Dec. 14, 1965 W. E. HAAS 3,222,749

BUILDING CONSTRUCTION

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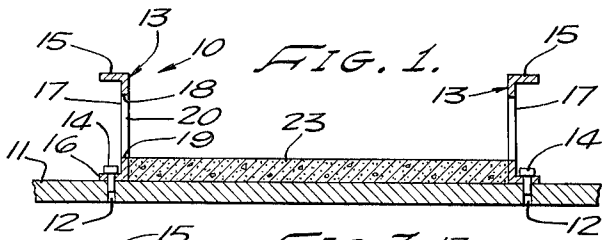

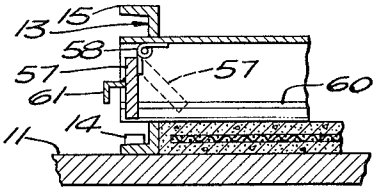

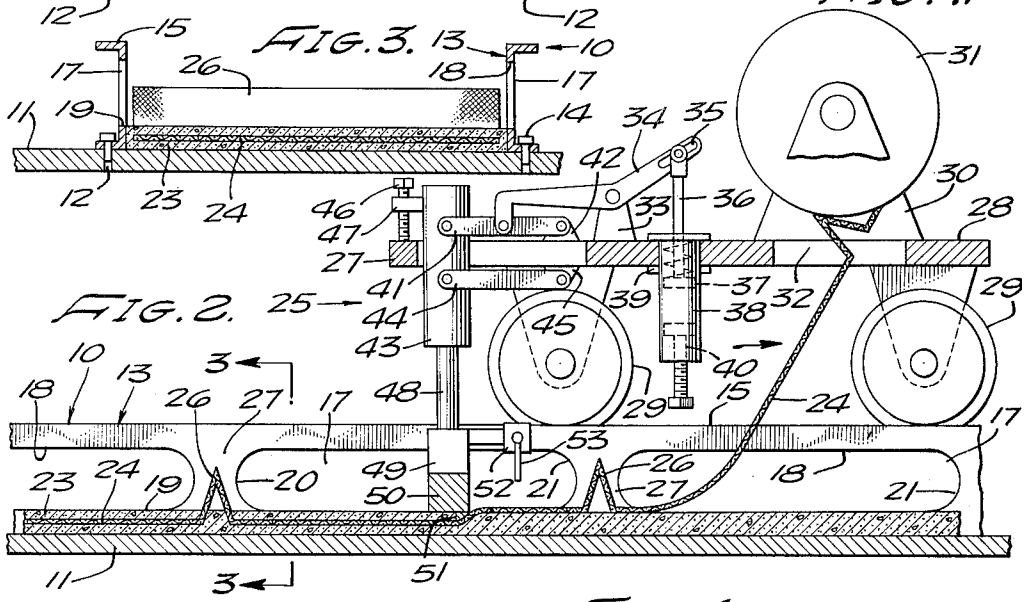

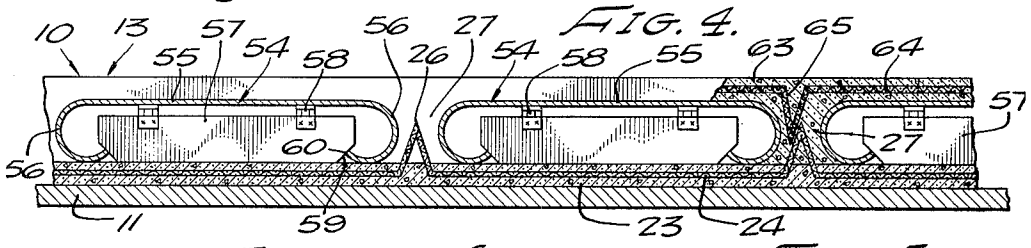

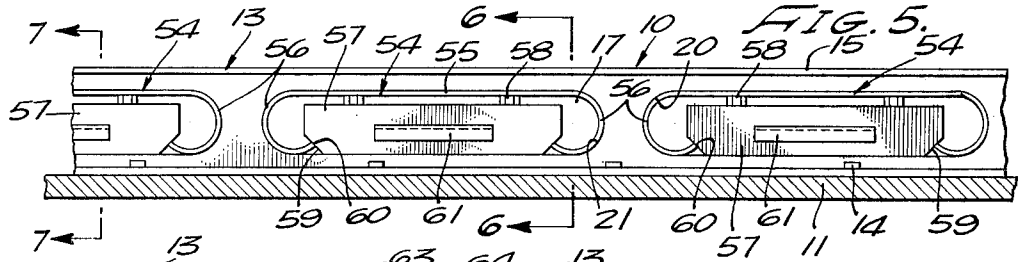

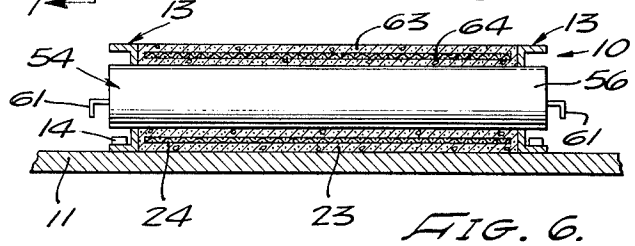

WILSON E. HAAS
INVENTOR.

BY Lyon & Lyon

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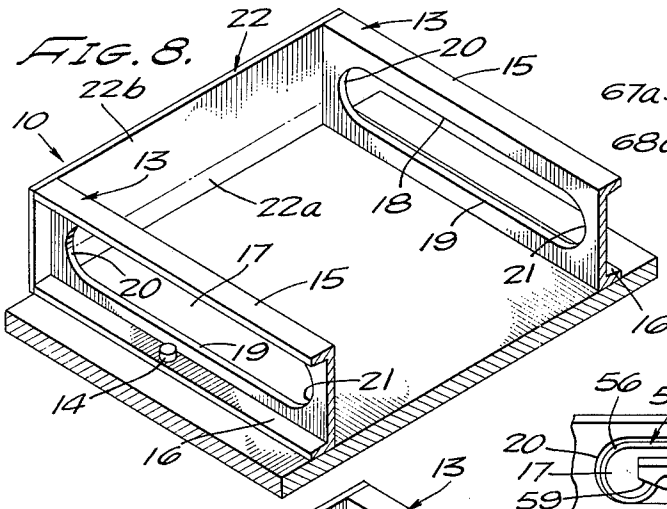
FIG. 8.



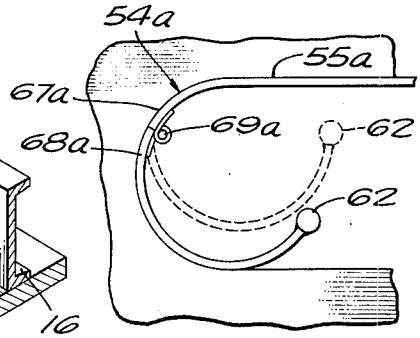


FIG. 12.

