Aug. 27, 1940. T. C. DURLEY 2,213,159

CONCRETE FORM

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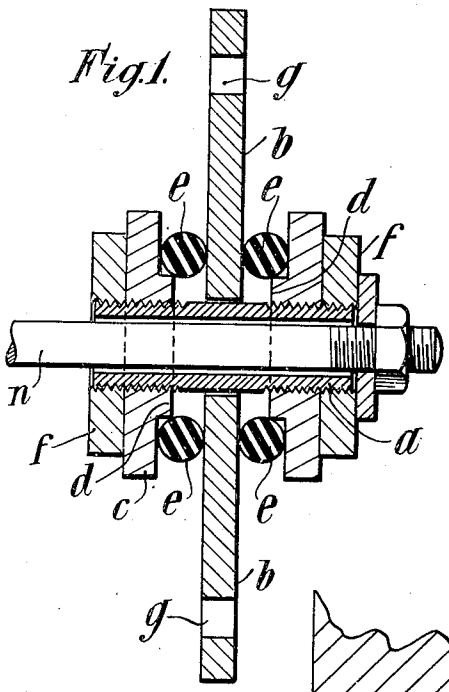
Fig. 1.



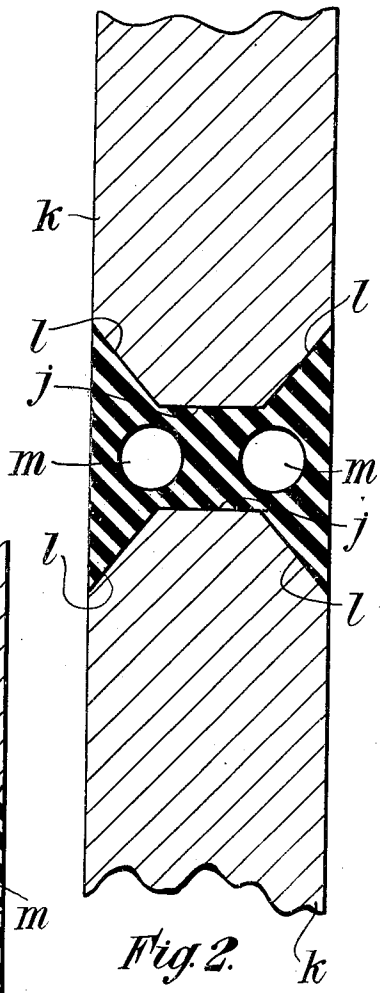


Fig. 2.

Fig. 3.

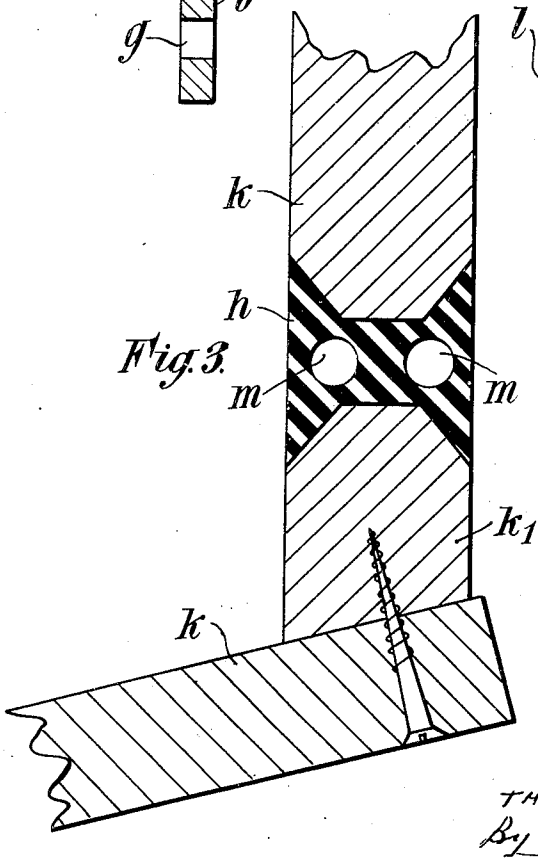


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Fig. 4.

