearance at the sides when releasing a casting between the form and casting, H is the lateral

depth of the keyway from the side of the form, V is the height from the form bottom to the critical point of the keyway to be cleared for stripping, f is the stress in the steel at the form bottom during arching, E is the modulus of elasticity of the steel, t is the thickness of steel being arched and n is a safety factor. K is approximately 1.82, L/R is in radians, other units are in the inches-pound system.

Formula 1 is useful for providing an approximate initial value for R. Thereafter Formula 2 is used, various values of R being tried until the equation is true to four significant figures.

It will be seen from Equation 3 that R is a definite factor in regard to the design of the casting form. As R decreases—and it is desirable to flex the form as little as possible—f increases. But f should always be kept below the yield point of the steel to prevent damage. As a rule, a factor of safety, n, say about 1.2, is used.

The value of R should be accurately controlled and duplicated for successive stripping operations. While there are a number of different ways in which the arching of the casting form can be accomplished, this invention provides a method and means for accomplishing this, which is simple and accurate. In general, this invention provides a rigid contour plate or block against which a casting form is forced to cause the form bottom to arch in a carefully controlled curve.

For a more complete disclosure of the invention reference is now made to the drawings wherein:

FIGURE 1 shows a sectional view of a stripping means embodying the present invention, the stripping means being in a normal condition prior to a stripping operation.

FIGURE 2 is a section generally similar to FIGURE 1 but showing the various parts in position for stripping and showing the casting raised from the form.

FIGURE 3 is a view similar to FIGURE 2 but showing a stripping means on a modified casting form.

FIGURE 4 is a perspective view of the contour members used in the device shown in FIGURE 3.

A form generally indicated by 10 for casting slabs is provided. Form 10 is of steel and has bottom 11 and sides 12 and 13. Sides 12 and 13 extend upwardly and have portions 14 and 15 extending inwardly of the form and shaped to create a grout keyway in the slab sides.

Attached to sides 12 and 13 of the form on the outside thereof are steel reinforcing members such as channels 17 and 18. These channels have flanges 19 to 22 inclusive. It is understood that the channels and form sides are rigidly attached at spaced regions throughout the length of the form, as by welding.

In the form illustrated in FIGURES 1 and 2, flanges 20 and 22 of the channels extend below bottom 11 of the form. In other modifications, the corresponding flanges may be level with bottom 11. The exact construction of the casting form may be varied. However, the nature of the steel used in the manufacture of the form, particularly bottom 11, is such as to satisfy the equations previously given. Due to the necessity for the sides of the slab clearing the keyway forming portions of the form, it is necessary to spread the form sides sufficiently so that a casting can be removed as illustrated, for example, in FIGURE 2.

The accurate opening of the form is accomplished by the apparatus illustrated in the drawing. Base 25 carries I beam 26 along the length of a form. I beam 26 has flanges 27 and 28 upon which base block 30 rests. Block 30 is of steel and also extends the full length of the casting form. Resting upon block 30 are inflatable tubes, here shown as two in number, 32 and 33. Inflatable tubes 32 and 33 are of any air-tight flexible ma-

terial such as rubber, rubberized canvas, or plastic, and are provided with means for introducing, maintaining and releasing air under pressure within the tubes.

Resting upon tubes 32 and 33 is contour plate 35 of steel or other rigid material. Spacer bars 34 of steel or the like are provided between base block 30 and contour plate 35 to limit the flattening of tubes 32 and 33. Contour plate 35 has cylindrical curved surface 36 which may have a generally arcuate shape as seen in section. It is understood that bottom 11 of the casting form is bent around top surface 36 of the contour plate. Surface 36 may be wide enough to accommodate the full width of the casting form.

Contour plate 35 may have a continuous contour surface 36 for the length of the form or as illustrated in FIGURES 3 and 4, may have a number of cross members 35' at spaced intervals along the length of the form for accomplishing the same purposes. Thus, for example, there may be a number of plates 35' say, about 1" thick, disposed at 3" intervals along the length of a casting form. Each plate 35' will have a curved top edge 36' also 1" wide. The contour plate may be made in sections.

In accordance with the present invention, surface 36 preferably has a radius R as defined in Equation 2 previously given. In theory each size casting form may require its individual contour plate. In practice, a number of sizes may be accommodated. As is well known, the cast concrete slabs may range in thickness or height from 4" up to 10" or 12". These same slabs may range in width from about 12" to as much as 40". The length may be up to 40 or 50 feet.

In order to anchor the sides of the form against upward movement during the stressing of the bottom of the form, hooks 38 and 39 are provided at spaced intervals for engaging rods 40 and 41 on the top or inside surfaces of bottom flanges 20 and 22. Hooks 38 and 39 may engage the flanges directly if desired. Hooks 38 and 39 are suitably anchored to base 25.