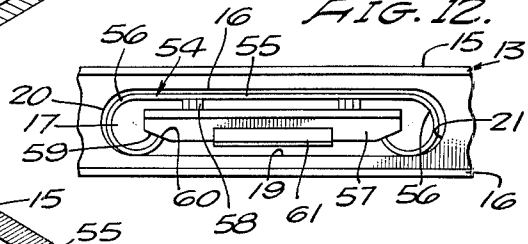
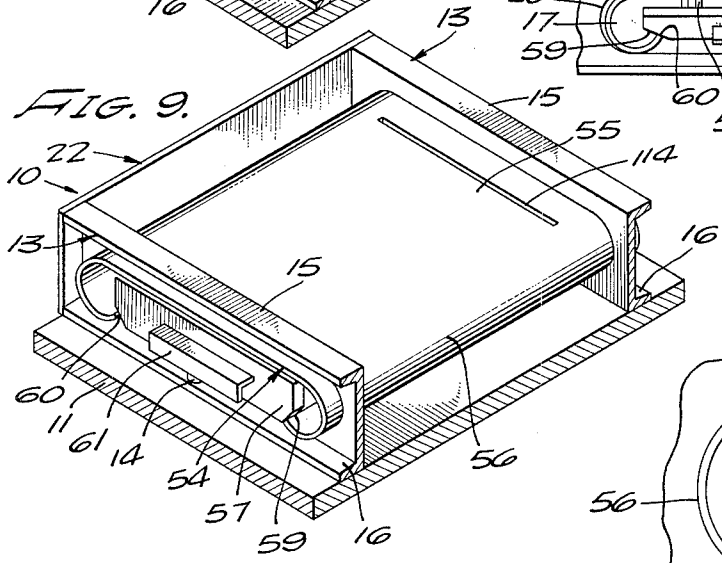


FIG. 10.

FIG. 9.



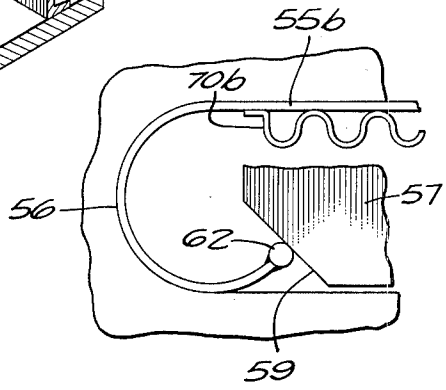


FIG. 13.

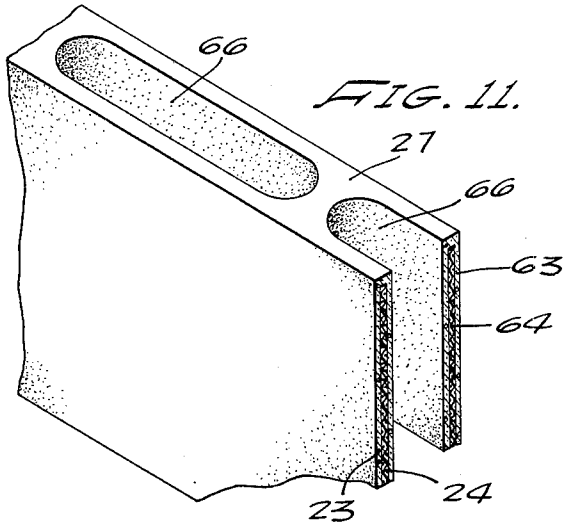


FIG. 11.

WILSON E. HAAS
INVENTOR.

BY Lyon Lyon

ATTORNEYS

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FIG. 14.

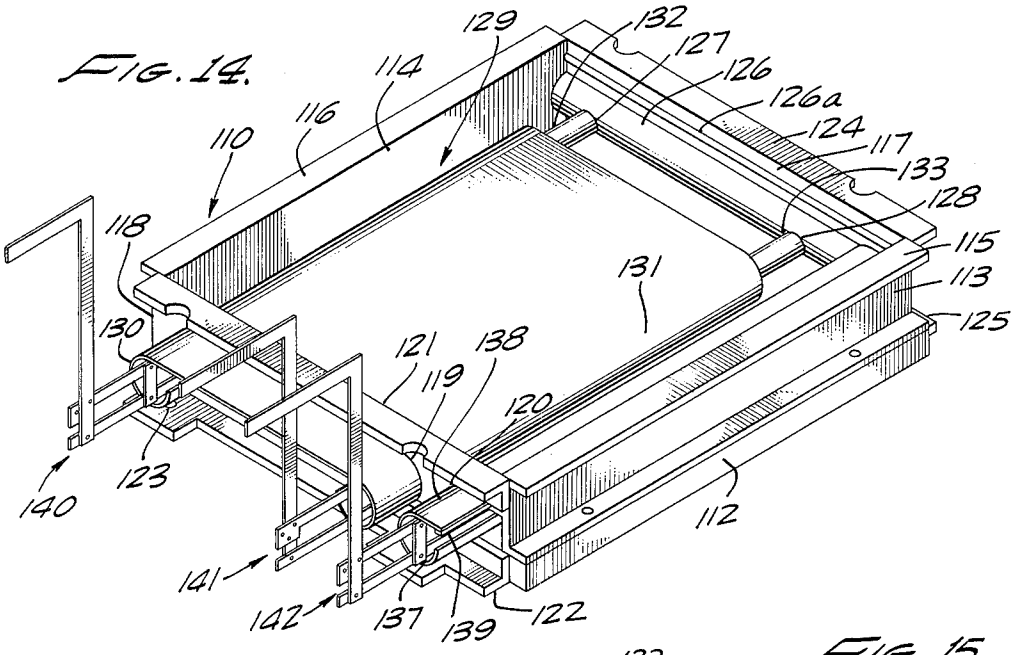
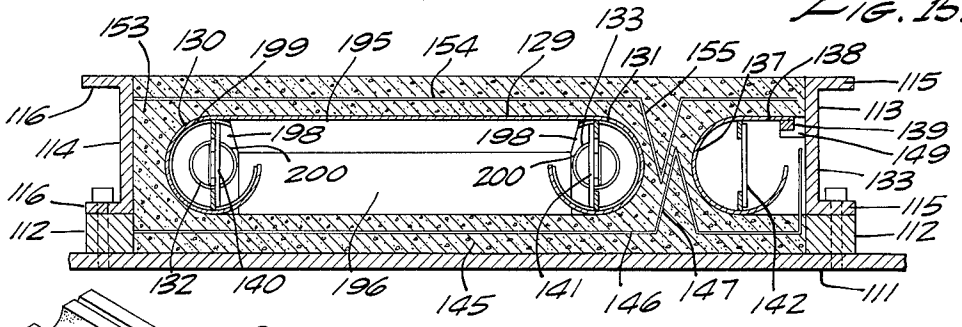


FIG. 15.