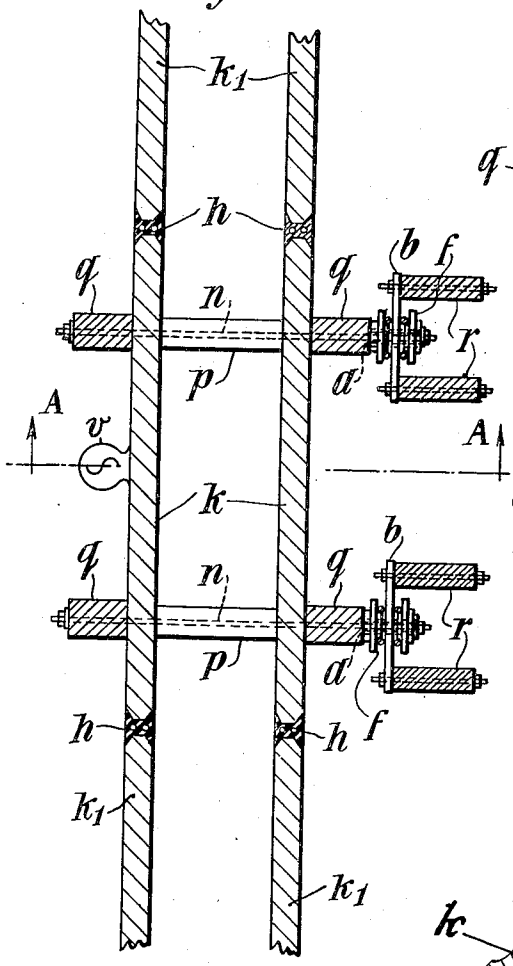


Fig. 5.

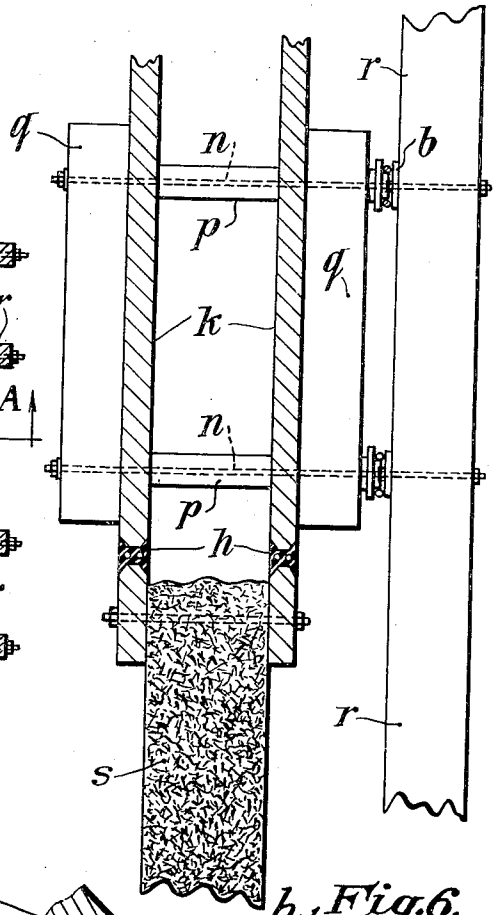


Fig. 7.

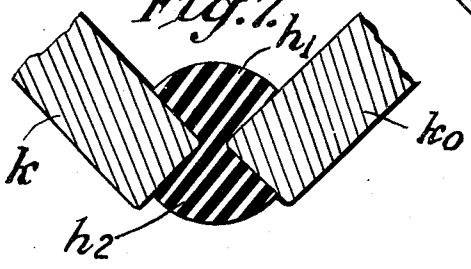
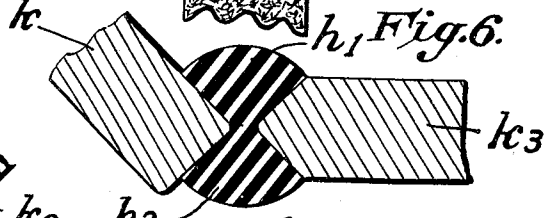


Fig. 6.



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Patented Aug. 27, 1940 2,213,159

UNITED STATES PATENT OFFICE

2,213,159

CONCRETE FORM

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Application July 23, 1938, Serial No. 220,952
In Great Britain July 23, 1937

9 Claims. (Cl. 25—131)

This invention relates to shuttering for use with vibrating apparatus for the consolidation of plain or reinforced concrete whilst it is being cast in situ.

In the usual shuttering arrangement for this purpose, the shutters which are acted upon by vibrators are rigidly connected to fixed framing members or to hardened concrete, or both, so that the shutters themselves or portions of them are substantially fixed in space. Such an arrangement entails disadvantages. If the shutters or portions of them are substantially incapable of movement, they are also incapable of transmitting an adequate amplitude of vibration to the whole of the wet concrete with which they are in contact. On the other hand, if they are not rigidly fixed (when assembled according to the usual methods) loss of cement grout and inaccuracy of alignment will result.

The object of the present invention is to provide a shutter panel or the like which is capable of transmitting vibration to the whole of the concrete with which it is in contact whilst maintaining accurate alignment of the work, and at the same time will prevent leakage of cement grout between adjacent shutters or between the shutters and existing work.

