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SHUTTERING FOR USE IN BUILDING STRUCTURES OF CONCRETE OR LIKE MATERIAL

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The present invention relates to shuttering for use in building structures of concrete or like material, and has for its chief object to provide an improved system of shuttering.

With the above object in view the present invention consists in a system of shuttering for use in building structures of concrete or like material, comprising a plurality of uprights each consisting of several relatively short lengths detachably connectable together, said uprights when in operative position being spaced apart in rows on opposite sides of the structure to be built, means for temporarily securing each length to the structure as it is formed, oppositely facing vertical channels in said uprights, and a shuttering panel mounted for vertical movement between adjacent uprights in each row by engagement of its opposite ends in the channels of adjacent uprights. Preferably means are mounted upon each panel for effecting positive lateral movement of the panel into and out of a position with its operative face aligned with the operative faces of adjacent uprights.

The present invention further consists in an adjustable shuttering panel, comprising parts which are slidable with respect to one another to vary the length of the panel and means for effecting relative sliding movement of said parts.

In order that the present invention may be more clearly understood and readily carried into effect reference may now be had to the accompanying drawings illustrating the same by way of example and in which—

Fig. 1 is an elevational view illustrating diagrammatically the use of the system of shuttering according to the present invention for forming a wall having a right angled corner in it.

Fig. 2 is a plan view of Fig. 1.

Fig. 3 is a perspective view of the arrangement shown in Figs. 1 and 2.

Fig. 4 is a view illustrating in a general way the use of the system according to the present invention.

Fig. 5 is a plan view illustrating the use of the system of the present invention for the formation of curved structures, such as chimneys.

Fig. 6 is a view illustrating a detail of the system of the present invention.

Fig. 7 is a rear elevational view of an alternative form of shuttering panel.

Fig. 8 is a plan view of the shuttering panel shown in Fig. 7, and

Figs. 9 to 12 illustrate an alternative constructional form of adjustable panel, Fig. 9 being an edge or plan view of the parts separated, Fig. 10

a rear elevational view of the parts separated, Fig. 11 rear elevational view of the panel adjusted in one position and Fig. 12 a cross sectional view on line XII—XII of Fig. 11.

Fig. 13 illustrates a rear elevational view of an adjustable panel with taper pieces attached to it for use in the formation of battered structures.

Fig. 14 is a plan view illustrating an alternative form of means for adjusting the spacing of the uprights in a row.

Fig. 15 and 16 are plan and cross-sectional views respectively of alternative means for adjusting a panel to or from its operative position.

Referring first to Figs. 1 to 3, 1 are uprights arranged in a row on one side of a proposed wall, and 2 are uprights arranged in a row on the other side of the proposed wall. As far as possible the uprights 1 and 2 in each row are spaced at equal distances apart longitudinally of the wall and each upright 1 in one row is disposed directly opposite an upright 2 in the other row. However, this is not possible at a corner. The distances between adjacent uprights in each row, except at a corner, are the same and correspond to the lengths of standard shuttering panels. The distances between adjacent uprights in the two rows are different from one another at a corner as shown. Uprights 1, 2 which are opposite one another are preferably linked together by cross stays 3 which may be either of fixed length to suit any desired thickness of the wall, or adjustable as shown so that they may be adapted to suit walls of different thicknesses.

The uprights 1, 2 are shown as built up of channel irons 4, 5 in convenient lengths bolted or otherwise detachably secured together back to back and placed so that the webs of the channel irons are at right angles to the length of the proposed wall. The first two lengths 6, 7 of channel iron in each upright are of unequal length so that the upper ends thereof break joint and facilitate the connection of additional lengths to any desired height.

At convenient intervals in each upright 1, 2 holes are drilled through both flanges as near to the web as possible, and bolts 8 are inserted in these holes before any concrete or like material is placed. In the drawings bolts 8 are shown associated with some only of the holes provided for them in the uprights 1, 2 and it is to be understood that the number of bolts 8 used and the question whether they are to be used in connection with all, or some only, of the holes provided in the uprights, depends upon the nature of the work in hand. The bolts 8 are of such length as

to project a substantial distance into the space to be filled with concrete or like material and each has means 9, such as a nut, detachably secured thereon, as by screwing. Before the concrete or like material is placed in position the projecting portions of the bolts between the channel irons 4, 5 or 6, 7 and the means 9 may be wrapped with paper, greased or otherwise treated to prevent adherence of the concrete or other material thereto and to facilitate ready removal of the bolts 8 after the concrete or other material has set. The means 9 are, however, not so wrapped or treated and are intended to remain firmly embedded in the concrete or other material when set. The bolts 8 and means 9 embedded in the concrete or other material provide a secure anchorage for the uprights 4, 5.