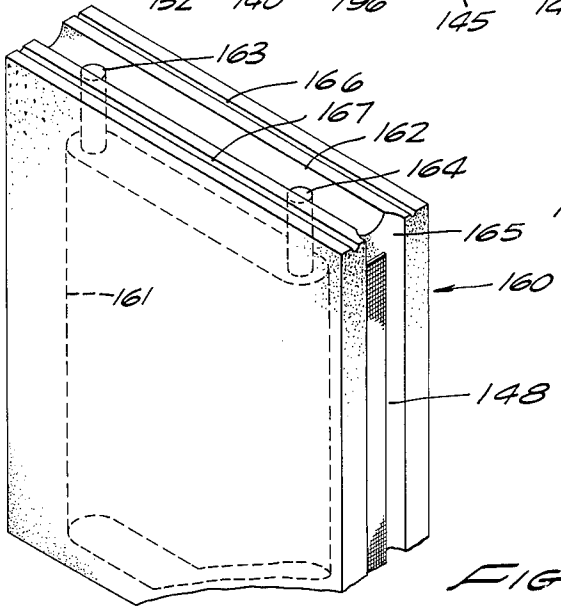
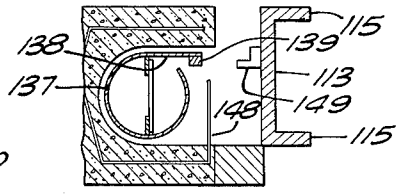


FIG. 19.

FIG. 16.



WILSON E. HAAS
INVENTOR.

BY Lyon & Lyon

ATTORNEYS

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FIG. 17.

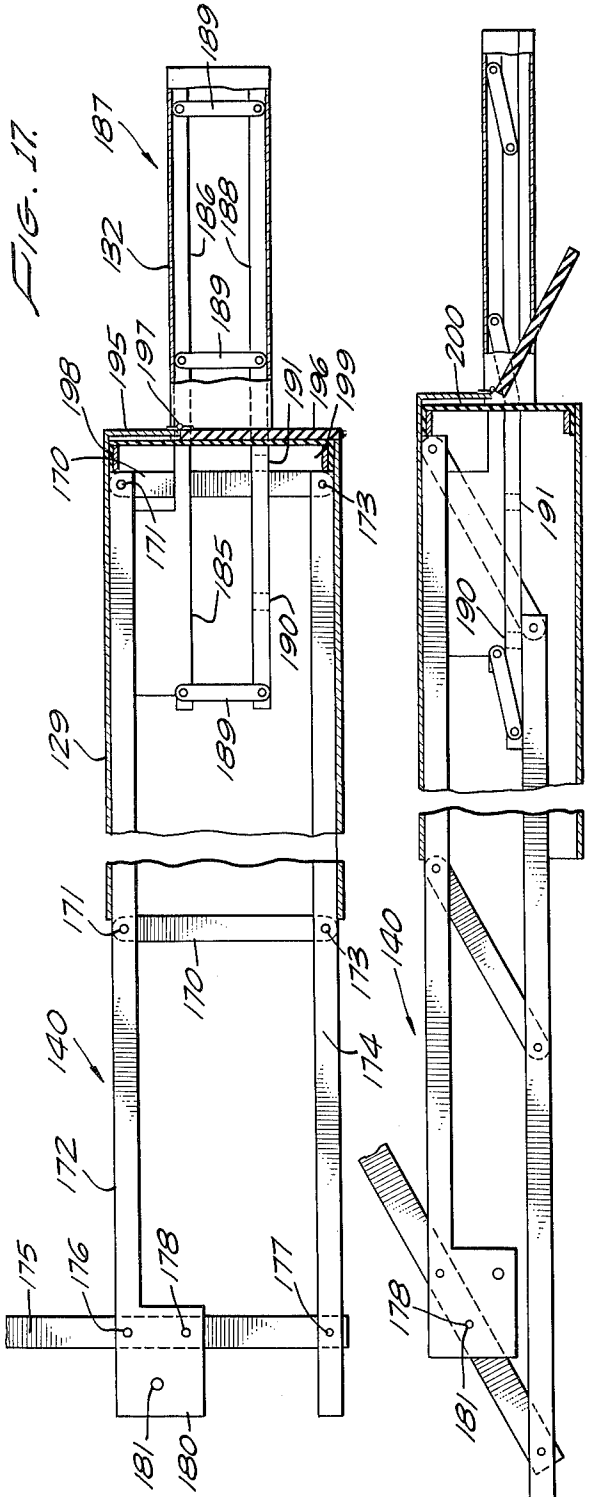
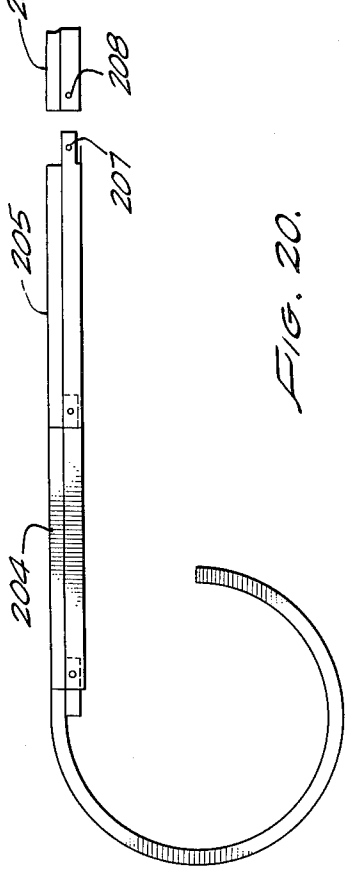


FIG. 18.

FIG. 20.



WILSON E. HAAS
INVENTOR.

BY Lyon & Lyon
ATTORNEYS

United States Patent Office 3,222,749 Patented Dec. 14, 1965

3,222,749

BUILDING CONSTRUCTION

Wilson E. Haas, 1511 Bolero Drive, Santa Barbara, Calif.

Filed Jan. 25, 1963, Ser. No. 255,147
18 Claims. (Cl. 25—121)

This application is a continuation-in-part of my application, Serial No. 170,874, filed February 2, 1962, and now abandoned.

The present invention relates generally to improved apparatus for constructing concrete walls, floors, roofs, and similar elements having hollow cores.

More specifically, the invention relates to the use of an improved type of bottomless, collapsible core mold together with a knockdown form as a means of easily and rapidly casing a concrete panel having hollow cores.

An object, therefore, of the present invention is to provide apparatus for casting concrete walls, floors, roofs, and similar elements which requires a relatively few number of parts and which can be easily used directly at the construction site, thus minimizing the handling and transportation expenses of precast units.

