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A. H. HAWES
SHUTTERING FOR USE IN MOLDING ARCHED
CONCRETE ROOF STRUCTURES

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4 Sheets-Sheet 1

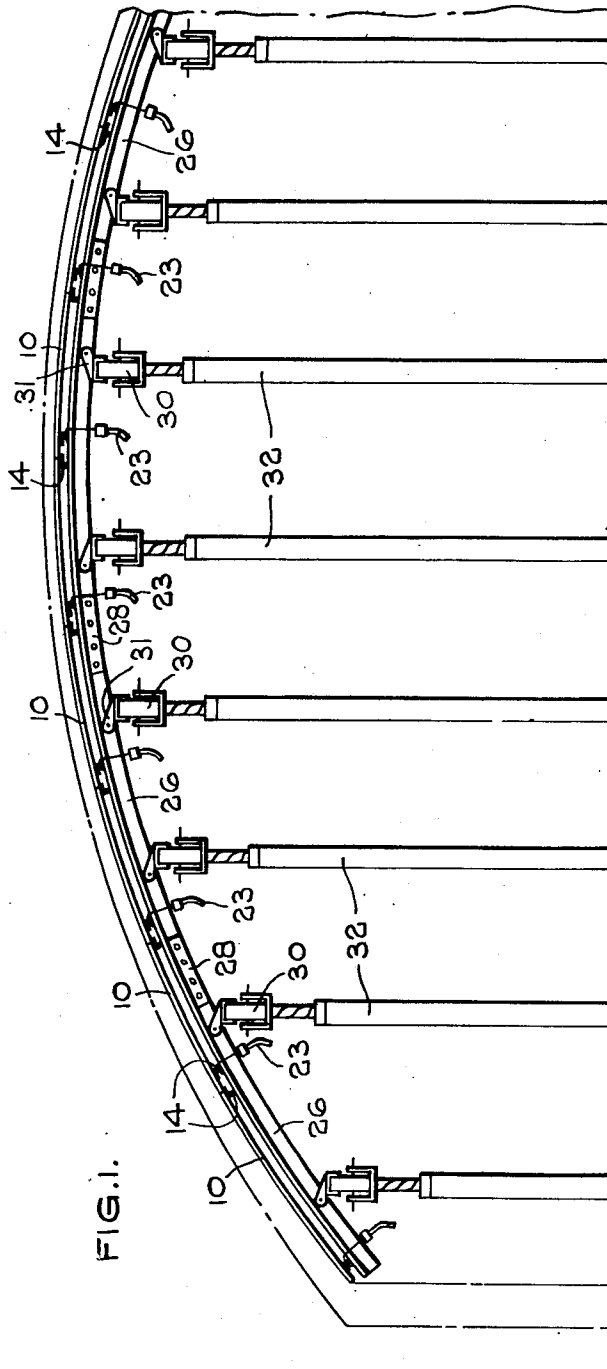


FIG. 1.