The uprights 4, 5, in addition to being braced together in pairs by the cross stays 3, are also braced by stringers 10, such as angle irons, which extend horizontally and connect uprights in the same row. The stringers 10 may be long enough to span any convenient number of spaces between the uprights in a row and each stringer may be provided with means, such as fixed clip 11, for engagement with one side of each upright and means 12, such as a cam screw, or the like, for co-operation with the opposite side of the same upright. In Figs. 1 to 3 and 5 the means 12 is shown as being in the form of a cam pivotally mounted upon the stringer 10 whilst in Fig. 14 an alternative arrangement is shown comprising a clip 13, similar to the clip 11, mounted upon the stringer 10 for sliding movement with respect thereto. For this purpose the clip 13 is secured by rivets or the like 14, which pass through an elongated hole 15 in the stringer 10, to one flange of an angle iron 16 which may be moved to bring clip 13 into and out of engagement with the upright by means of a bolt 17 which bears in a hole in an angle iron 18 fixed to the stringer 10 and co-operates with a nut 19. The cross stays 3 and stringers 10 retain the uprights on each side of the proposed wall properly aligned and in a vertical position to receive a row of shuttering panels 20. Each shuttering panel 20 spans the distance between a pair of adjacent uprights and its opposite ends engage in the grooves of the channel irons.

The shuttering panels 20 may be of any convenient constructional form. As shown in the drawings each panel comprises a thin metal plate 21 of any convenient height and long enough to span the distance between two adjacent uprights with a small clearance at each end stiffened by means of angle irons 22 secured thereto, as by welding or flush riveting. In the drawings the plate 21 is shown as being stiffened by two vertically disposed angle irons 22, one of which is positioned at or near each end of the plate, and three longitudinally extending angle irons two of which are positioned at or near the upper and lower longitudinal edges respectively and the third about midway of the width of the plate 21 as shown. The two outer vertically disposed angle irons are set so as to project beyond the ends of the plate 21 and the arrangement and proportioning of the several parts is such that when the panel 20 is pressed towards the proposed wall vertical flanges of the two angle irons positioned near the ends of the plate abut the inner faces of the flanges of the channel irons forming the uprights and the surface of the plate lies in a common plane with the outer surfaces of the channel irons constituting the uprights, as shown

in the drawings. The position just described is that which the panels occupy when the concrete or like material is being placed in position and may be termed the operative position of the panels.

To enable the panels 20 to be moved laterally into and out of operative position cams 23 may be pivotally mounted on the two vertical angle irons of each panel as shown, each cam 23 being provided with a handle 24 by means of which the cam may be caused to engage with either of the inner faces of the flanges of the adjacent channel iron to cause lateral movement of the panel to or from its operative position. Instead of using cams for this purpose the same or a similar result may be obtained by the use of screws, bolts or sliding wedges operated by a lever or by a hammer. In Figs. 15 and 16 the manner of mounting and using screw threaded bolts for effecting lateral adjustment of the panel 20 is shown. In this case each bolt 25 engages with a nut 26 secured between one flange of an angle iron 27 fastened to one of the vertical angle irons of the panel and a filler piece 28 bearing on or attached to the vertical angle iron of the panel 20. The bolt 25 projects freely through holes in the angle iron 27, the filler piece 28 and the vertical angle iron of the panel. With this construction by rotating bolts 25 mounted as described at each end of a panel the opposite ends of the bolts may be caused to engage with either of the inner faces of the flanges of adjacent channel irons to cause lateral movement of the panel to or from its operative position. As shown in Fig. 16 the flange of angle iron 27 may be cut away in the region of the bolt 25 to facilitate rotation thereof.

To avoid risk of a panel 20 dropping to the ground, for instance while being adjusted to a new position, safety catches 29 may be provided at each end of each panel. These catches 29 are preferably arranged to act as pawls and by their own weight automatically to engage with the nearest bolts 8 below should the panel drop by accident. The catches 29 can be held up by hand when it is desired to lower a panel 20. The position of the safety catches 29 may be so arranged in relation to the bolts 8 that the two will engage when a panel is in its operative position.