It is a further object of this invention to provide a mold for casting ocncrete walls with hollow cores which mold is readily collapsible, simple to operate, easy to clean, and economical to manufacture, and which can be used in grouped assemblies to cast an entire wall, floor, or roof panel at a time.

It is a further object of the present invention to provide a means for casting a concrete wall which is monolithic and does not require the addition of columns, beams, columns supports or framework and which may be provided with integral passageways for the installation of wiring, plumbing and the like.

It is another object of this invention to provide walls, floors or roofs of light weight and good insulation qualities because of large hollow cores, but of high structural strength because of integral beams, the continuity of reinforcement, homogeneous nature of such few joints as there are, and the ease in which whatever reinforcing members are necessary may be positioned.

Other objects and advantages of the present invention will be more apparent upon reference to the accompanying description and drawings in which:

FIGURE 1 is a partial sectional elevation of the knockdown form according to one embodiment of the present invention and showing a first layer of concrete therein;

FIGURE 2 is a side elevation, partly in section, showing a mechanism for embedding reinforcing mesh in a layer of concrete;

FIGURE 3 is a partial sectional elevation taken along line 3—3 of FIGURE 2, showing the wire mesh embedded in the first layer of concrete;

FIGURE 4 is an elevation, partly in section, of the form of FIGURE 1 showing the core molds in place and the second layer of concrete poured.

FIGURE 5 is a partial side elevation showing the core molds in place;

FIGURE 6 is a sectional view taken substantially along line 6—6 of FIGURE 5;

FIGURE 7 is a fragmentary sectional view taken along line 7—7 of FIGURE 5 showing the details of the spreader of the first embodiment of the invention;

FIGURE 8 is a partial perspective view of the knockdown form of the first embodiment of the present invention;

FIGURE 9 is a partial perspective view of the knockdown form with an inserted and expanded core mold according to the first embodiment of the present invention;

FIGURE 10 is a partial side elevation of the form of the first embodiment of the present invention showing the core mold collapsed;

FIGURE 11 is a partial perspective view of a section of wall made by the apparatus of the first embodiment of this invention;

FIGURE 12 is a fragmentary side elevation showing a modified form of core mold;

FIGURE 13 is a fragmentary side elevation showing another modified form of core mold;

FIGURE 14 is a partial perspective view of a knockdown form and expanded core mold according to a second embodiment of the present invention;

FIGURE 15 is a vertical section of the form and core mold assembly of FIGURE 14 after the concrete has been poured and the wire mesh embedded;

FIGURE 16 is a sectional detail showing the end cavity forming assembly;

FIGURE 17 is a side view, partially in section, showing the mold expander of RIGURE 14 in an expanded position;

FIGURE 18 is a side view, partially in section, showing the mold expander of FIGURE 14 in a collapsed position;

FIGURE 19 is a partial perspective view of a section of wall made by the apparatus of the second embodiment of the present invention; and

FIGURE 20 is a partial end elevation of a modified mold having a variable size jointed top.

Referring now to FIGURES 1 through 11 of the drawings, the knockdown form is generally denoted **10**. A base **11**, which provides bottom support for the concrete, has a plurality of mounting holes **12** by which longitudinal forms are attached to the base **11** with the pins **14**. The longitudinal forms **13** have an upper flange **15** and a lower flange **16** which provide rigidity and further provide a means of mounting the forms on a base. The forms **13** have a plurality of apertures **17** which are flat at the top **18** and bottom **19** and rounded at the sides **20** and **21**. The configuration of the hollow core will be that of the apertures **17** and the same may be varied as desired. The length of the forms **13** and the number of apertures therein can be varied depending upon the size of the wall, floor, or roof to be made. End plates **22** are attached to close the form, and other end plates (not shown) are attached to the other end. The resulting form is open at the top which allows easy access to the interior when working.

With the form thus constructed, a first layer of concrete **23** is poured level with the bottom edges **19** of apertures **17** which layer will constitute one of the wall surfaces. This layer may be quite thin in order to obtain a lightweight wall for easy handling. A reinforcing mesh **24** is spread over layer **23** and is embedded in said layer by a vibratory screed assembly generally denoted **25**. The mesh **24** is provided with preformed folds **26** spaced to coincide with the rib areas **27** and the column areas between the apertures **17**, and the mesh is positioned so that the folds **26** project into the rib areas **27**, the column areas, and the beam areas, to reinforce the same.

The mesh **24** may be simultaneously spread and embedded in concrete layer **23** by the vibratory screed assembly **25** which has a carriage having a platform or bed **28** and four flanged wheels **29** which ride upon the flanges **15** of forms **13**. The tread of the carriage can be adjusted according to the separation of the forms **13**. Rotatably mounted in bracket **30** on platform **28** is a drum **31** about which is wrapped the mesh **24** so that it is unwound through an aperture **31** and spread upon the concrete as the carriage is moved in the direction of the arrows.

It is important that the screed be positioned properly

to level the concrete and to embed the mesh to the right level. Furthermore, the screed must be lifted over the folds **26** so they are not flattened out. An adjustable linkage assembly is provided for these purposes. Pivotally mounted to a bracket **33** on platform **28** is a bell crank **34** having one end slotted as at **35** to which is slidably attached the shaft **36**. The shaft **36** is attached to the piston **37** of actuating cylinder **38**, which is mounted on platform **28** by retaining ring **39**. An adjustable stop **40** is provided in cylinder **38** to limit the extent of movement of piston **37** so that the screed is not raised higher than necessary.

The other end of bell crank **34** is attached to the top member **41** of a parallel motion linkage. Member **41** is pivoted at one end to a bracket **42** attached to platform **28** and at the other end to the screed cylinder **43**. The second member **44** of the parallel motion linkage is pivoted at one end to bracket **45** and at the other end to cylinder **43**. An adjustable stop **46** mounted in tab **47** and, abutting platform **28**, limits downward travel of the screed assembly to a desired level. The parallel motion linkage on cylinder **43** is provided in order to obtain vertical movement of the screed since better leveling of the concrete is obtained thereby.

The screed cylinder **43** provides vibratory action by an electric or pneumatic vibrator (not shown), and the shaft **48** supports the bracket **49** which holds screed **50**. Said screed **50** is a horizontally positioned bar having a flat bottom and extending substantially the entire width of the space between forms **13**. Spaced at intervals along the lower leading edge of screen **50** are a plurality of downwardly projecting fins **51**, the front edges of which are rounded. The fins **51** operate to embed the mesh **24** in the concrete layer **23** as the screed scrapes and levels the same, and said fins are of such length as to position the mesh near the center of the layer **23**. Attached to the forward side of the screed bracket **49** is a switch **52** having its actuating arm or toggle **53** extending downwardly so that it will strike the upwardly projecting mesh folds **26**. The switch **52** is operatively connected to actuating cylinder **38** so that when the toggle **53** strikes the fold **26**, the cylinder operates to move the linkage to lift the screed over the fold as the carriage moves in the direction of the arrows. When the carriage has moved on, the toggle is released from the fold, the cylinder is returned to its starting position and the screed lowered to its proper level again.