When inflatable tubes 32 and 33 have compressed air supplied thereto, the tubes will tend to assume a round shape and raise contour block or plate 35. By having sufficient tube area and applying sufficient air pressure to the tubes, considerable force can be exerted to cause bottom 11 of the casting form to be arched or bowed. When the form is arched sufficiently, as illustrated in FIGURE 2, for the casting to clear, removal of the casting may be effected. This may be accomplished by vacuum pads or other mechanical means at the top of the finished slab or by having the entire stripping apparatus turned upside down to let the casting drop out. Thereafter the air in tubes 32 and 33 is allowed to escape to a low or substantially zero pressure above atmosphere so that the form assumes the shape as illustrated in FIGURE 1. The form is removed and may then be cleaned and prepared for a new casting operation.

It is clear that the number of inflatable tubes will depend upon the width of the form, the air pressure used, and the amount of force necessary to bow the bottom of the form. In some instances only one inflatable tube is necessary while in other instances two or more may be necessary.

In applying air pressure to the inflatable tubes, great care need not be exercised to limit the air pressure, finally reached in the tubes. Due to the action of the apparatus, over-bending of the form is practically impossible since the lever or moment arm shortens as the form arches. Hence the final pressure in the tubes can vary quite widely without damage.

The stripping means can accommodate different kinds of casting forms. As illustrated in FIGURE 3, the casting form has stress supporting plate 11a below the cast-

ing form bottom 11'. The casting form proper can be of metal or plastic and the stresses are assumed by the side reinforcements and plate 11a which will be of steel. This casting form is more fully disclosed and claimed in the copending application of Mark J. Wise, filed April 25, 1961, Serial No. 105,425.

It is understood that the contour means for shaping the form bottom may be wider or somewhat narrower than the form bottom. By virtue of the invention, over-stressing and possible permanent deformation of a casting form is avoided. A wider and safer form opening is accomplished. The contour plate design eliminates costly trial and error methods, enables the designer to select the proper kind of steel for the form.

What is claimed is:

1. Apparatus for stripping cast concrete slabs from a steel casting form having a length of the order of 40 feet or more and being great in comparison to any transverse dimensions, said casting form having a generally U-shaped transverse section with the bottom being flat during casting and the sides extending at right angles to the bottom at all times, said casting form sides being shaped so that interlocking of the form sides and casing prevents simple lateral stripping, said casting form sides having laterally outwardly extending portions which can be engaged for arching the form bottom, said casting form requiring stripping by arching the casting form bottom to spread the sides sufficiently to release the casting, said casting form being susceptible to permanent damage by over-stressing parts of the form bottom, said stripping apparatus comprising rigid support means extending horizontally along straight lines for a distance of at least 40 feet for accommodating the full length of a casting form, said rigid support means having an upwardly curved contour supporting face as seen transversely, said contour face extending along straight lines longitudinally thereof, said curved contour face being dimensioned to accommodate substantially the width of the casting form bottom during arching, said contour face curve as seen transversely at all points thereof having a radius of curvature which is large enough so that during stripping no part of the casting form bottom will be overstressed, said contour face curve however having sufficient curvature to cause substantial arching of the form bottom so that the form sides can open substantially for effecting stripping, said casting form bottom when transversely straight being adapted to contact a small intermediate part, when seen transversely, of the contour face at the beginning of stripping, means disposed parallel to the length of said rigid support means but laterally on both sides of said rigid support means for engaging the lateral portions at the sides of said casting form, said last named means exerting a downward force when arching said casting form bottom, means for moving said rigid support means and the laterally disposed from engaging means relative to each other in a generally vertical direction with sufficient force to arch a casting form and spread the form sides for stripping, said arrangement permitting quick springing of a casting form while preventing excessive bending of the form bottom whereby the force exerting means for accomplishing the stripping need not be controlled with unusual care or delicacy, the shortening of the moment arm during arching making excessive arching practically impossible.

2. The construction according to claim 1 wherein said means laterally disposed with respect to the arched support means comprise a plurality of pivoted means, said pivoted means being movable about pivots parallel to the length of said arched support means and disposed in vertically offset relation to the curved support face, said pivoted means being swingable away from or toward lateral projectoins forming part of the casting forms.

3. The construction according to claim 2 wherein said pivot points are disposed below the level of said curved support face.

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4. The construction according to claim 1 wherein said means laterally disposed with respect to the arched support means comprise members supported at regions vertically offset from the level of said contour face to engage the form projections at the top.

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