To form a corner the channel irons of one of the uprights of the row on the inner side of the proposed wall may be placed at right angles to one another as shown at 30 in Figs. 2 and 3 instead of being bolted together back to back as hereinbefore described. Rigidity of the channel irons in this position may be obtained, firstly, by bolting an angle iron 31 to both of the channel irons and, secondly, by bolting a gusset plate 32 to the stringers 10. The completion of the shuttering at the inner side of the proposed wall may be effected in a variety of ways. For example, in the case of a sharp right angled corner, an angle iron 33 having lugs 34 welded or riveted thereto may be removably attached by studs passing through the adjacent channel iron as shown in Fig. 2, whilst in the case of a bevelled corner a part shaped as shown at 35 in Fig. 6 may be connected to the angle iron 31. For a rounded corner the shape of the part 35 shown in Fig. 6 may be modified as shown in dotted lines in that figure.

Modification of the shuttering on the outer side of the proposed wall is also necessary, and in this case as well the channel irons of one of the uprights may, if a right angle corner is desired, be placed at right angles to one another as

Although in the foregoing description the formation of a straight wall has been described it is to be understood that structures other than straight walls may be formed by suitable dispositions of the uprights, or by the use of shuttering of suitable form. For example, the system of the present invention may be used to form cylindrical or polygonal shafts or towers. In Fig. 5 the system is shown as applied in the case of a curved structure, such as a circular shaft. In this case the channel irons constituting the uprights 1, 2, are set in the required positions and curved shuttering panels 20 and stringers 10 are employed. Otherwise the arrangement is substantially the same as that already described.

Instead of using uprights made up of channel irons as described the uprights may be formed in any other convenient manner. Similarly the shuttering panels may be made other than as hereinbefore described.

The system of shuttering described is equally adaptable to three methods of advancing the shutters, (a) the "sliding" system wherein the shuttering is advanced continuously or at frequent intervals while concrete is placed continuously, the rate of progress upwards and the depth of shuttering in use being so adjusted that the concrete will be sufficiently set before losing the support of the upward moving shuttering, (b) the "climbing" system in which the upward move of a horizontal row of shutters is intermittent and alternates with the placing of fresh concrete, sufficient idle intervals being allowed for the concrete to set before each move of the shutters, and (c) the "leapfrog" system in which two or more horizontal rows of shutters are superimposed and the shutters forming the lower row are from time to time released and refixed on top of the other row or rows thus permitting the continuous placing of concrete without the necessity of sliding shuttering against the face of fresh unset concrete.

It is believed that the system according to the present invention has the following advantages, namely, (a) the absence of small loose parts which are so easily dropped, lost or mislaid; (b) the absence of any rakers or outside supports for the shuttering which is entirely self-supporting; (c) the avoidance of scaffolding. Working platforms for the men engaged on concreting can be carried by the uprights which are securely attached to the structure. These uprights may be removed as the work proceeds and be replaced at successively higher levels after each lift is completed. A chimney stack, silo or water tower could be thus carried to any height with a minimum of temporary plant; (d) the ease and speed with which the shuttering can be repeatedly used and raised for cleaning and refixed at successive levels as the work proceeds, with a minimum of movement, since the panels can remain between the uprights the whole time and for all these purposes; (e) the ease with which the shuttering can be kept in true alignment as the work proceeds and with which true alignment can be checked, and, if necessary, corrected from time to time by means of wedges placed between the channel iron uprights and the face of the structures; and (f) the small amount of shuttering required since all is in use and none left idle merely to serve as a support.

What I claim is:

1. A system of shuttering for use in building structures of concrete or like material, compris-

ing a plurality of uprights each consisting of several relatively short lengths detachably connectable together, said uprights when in operative position being spaced apart in rows on opposite sides of the structures to be built, means for temporarily securing each length to the structure as it is formed, oppositely facing vertical channels in said uprights, and a shuttering panel mounted for vertical movement between adjacent uprights in each row by engagement of its opposite ends in the channels of adjacent uprights.

2. A system of shuttering for use in building structures of concrete or like material, comprising a plurality of uprights, each consisting of several relatively short lengths detachably connectable together, said uprights when in operative position being spaced apart in rows on opposite sides of the structures to be built, means for temporarily securing each length to the structure as it is formed, oppositely facing vertical channels in said uprights, a shuttering panel mounted for vertical movement between adjacent uprights in each row by engagement of its opposite ends in the channels of adjacent uprights, and means mounted on each panel for effecting positive lateral movement of the panels into and out of a position with its operative face aligned with the operative faces of adjacent uprights.

3. A system of shuttering for use in building structures of concrete or like material, comprising a plurality of uprights each consisting of relatively short lengths detachably connectable together, said uprights when in operative position being spaced in rows on opposite sides of the structure to be built, bolts extending through the uprights at intervals, nuts threaded on said bolts, said nuts becoming permanently embedded in the structure, and a shuttering panel mounted for vertical movement between adjacent uprights in each row by engagement of its opposite ends in the channels of adjacent uprights.

