April 27, 1965 C. L. WOODWORTH 3,179,999

PORTABLE CASTING FORM FOR ROOF TILES

Filed May 22, 1961

FIG. 1.

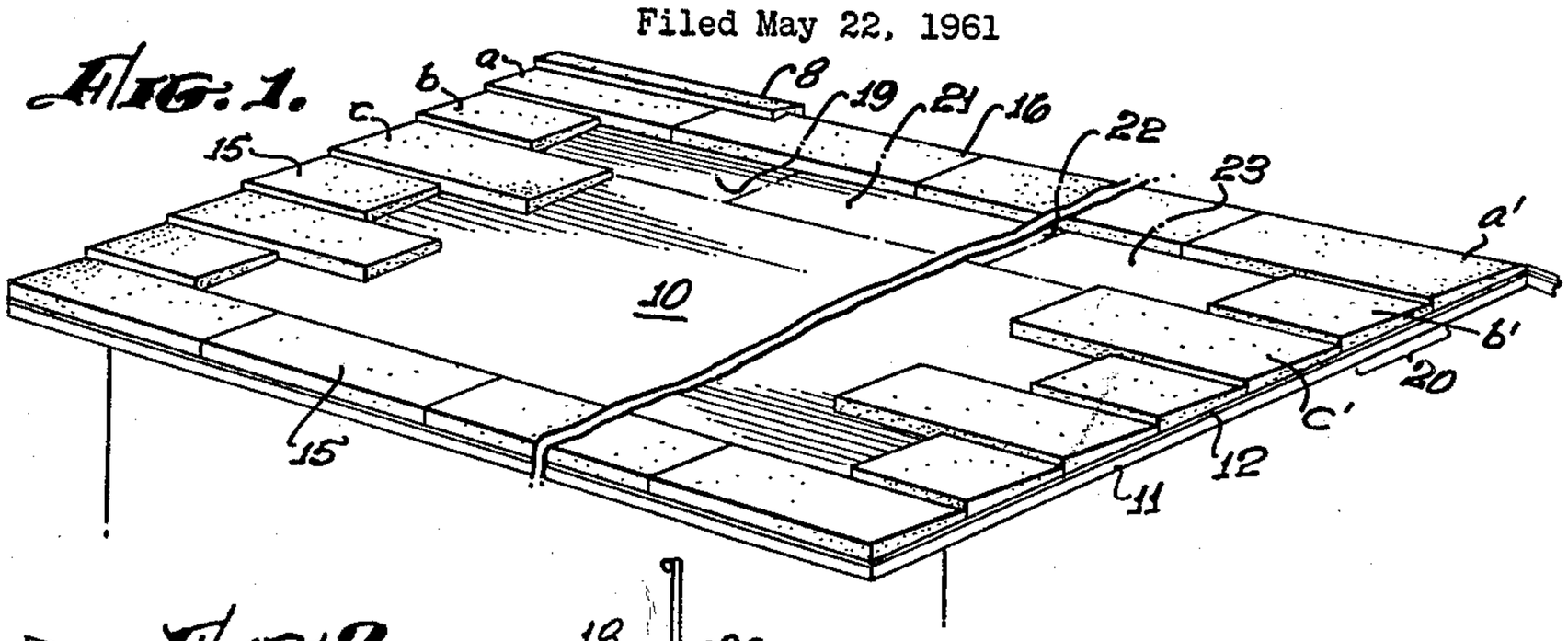

FIG. 3.