According to the present invention, a shutter panel is connected to an elastic or spring device which allows the shutter panel to have a limited and preferably adjustable amount of vibratory movement in a direction approximately at right angles to its own plane, the said device at the same time holding the shutter rigidly against movement outside the predetermined limits. In combination with the foregoing device, a flexible connection in the form of a strip of rubber or other suitable material is provided between the shutter panel and an adjacent shutter panel or support, whether in the same plane or at an angle thereto, which connection seals the joint and positively prevents leakage of cement grout. The faces of the strip which are in contact with the edges of the shutters are shaped to fit the latter by means of complementary projections and recesses, so that the strip is keyed or joggled to the edges of the shutters.

The invention is hereafter described with reference to the accompanying drawings, in which:

Fig. 1 is a sectional elevation of the elastic holding device in one form of construction.

Fig. 2 is a sectional view showing a flexible connection between two adjacent shutter panels.

Fig. 3 is a similar view showing a connection between two shutter panels in different planes.

Fig. 4 is a plan view, partly in section, showing a shuttering system provided with the elastic holding devices and flexible connections of Figs. 1 and 2 respectively.

Fig. 5 is an elevation of the shuttering system shown in Fig. 4, as seen in section on the line A—A.

Fig. 6 is a diagram representing another form of flexible connection.

Fig. 7 is a similar diagram showing the connected shutter panels lying at right angles to one another.

Referring to Fig. 1, the elastic holding device comprises a sleeve *a* which passes with a loose fit through a centrally apertured mounting plate *b*, the sleeve being screw-threaded externally for a portion of its length at each end. On each end of the sleeve there is screwed a nut or abutment *c* which is provided with a boss or shoulder *d*, around which is fitted an annulus *e* of resilient material, preferably rubber; springs of any suitable type may be employed instead of rubber rings. Lock nuts *f* are provided to fix the nuts *c* in their positions on the sleeve.

The mounting plate *b* may thus move relatively to the sleeve *a*, and its degree of movement is controlled according to the adjustable distance between the nuts *c*.

The plate *b* has other apertures *g*, through which it may be bolted or otherwise rigidly secured to a member or members of a shuttering system, and the sleeve *a* is rigidly connected by a bolt *n* passing through it to another member of the shuttering system. For example, the plate *b* may be secured to one of the shutter panels and the sleeve *a* secured by means of its connecting bolt *n* to the fixed framing of the shuttering system. By this means, two members of a shuttering system are connected together in such a way that they are free within predetermined but adjustable limits to move relatively to one another; if one member is substantially fixed in space, the other member is free to take up a forced vibration of controllable amplitude under the action of an out-of-balance rotor rigidly attached to it or of any other device of the known kind capable of inducing a forced vibration.

According to a further feature of the invention, a flexible connection between a moving shutter panel and the adjacent shutter panel or panels (which latter may also be made free to vibrate within a limited amplitude, or may be substantially fixed in space) consists of a strip of flexible material, preferably rubber, which is interposed

between adjoining edges of adjacent shutter panels.

As an example, Fig. 2 shows a strip *h* having two wedge-shaped portions and provided with opposed grooves *j*, preferably with sloping sides j^1 to permit of easy assembly and removal, and the edges of the shutters *k* are provided with chamfers *l* to fit into the sloping sides of the grooves *j*. If the shutter panels are made of metal, the edges may be suitably formed in the pressing or equivalent operation. The strip is preferably moulded with a hole or holes *m* of circular or other section, running throughout its length, in order to increase its flexibility under the action of a shearing movement of one shutter *k* relatively to the other.

The strip may be of any other suitable cross section, provided the edges of the shutters are cut to complementary shapes, so that the pressure of the wet concrete will hold the sides of the strip against the edges of the shutters, and prevent separation under the action of the wet concrete; for example, as shown in Fig. 6, the strip may be of X-shape in cross section, consisting of two sectors h^1 h^2 of a circle connected together at the "center" of the circle. When the shutters to be joined by means of this flexible strip lie at an angle to one another differing from a right angle, for example at 135° as indicated at *k* k^3, Fig. 6, or are aligned with one another, one or both of the shutters may have their edges splayed or chamfered to fit the gaps between the sectors h^1 h^2. Shutters which are joined at right angles by means of this flexible strip, as indicated at *k* k^0, Fig. 7, will require no special treatment at their edges, the corners fitting into the gaps between the sectors h^1 h^2.

Where it is desired to make a flexible connection between two shutter panels in different planes, as shown in Fig. 3, one of the shutters *k* may be provided with a narrow panel or strip k^1 rigidly connected thereto by screws or other means, this strip k^1 being set angularly so as to be in the same plane as the other shutter *k*, so that a connection may be made by a flexible strip *h* as above described.

Figs. 4 and 5 show an example of an assembled system of shuttering for casting a concrete wall.

Two of the shutter panels *k*, between which concrete is to be poured, are connected together by bolts *n* which pass through spacers or distance pieces *p* between the panels, each bolt being also secured to the sleeve *a* of an elastic holding device such as above described, the panels being thereby rigidly connected to the sleeve. The bolts *n* may also pass through stiffening members *q* which are rigidly attached to the shutter panels *k*.