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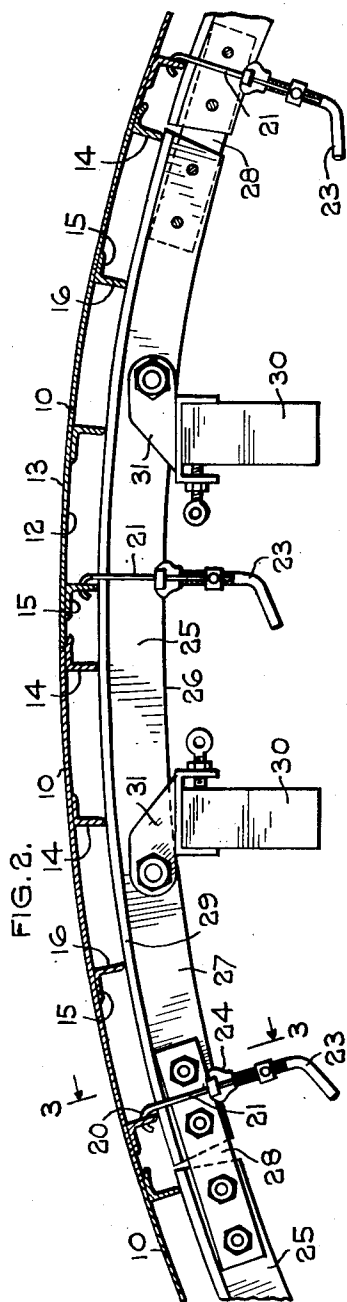
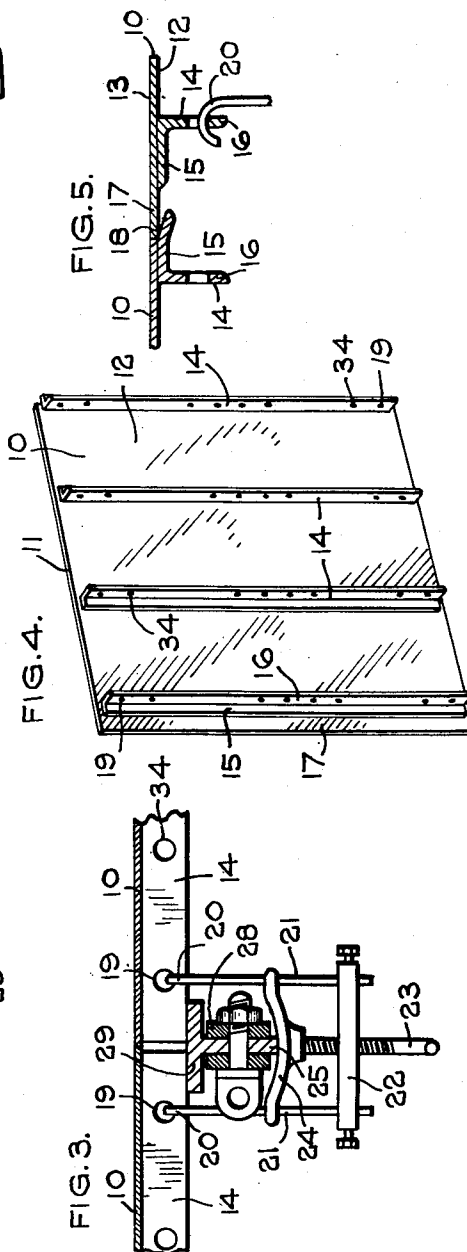
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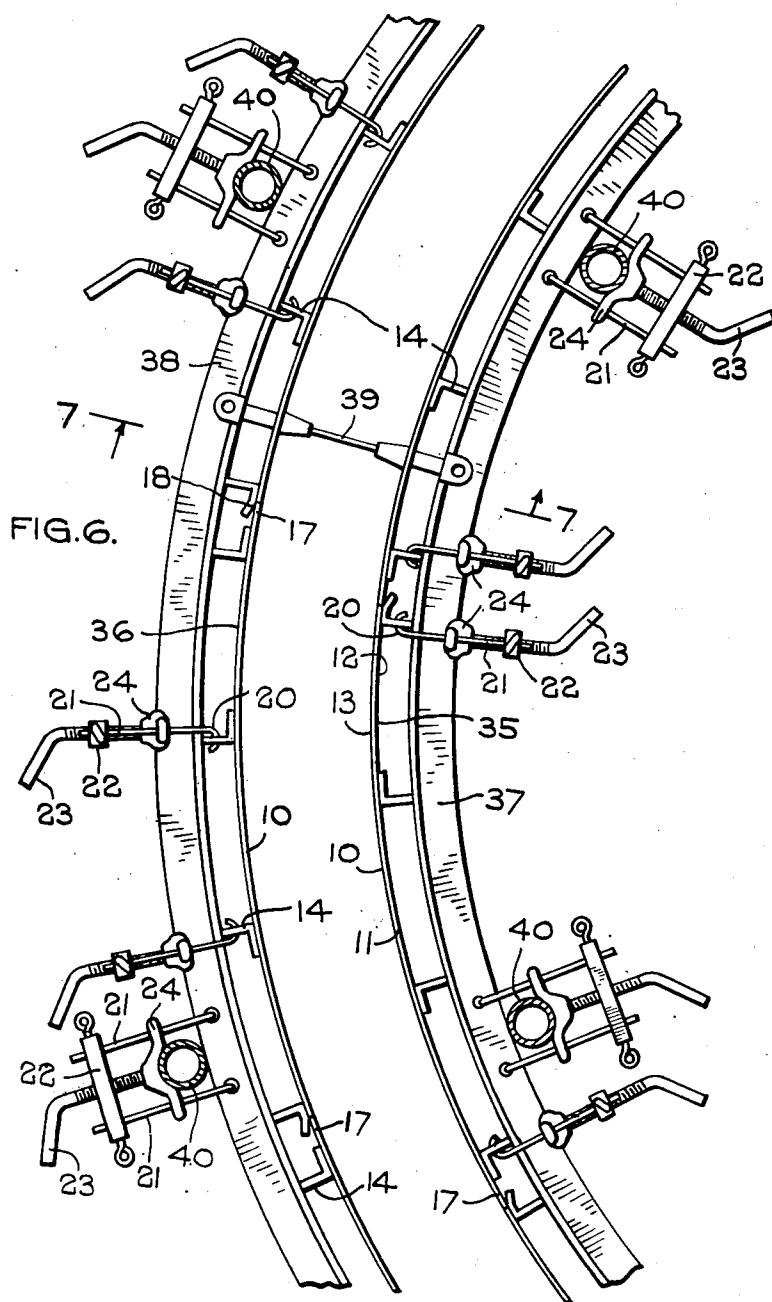