The necessity of using a system of the type described to level the concrete and simultaneously spread and embed the mesh resides in a necessity of completing this operation quickly so that the second layer of concrete, to be poured subsequently, will blend with the first layer to form a monolithic structure. The concrete mixture used herein may have low water content to obtain a maximum strength, as the vibratory screed will facilitate spreading.

After the mesh is embedded, as shown in FIGURE 3, a collapsible open core mold **54** is inserted in each of the apertures **17**, as shown in FIGURE 10. The core molds **54** have a top portion **55**, which coincides with the top edge **18** of apertures **17**, and a pair of arcuate side members **56** which coincide, in part, with sides **20** and **21**. The top portion **55** is slotted, permitting projection of mesh folds into column and beam areas as necessary. In the collapsed position, the core mold is of reduced dimension and both the horizontal and the vertical directions due to the inward curling of the resilient sides **56** of the core mold. Such reduction in size facilitates the insertion and extraction of the core mold. To expand the arcuate sides **56** a spreader **57** is provided at each end of core molds and is mounted by hinges **58** secured on the underside of top portion **56** so it will pivot downwardly from the horizontal to the vertical position. The lower corners of spreader **57** have diverging faces **59** which abut the inner projecting ends **60** of arcuate sides **56** as the spreader is swung downwardly (see FIGURE 7) and said diverging faces **59** wedge the arcuate sides **56** outwardly to form a tight fit of the core molds **54** in the apertures **17**, as is shown in FIGURE 9. The spreaders **56** are provided with grips **61** by which the spreaders may be moved.

The curvature of the arcuate sides **56** forms an arc greater than a semicircle to prevent seepage of concrete from the second concrete layer into the interior of the core mold.

When the core molds **54** are in place, a second layer of concrete **63** is poured until level with the top flanges **15** of forms **13**. Reinforcing rods (not shown) may be added in the rib areas **27** before the concrete is poured. A second mesh **64**, having preformed folds **65**, is laid and embedded by the screed apparatus substantially as hereinabove shown and described. The mesh **64** is positioned so that the preformed folds **65** project down into the rib areas **27** where the folds **26** are, thus providing a reinforced tie between the outer and inner concrete layers and similarly the ribs, columns, and the beams.

When the concrete layers **63** and **23** have set sufficiently, the core molds **54** may be collapsed again by moving the spreaders **57** to the horizontal position. Thus collapsed, the core molds are extracted from the apertures **17** leaving hollow cores **66**. The exterior forms **13** and **22** can then be knocked down leaving a completed wall panel.

A modified form of the core mold **54A** is shown in FIGURE 12. The arcuate side members are in two sections **67***a* and **68***a* and they are connected by the hinge **69***a*. The hinge is situated above the horizontal center line of the core mold **54***a*, but below the verticle center line, so that when the section **68***a* is pivoted inwardly an immediate reduction of two dimensions is obtained. If the hinge was placed on the horizontal center line of the core mold, that is, at zero degrees or 180 degrees for the right and left end hinges respectively, the mold could not be reduced in width and therefore could not be withdrawn from the wall. On the other hand, if the hinge was placed on the verticle center line, that is, at 90 degrees the mold side could be reduced in width but it could not swing up and over the concrete which inevitably seeps under the mold and once again the mold could no be withdrawn from the wall. It has generally been found preferable to locate the hinges at 45 degrees and 135 degrees to provide the mold size with maximum possible movement in both directions.

FIGURE 13 shows an additional modification which may be desired when using long core molds which must support a great deal of wet concrete. A corrugated reinforcing **70***b* is secured to the underside of the top portion **55***b*, adding support thereto. The strip **52** is of advantage in reinforcing the molds, particularly long ones.

Turning now to FIGURES 14 through 19, there is shown another embodiment of the present invention. It is often desirable to provide wall panels with integral beams and thereby meet the lateral bracing requirements of building codes without the necessity of erecting other beams, bracing or framework. Also it is often desirable to provide wall panels with integral conduits for electrical wiring, piping and the like. The apparatus shown in FIGURES 14 through 19 is adapted to provide such panels.

Referring now to these figures, a knockdown form is generally indicated at **110**. A base **111** provides bottom support for the concrete and is provided with suitable mounting holes by which the lower portions **112** of end forms are attached to the base **111**. The end forms also have upper portions **113** and **114** which are U-shaped, each having a pair of flanges **115** and **116** respectively. A pair of longitudinal forms **117** and **118** are also mounted on the base **111** to form a complete enclosure.

The longitudinal form **118** has an aperture **119** formed therein, the aperture being flat on the top and bottom

and round at the sides as was the case in the forms 13. The form 118 also has an aperture 120 therein, this aperture also having flat top and bottom surfaces but having only a single rounded surface, the other end of the aperture 120 being open. The form 118 is also provided with upper flanges 121 and lower flanges 122, the lower flanges 122 being provided with holes 123 for attaching the form to the base.

The rear longitudinal form 117 is generally U-shaped and is provided with upper and lower flanges 124 and 125. The base of the U, which forms the actual mold surface, is provided with a central rounded protrusion or ridge 126 which extends along its entire length and, if desired, with a pair of flanking protrusions or ridges 126*a* (only one of which is shown). When the concrete has been poured, the ridge 126 will form a conduit in the upper wall surface suitable for carrying wiring, piping or other utilities while the ridges 126*a* will form channels for carrying sealing compounds or the like. The protrusion or ridge 126 is provided with a pair of apertures or indentations 127 and 128 for a purpose to be described presently.

A bottomless, collapsible core mold, generally indicated at 129, is shown inserted in the aperture 119 of the form 118. As was the case with the molds shown and described previously, this mold has a flat upper surface and a pair of arcuate side portions 130 and 131. Unlike the molds shown previously, however, the mold 129 is provided with extensions 132 and 133 which extend into the apertures 127 and 128 of the protrusion 126. These extensions 132 and 133 provide integral internal conduits for passing utility lines of various types vertically through the beams, and also support one end of the mold.

A second form 137 is inserted in the aperture 120 and is provided with a slot or other suitable means at its rearmost section to cooperate with the protrusion or ridge 126 in the form 117 and prevent concrete from entering into the form 137. The mold 137 is generally arcuate in shape but is provided with a flat upper surface 138 which has a reinforced edge portion 139 fastened thereto. This mold serves to form an end cavity which may be filled with concrete and reinforcement to join the wall section to another wall section, thereby providing a strong joint without the necessity of erecting form work or making a welded connection. The molds 129 and 137 are shown in an expanded condition, three expanders generally indicated at 140, 141, and 142 being used for this purpose. These expanders will be explained more fully in connection with FIGURES 17 and 18.