A vibrator *v* is shown mounted upon the panel *k* on the left hand side of Fig. 4.

The plates *b* of the elastic holding devices are free to move relatively to the sleeves *a*, and are in turn rigidly connected by bolting or otherwise to framing members *r* which are substantially fixed in space by connection to the ground or to existing hardened concrete in the lower part of the wall or otherwise. Between the vertical edges of the shutter panels *k* and of the adjacent shutter panels k^1 there are interposed the flexible strips *h*, such as already described.

Fig. 5 illustrates the manner in which the shutters *k* intended to provide the formwork for casting concrete on top of existing hardened concrete *s* at the lower part of the wall, can be supported by fixed shutters k^2 rigidly connected to the hardened concrete. Flexible strips *h* are interposed between the shutters *k* and the fixed shutters k^2.

The shutter panels *k* may be put into a state of vibration by connecting a suitable vibrating device (not shown) to either of them, that is to the shutters adjacent to the framing *r* or to those on the other side of the wall; the floating connection between the shutter panels *k* and the rigidly fixed framing members *r* restricts the amount of movement of the panels and prevents them from losing their alignment, and the flexible connections *h* allow any one or if desired the whole of the shutter panels *k* to move in vibration, whilst preventing any leakage of cement grout between these panels and the hardened concrete *s*.

The connections *h* also allow of the erection and dismantling of any one panel independently of adjacent panels.

What I claim is:

1. A flexible connection between panels of concrete shuttering, comprising a strip of rubber or equivalent material, adapted to be laid between adjacent shutter panels, the section of the strip consisting of two wedges connected together substantially in X-shape, the tapering faces being held against the edges of the shutters by the pressure of the concrete in the casting operation.

2. In shuttering for concrete cast in situ, a connection between adjacent shutter panels, characterized by the fact that the connection is formed by a strip of flexible material having its faces in contact with the edges of the panels formed with recesses extending continuously and longitudinally of the strip, the cross-section of the edges of the panels being complementary to that of said recesses.

3. In the art of casting concrete, the combination of a plurality of mold panels, means for imparting forced vibration to one of said panels, means for controlling said vibration to a limited movement in a direction substantially perpendicular to the plane of the vibrating panel, and flexible means for jointing the edges of said vibrating panel and other panels adjacent thereto.

4. In the art of casting concrete, the combination of a plurality of mold panels, means for imparting forced vibration to one of said panels, means for controlling said vibration to a limited movement in a direction substantially perpendicular to the plane of the vibrating panel, and flexible strips of molded rubber for jointing the adjacent edges of said panels, said strips and edges being formed with complementary projections and recesses adapted to key said strips to said edges.

5. In shuttering for use with vibrators for the consolidation of concrete cast in situ, a shutter panel adapted for connection to a vibrator, elastic means for connecting edges of the shutter panel to adjacent parts of the shuttering, and an elastic device connected to the shutter panel, the said device having a limited and preferably adjustable range of vibratory movement in a direction at right angles to the plane of the shutter panel.

6. In shuttering for use with vibrators for the consolidation of concrete cast in situ, a shutter panel adapted for connection to a vibrator, a member substantially fixed relatively to the ground, and an elastic device connected to the shutter panel, the said device comprising an

apertured mounting member, a sleeve movable longitudinally within the aperture of the mounting member, abutments screwed upon the ends of the sleeve, annular members of rubber or like resilient material engaged between the mounting member and the abutments, and a bolt passing through the sleeve, the mounting member and bolt being adapted to be connected to the substantially fixed member and to the shutter panel respectively.

7. In shuttering for concrete cast in situ, the combination of a shutter panel, a member substantially fixed relatively to the ground, flexible means for connecting edges of said shutter panel to adjacent parts of the shuttering, a vibrator connected to said shutter panel, and an elastic device with limited range of movement connected between said shutter panel and said substantially fixed member, operation of said vibrator causing said shutter panel to vibrate as a whole in a direction perpendicular to the plane of said shutter panel, and said elastic device acting to limit the vibration of said shutter panel.

8. In the art of casting concrete, the combination of a plurality of mold panels, a member substantially fixed relatively to the ground, a vibrator connected to one of said mold panels, an elastic device with adjustable range of movement connected between said substantially fixed member and said one mold panel, and flexible means for jointing the edges of said one mold panel to the edges of adjacent mold panels.

9. In the art of casting concrete, the combination of a plurality of mold panels, a member substantially fixed relatively to the ground, a vibrator connected to one of said mold panels, an elastic device with adjustable range of movement connected between said substantially fixed member and said one mold panel, and flexible strips of molded rubber for jointing the edges of said one mold panel to the edges of adjacent panels, said strips and edges being of complementary cross-sections.

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