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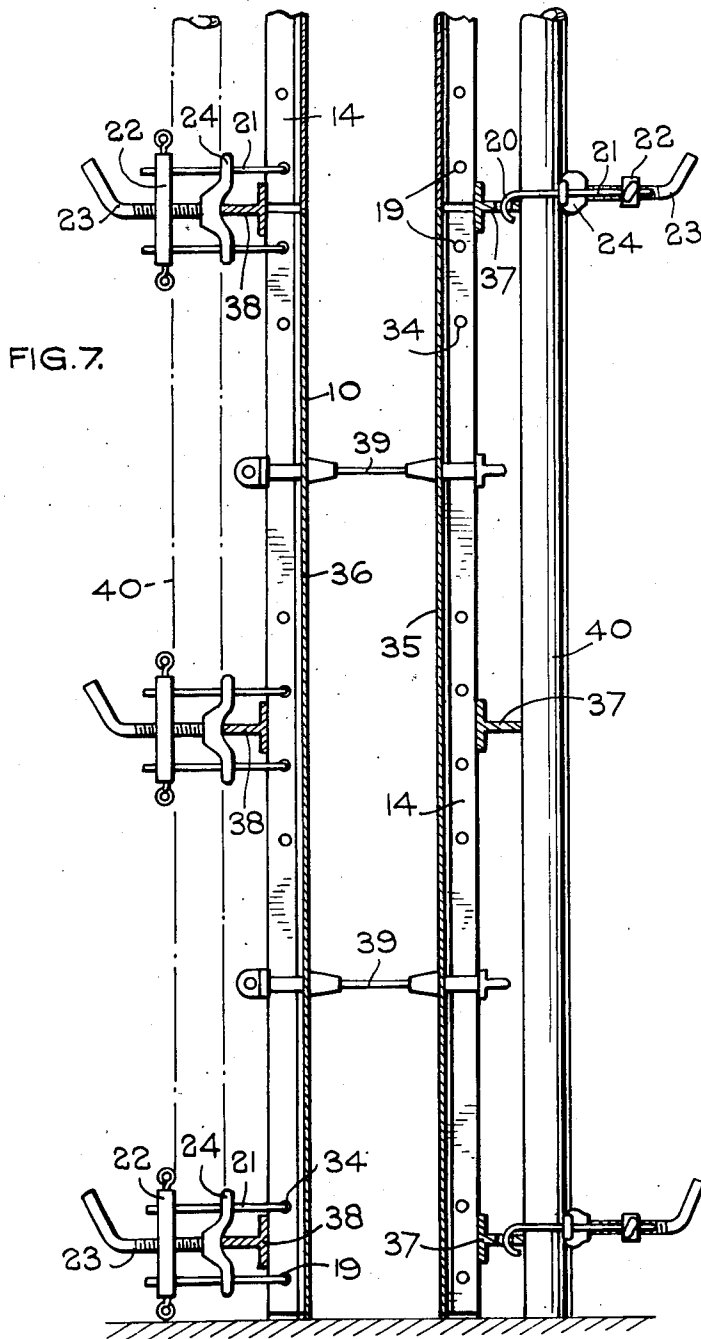
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SHUTTERING FOR USE IN MOLDING
ARCHED CONCRETE ROOF STRUCTURES