4. A system of shuttering for use in building structures of concrete or like material, comprising a plurality of uprights each consisting of relatively short lengths detachably connectable together, said uprights when in operative position being spaced in rows on opposite sides of the structure to be built, bolts extending through the uprights at intervals, nuts threaded in said bolts, said nuts becoming permanently embedded in the structure, a shuttering panel mounted for vertical movement between adjacent uprights in each row by engagement of its opposite ends in the channels of adjacent uprights, and means mounted on each panel for effecting positive lateral movement of the panels into and out of a position with its operative faces aligned with the operative faces of adjacent uprights.

5. A system of shuttering for use in building structures of concrete or like material, comprising a plurality of uprights each consisting of several relatively short lengths detachably connectable together, said uprights when in operative position being spaced apart in rows on opposite sides of the structure to be built, means for temporarily securing each length to the structure as it is formed, oppositely facing vertical channels in said uprights, and a shuttering panel mounted for vertical movement between adjacent uprights in each row by engagement of its opposite ends in the channels of adjacent uprights, said panel including a facing plate of sufficient length to bridge the space between adjacent uprights, and angle irons secured to said plate to stiffen the same and projecting at op-

shown at 36 in Figs. 2 and 3 and connected by an angle iron 37 to give rigidity; gusset plates 38 may also be secured to the stringers 10 to give additional rigidity. If a curved or bevelled corner is desired the channel irons may be spaced apart and a suitably shaped member connected to them.

To provide for the formation of structures, such as walls of various lengths, a selection of panels 20 of various dimensions may be provided, but to avoid the need for a great number of these an adjustable panel or panels may be used. One form of such a panel is shown in Figs. 7 and 8 and comprises two parts 39 and 40 which are slidable with respect to one another. Each part comprises a thin facing plate 41, 42 and suitably disposed angle irons for stiffening purposes. Means, such as threaded rods 43, 44, engaging with each part, may be provided for effecting relative movement of the parts 39, 40 whilst nuts and bolts 45 may be provided for locking the parts in any desired position of adjustment.

An alternative form of adjustable panel is shown in Figs. 9 to 12 inclusive. The panel comprises two parts 46, 47 each comprising a thin metal plate 48 stiffened at the edges by channel irons 49. The flanges of the upper and lower channel irons of one part are cut away as shown in Figs. 9 and 10 and the upper and lower channel irons are so positioned relatively to the corresponding channel irons of the other part that the resulting projecting portion 50, 51 seat in the channel irons of the other part and tend to stiffen the panel against relative lateral movement of the parts. Each part is provided with a vertically disposed angle iron 52 and means, such as threaded rods like the rods 43, 44 of the arrangement shown in Figs. 7 and 8, in engagement with the angle irons 52, for effecting relative longitudinal movement of the parts 46, 47. The two parts may be locked in any position of relative adjustment by nuts and bolts 54 which project through elongated holes in the upper and lower channel irons associated with each part.

For use in forming battered walls which intersect taper pieces 55 may be secured to the opposite ends of an adjustable panel like that shown in Figs. 7 to 12, as shown in Fig. 13. The angle or taper of the pieces 55 may be as necessary to suit the work in hand.

In the use of a system of shuttering as above described uprights 1, 2 each consisting of lengths 6, 7 of channel iron of unequal length are first arranged in rows on opposite sides of the structure at appropriate distances apart and are then linked together by cross stays 3 and stringers 10 after having been adjusted for spacing and verticality.

A shuttering panel 20 is then placed in position between each pair of adjacent uprights 1, 2 and lowered to the lowest position, i. e., on to the ground or a footing provided for the structure, so as to form a mould into which concrete or like material can be placed. Each panel 20 is then adjusted by means of the cams 23, bolts 25 or the like into operative position after which placing of the concrete or like material takes place. After the concrete has set or partially set the cams 23, bolts 25 or the like are operated to move the panels 20 away from the face of the concrete or other material and the panels 20 can then be raised into their next position in which their lower edges should overlap slightly the top of the concrete or other material which

has just set, or partially set. The panels 20 are then adjusted by operation of the cams 23, bolts 25 or the like into operative position and more concrete or like material is placed into the mould formed by the several panels 20 in their new positions. When this further concrete or like material has set or partially set the panels 20 are moved laterally of the structure by operation of the cams 23, bolts 25 or the like and raised to a further new position and the procedure described is repeated until a wall of the desired height has been formed.