The wall panel is assembled in essentially the same manner as previously described. A first layer of concrete 145 is poured level with the bottom of the aperture 119 and the top of the lower portions 112 of the end forms, the height of these two elements preferably being the same. A reinforcing mesh 146 having preformed folds 147 is embedded in the the layer 145 by a vibratory screed assembly similar to that shown in FIGURE 2. The mesh 146 may, if desired, be provided with an end fold 148 which extends into the end cavity 120.

The core molds 129 and 137 are now inserted into the apertures 119 and 120, the ends of the extensions 132 and 133 of the mold 129 being inserted into the apertures 127 and 128 in the end form protrusion or ridge 126. The upper portions 113 and 114 of the end forms are now fastened in place on the lower portions 112. As can be seen from FIGURES 15 and 16, the upper portion 113 is provided with an interior ledge 149 which cooperates with the reinforced edge 139 of the end cavity mold 137 and thus supports the top 138 of the mold against the weight of the concrete that is disposed upon it. After the molds have been inserted in place and expanded by means of the expanders 140 and 141 and 142, a second layer of concrete 153 is poured and a second reinforcing mesh 154 with preformed folds 155 is embedded in this layer of concrete.

After the concrete has set sufficiently, the molds 129 and 137 are collapsed and removed from the forms and the wall. The forms can then be knocked down, leaving a wall section of the configuration shown in FIGURE 19. As can be seen, the wall panel 160 has an integral beam 160*a* running along the top of the panel above the central cavity 161. A channel 162 is formed in the beam 160*a* and is joined to the central cavity 161 by passageways 163 and 164 extending through the beam 160*a*. These various openings were of course formed by the mold 129, the mold extensions 132 and 133 and the protrusion 126.

The side of the wall panel 160 is also provided with a channel 165 communicating with the channel 162. The end fold 148 of the reinforcing mesh 146 extends into this channel. Two smaller channels 166 and 167 also run across the top of the wall panel parallel to the channel 162 and serve to hold a caulking or sealing compound so that a joint between the wall panel and a roof member can be easily and effectively sealed. These channels are formed by the ridges 126*a* on the inner surface of the longitudinal mold 117.

Referring now to FIGURES 17 and 18, there are shown the two positions of the expanders 140 and 141. Each of the expanders 140 and 141 is provided with a plurality of legs 170, the tops of which are pivotally fastened by pins 171 to a stringer 172 and the bottoms of which are pivotally fastened by pins 173 to a spreader 174. A handle 175 is also pivotally connected to the stringer 172 by pin 176 and is pivotally mounted to the spreader 174 by a pin 177.

The handle 175 is provided with a spring pin 178 which enters a hole 179 in an expanded end portion 180 of the stringer 172. This spring pin 178 serves to keep the handle upright when the expander is in an expanded position. The portion 180 of the stringer 172 is also provided with a second hole 181 which cooperates with the spring pin 178 to keep the expander rigid when it is in its collapsed position. The elements just described are all that are necessary for the expander 142. The expanders 140 and 141, however, require further apparatus for cooperation with the expansion molds 132 and 133.

Attached to the front portion of each of the stringers 172 of these expanders is a block 185 which comprises the rear portion of a stringer 186 of an extension expander 187. The extension expander 187 also has a spreader 188 and a plurality of pivotally mounted legs 189 connecting the stringer 186 to the spreader 188. The spreader 188 is provided with a pair of studs 190 and 191 for cooperation with the furthermost leg 170 of the expander 140.

The mold 129 is provided on its forward edge with a downwardly depending flange 195 which extends substantially along the entire length of the flat top portion of the mold 129. A flap 196 is connected to the flange 195 by means of one or more hinges 197 which enable the flap 196 to pivot outwardly from the mold 129. The ends of the arcuate portions 130 and 131 of the mold 129 are covered with flexible diaphragms 198 which are held in place by flexible rings 199 which conform to the inner shape of the portions 130 and 131. The diaphragms 198 are provided with central apertures 200 which receive and engage the ends of the mold extensions 132 and 133. The mold extensions 132 and 133 are made of resilient material that forms an arc greater than 360 degrees so that the material overlaps itself when in both the collapsed position and the expanded position.

After the molds have been inserted into the form, the expanders are positioned and the handles 175 brought to a vertical position. This causes the legs 170 to assume a vertical position, separating the stringer 172 and spreader 174 and thereby expanding the arcuate sections 130 and 131 of the mold 129. With the expanders 140 and

141, the movement of the furthermost leg 170 to a vertical position cause it to engage the stud 191 on the spreader 188 of the extension expander 187 with the result that it moves along its longitudinal axis, causing the legs 189 to assume an upright position. This causes the expansion of the extension molds 132 and 133 to their expanded position.

Expansion of the mold 129 enables the flap 136 to pivot downwardly to its vertical position and, together with the diaphragms 198, prevent concrete from entering into the mold from the front. When the concrete is poured, the integral beam 160*a* is formed between the flange 195, flap 196 and diaphragms 198 on one side, and the form 117 on the other side. After the concrete has been poured and set, the handle 175 is pushed forward with the result the spreader 174 moves to the rear and the legs 170 collapse. As the furthermost leg 170 collapses, it engages the stud 190 causing the spreader 188 to move to the rear and the legs 189 to collapse allowing the extension mold 132 to resume is contracted shape. Slight movement of the mold 129 causes the flap to pivot outwardly and the entire mold structure and expanders can be removed from the wall section.

FIGURE 20 illustrates a modified mold which is useful in either of the embodiments of the present invention previously described. In this mold, the flat upper surface is made of a plurality of sections 204, 205 and 206. Each of these sections is provided with a pin 207 and a socket 208 by means by which they may be joined together and to the arcuate side portions of the mold, thus enabling the mold to be constructed with any desired width. It should be understood that the mold modification shown in FIGURES 12 and 13 are equally applicable to either of the embodiments of the invention shown and described.

It should be also be understood that any number of mold supporting apertures could be provided in the forms and not just the limited number illustrated, and that these apertures could be provided with any convenient dimensions or shapes, so long as the molds used could conform to them. Other apparatus could be used to expand the various molds within the scope of the present invention, as could other procedures for pouring concrete, with or without reinforcing meshes.

As can be seen from the foregoing description, inexpensive and convenient apparatus has been provided for forming concrete wall, floor and roof panels having hollow cores therein. The core forming molds according to the present invention, being bottomless, require considerably less material in their manufacture and thus are cheaper than those heretofore known. The simplicity and ease in handling the present apparatus enable the panels to be constructed at the building site, and thus reduce costs further by eliminating transportation expenses. The panels can be easily reinforced, if necessary, and thus a structure of any required strength may be constructed with them.