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This invention relates to shuttering for use in forming structures of concrete and other material which is cast in situ and allowed to harden and is concerned with shuttering for use in forming arched roofs and other curved structures, for example, circular cooling towers of electric power stations.

The invention has for its object the provision of an improved form of shuttering which will enable surfaces of generally curved form to be cast to the particular curvature desired.

According to the present invention I provide shuttering plates formed from flexible metal sheets provided with reinforcing members in which one edge of each plate is provided with a lip adapted to be received in a recessed edge on an adjacent plate, the reinforcing members adjacent the lipped edges of their associated plates being clamped to a supporting scaffolding structure in such a manner as to secure the adjacent recessed edge plate to such structure by the same clamps so that an economy in the number of clamps required is effected.

Referring to the drawings:

Figure 1 is a side elevation of a shuttering structure for forming an arched roof embodying shuttering plates in accordance with the present invention.

Figure 2 is a sectional side elevation to an enlarged scale of the upper part of the structure depicted in Figure 1.

Figure 3 is a sectional view on the line 3—3 of Figure 2.

Figure 4 is a perspective view of one of the shuttering plates embodying the present invention.

Figure 5 is a sectional view to an enlarged scale of the meeting edge portions of one pair of contiguous shuttering plates which are depicted in Figure 2.

Figure 6 is a part-sectional plan view of a shuttering structure embodying shuttering plates in accordance with the present invention for use in forming a circular wall of a tower.

Figure 7 is a sectional view on the line 7—7 of Figure 6.

Referring firstly to Figures 1 to 5 of the drawings, shuttering in accordance with the present invention comprises a plurality of identical shuttering plates indicated at 10 in Figure 4, each shuttering plate consisting of a resilient flexible relatively thin rectangular metal sheet 11 formed preferably of aluminium or an aluminium alloy, the sheets being reinforced at intervals along one face 12 thereof, namely, the face opposite to the face 13 which is to be presented to the material

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which is being cast with a plurality of spaced parallel reinforcing members 14.

Each of these reinforcing members conveniently comprises metal bars of angle section, one of the flanges 15 of each of which is secured rigidly as by welding to the face 13 of the flexible sheet so that the other flange 16 of each bar projects at right angles to the plane of the adjacent part of such face.

The sheets are adapted to be bent to the desired curved configuration in a direction extending at right angles to the length of the reinforcing members 14, that is to say, the latter extend at right angles to the direction of bending.