The lowermost lengths 6, 7 of channel iron constituting the uprights 1, 2 do not extend the whole height of the wall to be formed, but are, in fact, of short length relative to such height and may, for instance, only be long enough to accommodate two lifts of the panels 20. It is therefore necessary to secure additional lengths of channel iron to the lengths 6, 7 as the formation of the wall proceeds, and to link such additional lengths together by cross stays 3 and stringers 10 as described in connection with the lengths 6, 7. As the height of the wall rises the lowermost lengths 6, 7 of channel iron are no longer required and may be removed and used to increase the height of the uprights. In fact as the height of the wall rises the lower lengths of channel iron may be removed and re-used as described in the case of the lowermost lengths 6, 7. It will be appreciated that each length of upright is firmly secured to the wall as it is formed by the bolts 8 and means 9, and that the shuttering "climbs up" the wall as the height of the wall increases in the manner shown in a general way in Fig. 4 in which the two lengths of uprights shown in dot and pick lines have been removed for re-use when required on the ends of the uprights shown in full lines.

Owing to the fact that the uprights 1, 2 are firmly secured to the wall as it is formed no scaffolding is required to support the shuttering with the result that great economy in the use of material is achieved. Further, the whole of the parts with the exception of the means 9 are removable and available for re-use.

In some cases owing to the size and weight of the shuttering panels employed it may be desirable to use lifting tackle to raise the panels from one position to another and such tackle may, in the system according to the invention, be detachably connected to the uprights as shown at 56 in Fig. 4.

Further, in the system according to the present invention the shuttering panels 20 may be adapted to be moved continuously, the necessary lifting gear being secured to the uprights in a manner similar to that described in the preceding paragraph. In this case the cams 23, bolts 25 or the like might be replaced by rollers or shoes to facilitate movement of the panels with respect to the uprights.

It will be noted that when lifting tackle is used for the panels such tackle is located close to the uprights so as not to interfere with the work of men placing the concrete in the mould formed by the shuttering.

The uprights 1, 2 may also be used, if kept well in advance of the shuttering panels 20, to provide a means for supporting any reinforcement, such as a steel network, that may be required in the wall, or for the attachment of a light derrick for hoisting concrete or other material up to the working position, or for supporting a platform to accommodate men at the working position.

posite side edges of the plate for engagement in said channels.

6. A system of shuttering for use in building structures of concrete or like material, comprising a plurality of uprights each consisting of several relatively short lengths detachably connectable together, said uprights when in operative position being spaced apart in rows on opposite sides of the structures to be built, means for temporarily securing each length to the structure as it is formed, oppositely facing vertical channels in said uprights, and a shuttering panel mounted for vertical movement between adjacent uprights in each row by engagement of its opposite ends in the channels of adjacent uprights, said panel including a facing plate of sufficient length to bridge the space between adjacent uprights and angle irons secured to said plate to stiffen the same and projecting at opposite side edges of the plate for engagement in said channels, and means mounted on each panel for effecting positive lateral movement of the panels into and out of a position with its operative face aligned with the operative faces of adjacent uprights.

7. A system of shuttering for use in building structures of concrete or like material, comprising a plurality of uprights each consisting of several relatively short lengths detachably connectable together, said uprights when in operative position being spaced apart in rows on opposite sides of the structures to be built, means for temporarily securing each length to the structure as it is formed, oppositely facing vertical channels in said uprights, a shuttering panel mounted for vertical movement between adjacent uprights in each row by engagement of its opposite ends in the channels of adjacent uprights, and safety means for automatically arresting undesired vertical movement of the panels.

8. A system of shuttering for use in building structures of concrete or like material, comprising a plurality of uprights each consisting of relatively short lengths detachably connectable together, said uprights when in operative position being spaced in rows on opposite sides of the structure to be built, bolts extending through the uprights at intervals, nuts threaded on said bolts, said nuts becoming permanently embedded in the structure, a shuttering panel mounted for vertical movement between adjacent uprights in each row by engagement of its opposite ends in the channels of adjacent uprights, and pawl-like catches mounted on the panels for automatically engaging said bolts and preventing undesired movement of the panels.

9. A system as claimed in claim 1 in which each upright comprises lengths of channel iron bolted back to back.

10. A system of shuttering for use in building structures of concrete or like material, comprising a plurality of uprights each consisting of relatively short lengths of channel iron bolted back to back, said uprights when in operative position being spaced apart in rows on opposite sides of the structure to be built, bolts extending through said uprights at intervals, nuts threaded on said bolts, said nuts becoming firmly embedded in said structure, a shuttering panel mounted for vertical movement between adjacent uprights in each row by engagement of its opposite ends in the channels of adjacent uprights, cam means mounted upon each panel for moving said panel laterally into and out of operative position by engagement with the flanges of the channel iron, and safety catches mounted upon each panel for automatically engaging said bolts.

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