The invention may be embodied in other specific forms not departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

I claim:

1. A mold for poured concrete construction comprising: a base, an opposed pair of longitudinal apertured forms attached to said base and a pair of end plates, collapsible open core molds inserted in said apertures each having a top portion and a pair of resilient arcuate side members the edges of which project inwardly, side spreader means in said core molds including substantially flat rectangular plates pivotally attached to the top portion of said core molds at each end thereof, said spreader means having diverging faces which engage the inner projecting edges of said arcuate side members to spread the same outwardly when said spreader is in the vertical position, the curvature of said resilient arcuate side members being such as to allow a simultaneous decrease in both the horizontal and vertical dimensions when the spreader is moved to the horizontal position so that the core mold is easily extracted from or inserted into the said apertured forms, the curvature of the said side portions constituting an arc greater than a semicircle when in the expanded position and the inner edge of said side portions having a flange to restrict the seepage of concrete into the interior of the core.

2. A mold for poured concrete construction comprising: a base, an opposed pair of longitudinal apertured forms attached to said base and a pair of end plates, collapsible open core molds inserted in said apertures, each having a top portion and a pair of resilient arcuate side members the edges of which project inwardly, said arcuate side members having a pivotal joint therein, side spreader means in said core molds including substantially flat rectangular plates pivotally attached to the top portion of said core molds at each end thereof, said spreader means having diverging faces which engage the inner projecting edges of said arcuate side members to spread the same outwardly when said spreader is in the vertical position, the pivotal joint and the resilience of said arcuate side members combining to allow a signficant simultaneous decrease in both horizontal and vertical dimensions when the spreader is moved to the horizontal position so that the core mold is easily extracted from or inserted into the said apertured forms, the curvature of the said side portions constituting an arc greater than a semicircle when in the expanded position sufficient to restrict the seepage of any concrete into the interior of the core.

3. A mold for poured concrete construction comprising: a base, an opposed pair of longitudinal apertured forms attached to said base and a pair of end plates, collapsible open core molds inserted in said apertures, each having a top portion and a pair of resilient arcuate side members the edges of which project inwardly, said top portion provided with a corrugated reinforcing means on the underside thereof, said arcuate side members having a pivotal joint therein, side spreader means in said molds including substantially flat rectangular plates pivotally attached to the top portion of said molds at each end thereof, said spreader means having diverging faces which engage the inner projecting edges of said arcuate side members to spread the same outwardly when said spreader is in the vertical position, the pivotal joint and the resilience of said arcuate side members combining to allow a significant simultaneous decrease in both horizontal and vertical dimensions when the spreader is moved to the horizontal position so that the mold is easily extracted from or inserted into the said apertured forms, the curvature of the said side portions constituting an arc greater than a semicircle when in the expanded position and prevent the seepage of any concrete into the interior of the mold.

4. Apparatus for casting concrete panels having hollow cores, comprising in combination: a base; a pair of end forms attachable thereto; a pair of longitudinal forms attachable to said base and cooperating with said end forms to form an enclosure for receiving a first layer of concrete; at least one of said longitudinal forms having an aperture therein; a collapsible, bottomless mold for insertion into said aperture, said mold having a top portion and resilient arcuate side members, the curvature of said arcuate side members constituting an arc greater than a semicircle when in an expanded position and being such that the mold in a collapsed position is of lesser dimension in both the vertical and horizontal planes than said aperture; said top portion being a discontinuity

in the arcs of said side members; expander means for insertion into said mold, said expander means operable in a first position to expand said mold to an expanded position in said aperture whereby said enclosure may receive a second layer of concrete to a level above the top portion of said mold, and operable in a second position to simultaneously collapse said mold in both the vertical and horizontal dimensions whereby it may be removed from the hollow core formed thereby through said aperture.

5. Apparatus for casting concrete panels having hollow cores, comprising in combination: a base; a pair of end forms attachable thereto; a pair of longitudinal forms attachable to said base and cooperating with said end forms to form an enclosure for receiving a first layer of concrete; a bottomless, collapsible mold; one of said longitudinal forms having an aperture therein for receiving said mold, the other longitudinal form having means to support said mold in position relative to said base; said mold having a top portion and resilient arcuate side members, the curvature of said arcuate side members constituting an arc greater than a semicircle when in an expanded position so that the inwardly projecting edge restricts seepage of concrete into said mold, the curvature being such that the mold in a collapsed position is of lesser dimension in both the vertical and horizontal planes than said aperture; said top portion being a discontinuity in the arcs of said side members; and expander means for insertion into said mold, said expander means operable in a first position to expand said mold to an expanded position in said aperture whereby said enclosure may receive a second layer of concrete to a level above the top portion of said mold, and operable in a second position to simultaneously collapse said mold in both the vertical and horizontal dimensions whereby it may be removed from the hollow core formed thereby through said aperture.

6. Apparatus for casting concrete panels having hollow cores, comprising in combination: a base; a pair of end forms attachable thereto; a pair of longitudinal forms attachable to said base and cooperating with said end forms to form an enclosure for receiving a first layer of concrete; a bottomless, collapsible mold, said mold including a main section having a top portion and resilient arcuate side members, and an extended arcuate section, the curvature of said extended section constituting an arc greater than 360°; said resilient side members of said main section being collapsible to reduce the size of the mold; one of said longitudinal forms having an aperture therein for receiving said mold and supporting said main section thereof; the other of said longitudinal forms having an opening for receiving and supporting the extended section of said mold; and expander means for insertion into both sections of said mold, said expander means operable to expand or collapse said mold.

7. Apparatus for casting concrete panels having hollow cores, comprising in combination: a base; a pair of end forms attachable thereto; a pair of longitudinal forms attachable to said base and cooperating with said end forms to form an enclosure for receiving a first layer of concrete; a bottomless, collapsible mold, said mold including a main section having a flat top portion and resilient arcuate side members collapsible to reduce the size of the mold and a flexible diaphragm mounted on one end of said main section, and an extended arcuate section mounted on said diaphragm, the curvature of said extended section constituting an arc greater than 360°; one of said longitudinal forms having an aperture therein for receiving said mold and supporting said main section thereof, the other of said longitudinal forms having an opening for receiving and supporting the extended section of said mold; and expander means for insertion into both sections of said mold, said expander means operable in a first position to expand said mold to an expanded position whereby said enclosure may receive a second layer of concrete to a level above the top portion of said mold, and operable in a second position to collapse said mold whereby it may be removed through said aperture from the hollow core formed thereby.