The flange 16 of at least one of the reinforcing members of each shuttering plate 10 is adapted to be secured detachably to a supporting scaffolding structure, and in order to enable one such reinforcing member only of each shuttering plate to be so secured, with consequent reduction in the amount of securing means provided, each of the reinforcing members 14 extends parallel to one pair of opposite edges of the rectangular sheet 11, and one of these edges is extended beyond the adjacent reinforcing member to form a lip 17 at one edge of the plate, while at the opposite edge of the plate the flange 15 of the reinforcing member projects beyond the edge of the sheet 11 to form a recess 18 which is adapted to receive the lip 17 of the next adjacent plate.

The reinforcing member 14 beyond which the lip 17 projects is, in such an arrangement, the only reinforcing member which is required to be secured to the supporting structure, and for this purpose the flange 16 of such member is formed at each end thereof with a hole 19, as shown in Figure 3, to receive detachably the hooked ends 20 of a pair of spaced parallel wires 21, which wires form part of a U-shaped clamp shown most clearly in Figure 3, the wires being connected by a bridge piece 22, in a threaded hole of which works a clamping screw 23 carrying a pressure plate 24 adapted to engage with the edge of the web 25 of one of a number of supporting ribs 26 which are provided for supporting the shuttering plates, the ribs being disposed in spaced parallel relationship at right angles to the length of the reinforcing members 14 and being of curved configuration to correspond to the curvature of the arched roof which is to be formed.

Each rib is made in a number of sections 27, each of T form in cross section and connected together detachably by fish plates 28, the centres of the ribs 26 being spaced apart by a distance corresponding to the overall dimension of the

shuttering plates in a direction along the length of the members 14, so that the two ends of each of the reinforcing members rest on the head 29 of each T section rib.

The reinforcing member 14 of each shuttering plate which is adjacent the lip 17 is thus clamped at each end to the ribs 26 in the manner described with the shuttering plates disposed with the edges of their sheets 11 in abutment with one another, and with the lip 17 of each plate engaging within the recess 18 of the adjacent edge of the contiguous plate so as to apply the clamping pressure to the base of such recess 18 which is formed by the adjacent flange 15, and secure the edge portion of the associated plate in the desired position with the reinforcing member adjacent such recess in tight engagement with the head 29 of each adjacent pair of ribs 26.

Thus the shuttering plates are secured with the flanges 16 of each reinforcing member in tight engagement with the head 29 of each rib with the shuttering plates curved to the configuration of the curved ribs 26 corresponding to the desired curvature of the roof to be formed.

The ribs 26 are supported at intervals upon purlins 30 extending at right angles to the length of the ribs, to which purlins they are connected by clamps 31, the purlins being supported from the ground through the medium of struts 32 as shown in Figure 1.

Adjacent the flanges 15 of each reinforcing member the flexible sheets 11 will necessarily be straight, and in order to permit of the abutting edges of the sheets along each lip 17 being disposed at a slight angle to one another so that the sheets 11 collectively present a surface which is curved as far as possible over its entire area, the flange 15 of the reinforcing member adjacent each recess 18 is bent in a direction away from such recess where it projects beyond the edge of the associated sheet as indicated at 33 in Figure 5.

The flanges 16 of the reinforcing members are provided with additional holes 34 to receive the arms of additional U-shaped clamps if desired, but normally such additional clamps would not be required in the case of an arched roof where the shuttering plates are supported from beneath and extend in a more or less horizontal direction. Thus with the arrangement described, it will be seen that the U-shaped clamps employed are utilised in a particularly economical manner.

In Figures 6 and 7 the invention is shown as applied to the casting in concrete of part of a circular wall, for example, the wall of a cooling tower as used in an electric power station, for which purpose it is necessary to provide instead of a single set of shuttering plates for forming one face of the structure as in the arrangement already described, two sets of shuttering plates, each for forming one of the two faces of the wall, one set of shuttering plates being curved to convex configuration as in the arrangement already described, and as indicated generally at 35 in Figure 6, for forming the inner face of the wall, and the other set being formed to concave configuration as indicated generally at 36 to form the outer face of the wall.

The two sets of shuttering plates are supported from arched ribs 37 and 38 of convex and concave form respectively to which they are secured in manner similar to the preceding arrangement, the individual shuttering plates having a configuration identical with that shown in Figure 4.

As in the arrangement shown in Figure 6 and

7, the shuttering plates are not being supported from beneath. The convex curved plates 35 are clamped to the ribs 37 at the four corners of each plate so that twice as many U-shaped clamps are used than is the case with the preceding arrangement for each plate, while in the case of the concave shuttering plates 36, in order to secure the plates in the desired concave configuration intermediate their extremities, the U-shaped clamps are connected to the reinforcing members 14 which are nearest to the centre of each plate, and it is found that by providing the lip 17 along one edge of each plate engaging in the recess 18 at the adjacent edge of the contiguous plate, the clamping of the reinforcing members 14 adjacent such lip and recess is unnecessary.

The concave plates 36 are preferably clamped centrally of their length as well as at each end thereof as indicated in Figure 7.

Spacing members, which do not form any part of the present invention, are provided at intervals as indicated at 39 for maintaining the opposed faces of the two sets of shuttering plates spaced by the requisite distance apart.

The sets of ribs 37 and 38 are clamped at intervals to vertically extending supporting tubes 40.

The shuttering plates described can be bent to varying curvatures corresponding to the particular curvature of the structure to be formed so that the same plates can be used repeatedly for forming structures of different curvature, or if desired, for forming structures of plane form, and the fact that the plates are resilient ensures that they resume flat configuration when released after use.

What I claim then is:

1. Shuttering for the purpose described comprising a plurality of supporting members of similar curved configuration, means supporting said members in spaced parallel relationship with their respective axes of curvature aligned, a plurality of flexible sheet metal shuttering plates arranged in parallel rows, reinforcing members extending longitudinally of the rows along one pair of opposite edges of each plate, said plates being secured to said reinforcing members, said reinforcing members extending transversely of said supporting members with the ends of adjacent reinforcing members of contiguous plates in a row abutting on a common supporting member, one of said opposite edges of each plate projecting beyond the adjacent reinforcing member and constituting a lip extending along each of said plate edges, the reinforcing member adjacent the other of said opposite edges of each plate projecting beyond the adjacent plate edge to form in co-operation therewith a recess extending along each of such plate edges, each lip on one row of plates entering the recess at the edge of the adjacent row of plates, and a single clamping member securing the two contiguous ends of two aligned reinforcing members adjacent the lipped edge of each plate to the supporting member with which said reinforcing members abut.

2. Shuttering for the purpose described comprising a plurality of supporting members of similar curved configuration, means supporting said members in spaced parallel relationship with their respective axes of curvature aligned, a plurality of flexible sheet metal shuttering plates arranged in parallel rows, reinforcing members extending longitudinally of the rows along one pair of opposite edges of each plate, said plates

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being secured to said reinforcing members, said reinforcing members extending transversely of said supporting members with the ends of adjacent reinforcing members of contiguous plates in a row abutting on a common supporting member, one of said opposite edges of each plate projecting beyond the adjacent reinforcing member and constituting a lip extending along each of said plate edges, the reinforcing member adjacent the other of said opposite edges of each plate projecting beyond the adjacent plate edge to form in co-operation therewith a recess extending along each of such plate edges, each lip on one row of plates entering the recess at the edge of the adjacent row of plates, each of said reinforcing members along the lipped edge of each plate having a hole at each end of said reinforcing member, a substantially U-shaped clamping member comprising a pair of arms joined together by a connecting part, the extremities of the arms of which clamping member engage one with each hole in the two contiguous ends of a pair of aligned reinforcing

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members, and clamping means on said connecting part engaging releasably with said reinforcing member on the face thereof which is most remote from said plates to secure each of the adjacent plates thereto.

ALBERT HENRY HAWES.

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