8. Apparatus for casting concrete panels having hollow cores, comprising in combination: a base; a pair of end forms attachable thereto; a pair of longitudinal forms attachable to said base and cooperating with said end forms to form an enclosure for receiving a first layer of concrete; a bottomless, collapsible mold, said mold incluuding a main section having a flat top portion and resilient arcuate side members collapsible to reduce the size of the mold in both horizontal and vertical directions and a flexible diaphragm mounted on an end of the main section, and an extended arcuate section mounted on said diaphragm, the curvature of said extended section constituting an arc greater than 360°; one of said longitudinal forms having an aperture therein for receiving said mold and supporting said main section thereof, the other of said longitudinal forms having a protrusion formed on its inner surface and extending from one end form to the other, said protrusion having an opening therein for receiving and supporting said extended section of said mold; and expander means for insertion into both sections of said mold, said expander means operable in a first position to expand said mold to an expanded position whereby said enclosure may receive further concrete between said main mold section and said other longitudinal form and covering said mold to a level above the top portion of said mold, and operable in a second position to collapse said mold whereby it may be removed through said aperture from the hollow core formed thereby.

9. The apparatus of claim 8 wherein a second aperture is provided in one end of said one longitudinal form, said second aperture receiving a second mold having a flat top surface for cooperation with one of said end forms, and a resilient, arcuate side member, the curvature of said arcuate side member constituting an arc greater than a semicircle when in an expanded position, and wherein an expander means is provided for expanding said second mold.

10. The apparatus of claim 8 wherein said expander means comprises a plurality of expanders, each of said expanders comprising first and second horizontal members, a plurality of legs joining said members and being pivotally connected to each of said members, a handle pivotally connected to each of said members, third and fourth horizontal members, said third horizontal member being fixedly connected to said first horizontal member and extending therebeyond, a second plurality of legs joining said third and fourth members and being pivotally connected to each of said third and fourth members, and first and second studs mounted on said fourth member on either side of one of said first plurality of legs whereby movement of said hand in a first direction causes said first plurality of legs to assume a vertical position, movement of said one leg against said first stud causing said fourth member to move and thereby causing said second plurality of legs to assume a vertical position, and movement of said handle in another direction causing said first plurality of legs to move from said vertical position, movement of said one leg against said second stud causing said fourth member to move thereby causing said second plurality of legs to move from said vertical position.

11. A bottomless, collapsible mold for use in conjunction with knockdown forms in the casting of concrete panels having hollow cores, comprising: a main section including a flat top member, a pair of arcuate side members connected to said top member, the curvature of said arcuate side members constituting an arc greater than a semicircle when in an expanded position, said side members being collapsible to reduce the size of the mold in both the horizontal and vertical dimensions and a flexible diaphragm connected to one end of said main section; and an arcuate resilient extended section mounted on said

diaphragm, the curvature of said extended section constituting an arc greater than 360°.

12. A bottomless collapsible mold for use in conjunction with knockdown forms in the casting of concrete panels having hollow cores, comprising: a main section including a flat top member having a downwardly descending flange at one end thereof, a pair of arcuate side members connected to said top member, the curvature of said arcuate side members constituting an arc greater than a semicircle when in an expanded position, said side members being collapsible to reduce the size of the mold in both the horizontal and vertical dimensions, a pair of flexible diaphragms connected to the ends of said side members adjacent to said flange, and a flap hingedly mounted on said flange and positioned between said diaphragms; and a pair of arcuate, resilient extended sections, each of said sections mounted on one of said diaphragms, the curvature of each of said extended sections constituting an arc greater than 360°.

13. A bottomless, collapsible mold for use in conjunction with knockdown forms in the casting of concrete panels having hollow cores comprising: a top portion and a pair of resilient arcuate side members the edges of which project inwardly, side spreader means attached to said top portion at either end thereof, said spreader means including substantially flat rectangular plates having diverging faces which engage the inner projecting edges of said arcuate side members to spread the same outwardly when said spreader is in the vertical position, the curvature of said resilient arcuate side members being such as to allow a simultaneous decrease in both the horizontal and vertical dimensions when the spreader is moved to the horizontal position so that the mold is easily extracted from or inserted into said knockdown forms, the curvature of the said side portions constituting an arc greater than a semicircle when in the expanded position and the inner edge of said side portions having a flange to restrict the seepage of concrete into the interior of the core.

14. A bottomless, collapsible mold for use in conjunction with knockdown forms in the casting of concrete panels having hollow cores, comprising: a main section including a flat top member, a pair of arcuate side members connected to said top member, said arcuate side members each having a pivotal joint therein, each of said pivotal joints being positioned at a point above the horizontal center line and intermediate the horizontal and vertical center lines of its respective arcuate side member whereby said side members are collapsible to simultaneously reduce the size of the mold in both the horizontal and vertical dimensions, the curvature of said side members constituting an arc sufficiently greater than a semicircle to restrict the seepage of concrete into the interior of the core when in an expanded position.

15. The mold of claim 14 wherein said pivotal joints are positioned on the radii of each of said arcs at approximately 45° relative to the horizontal center line thereof.

16. The apparatus of claim 14 wherein said mold is provided with side spreader means including substantially flat rectangular plates pivotally attached to the top portion of said core mold at each end thereof, said spreader means having diverging faces which engage the inner projecting edges of said arcuate side members to wedge the same outwardly when said spreader is in the vertical position.

17. A mold for poured concrete construction comprising: a base, an opposed pair of longitudinal apertured formed attached to said base and a pair of end plates, collapsible open core molds inserted in said apertures each having a top portion and a pair of resilient arcuate side members the edges of which project inwardly, each of said arcuate side members having a pivotal joint therein, each of said pivotal joints being located intermediate the vertical and horizontal center lines of its respective side member, side spreader means in said core molds including substantially flat rectangular plates pivotally attached to the top portion of said core molds at each end thereof, said spreader means having diverging faces which engage the inner projecting edges of said arcuate side members to spread the same outwardly when said spreader is in the vertical position, said pivotal joints and the resilience of said arcuate side members combining to allow a simultaneous decrease in both horizontal and vertical dimensions when the spreader is in the horizontal position so that the core mold is easily extracted from or inserted into said apertured forms, the curvature of said side portions constituting an arc greater than a semicircle when in the expanded position and the inner edge of said side portions having a flange to restrict the seepage of any concrete into the interior of the core.

18. The mold of claim 17 wherein said pivotal joints are positioned at approximately 45° and 135°.

References Cited by the Examiner

UNITED STATES PATENTS

1,442,691	1/1923	Lyman	25—131.5
1,708,555	4/1929	Smith	25—154
1,964,386	6/1934	Nose	25—128
1,996,678	4/1935	Leggat et al.	25—128
2,192,183	3/1940	Deutsch	25—128
2,077,356	3/1950	Day	94—48
2,630,614	3/1953	Peterson	25—128
2,950,659	8/1960	Smiley	94—48

FOREIGN PATENTS

321,857	1/1903	France.
292,425	6/1928	Great Britain.
568,820	4/1945	Great Britain.
587,255	4/1947	Great Britain.
629,611	9/1949	Great Britain.

WILIAM J. STEPHENSON, *Primary Examiner.*

ROBERT F. WHITE, *Examiner.*