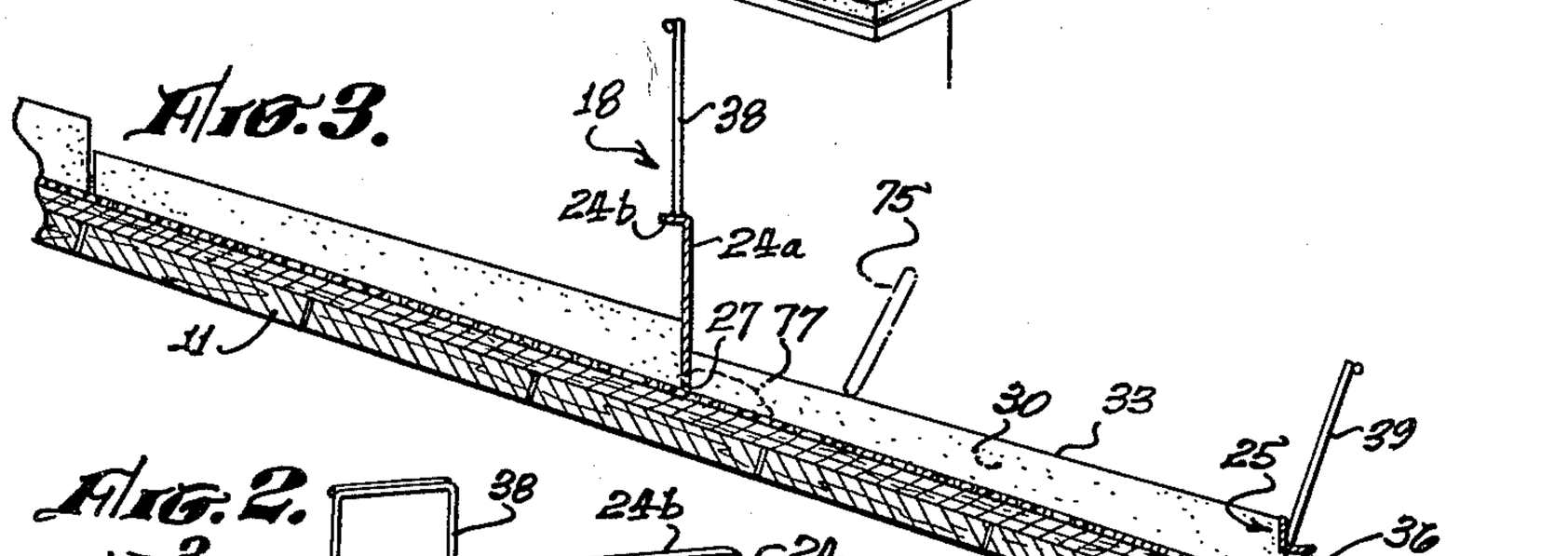

FIG. 2.

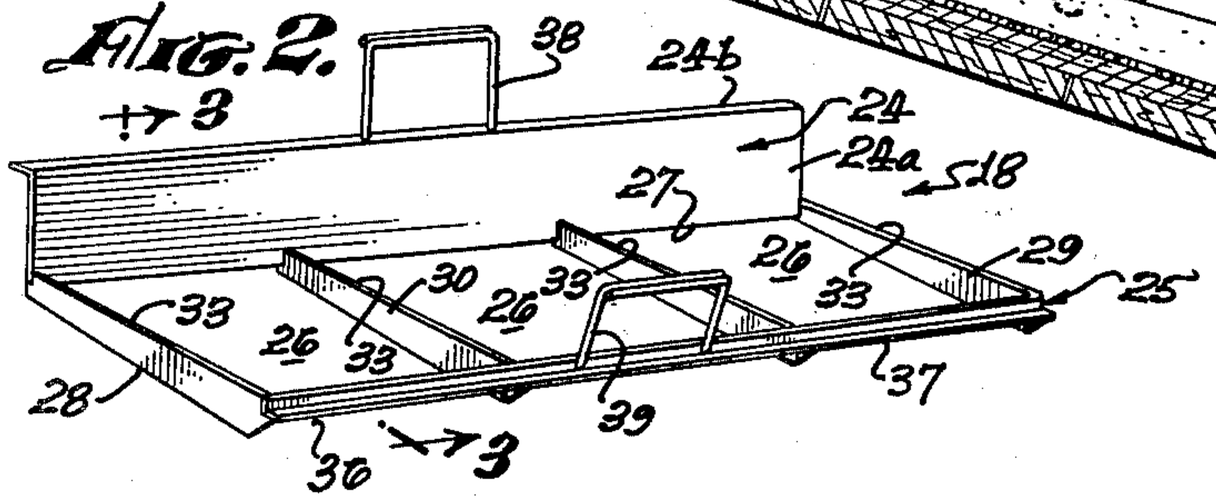

FIG. 5.

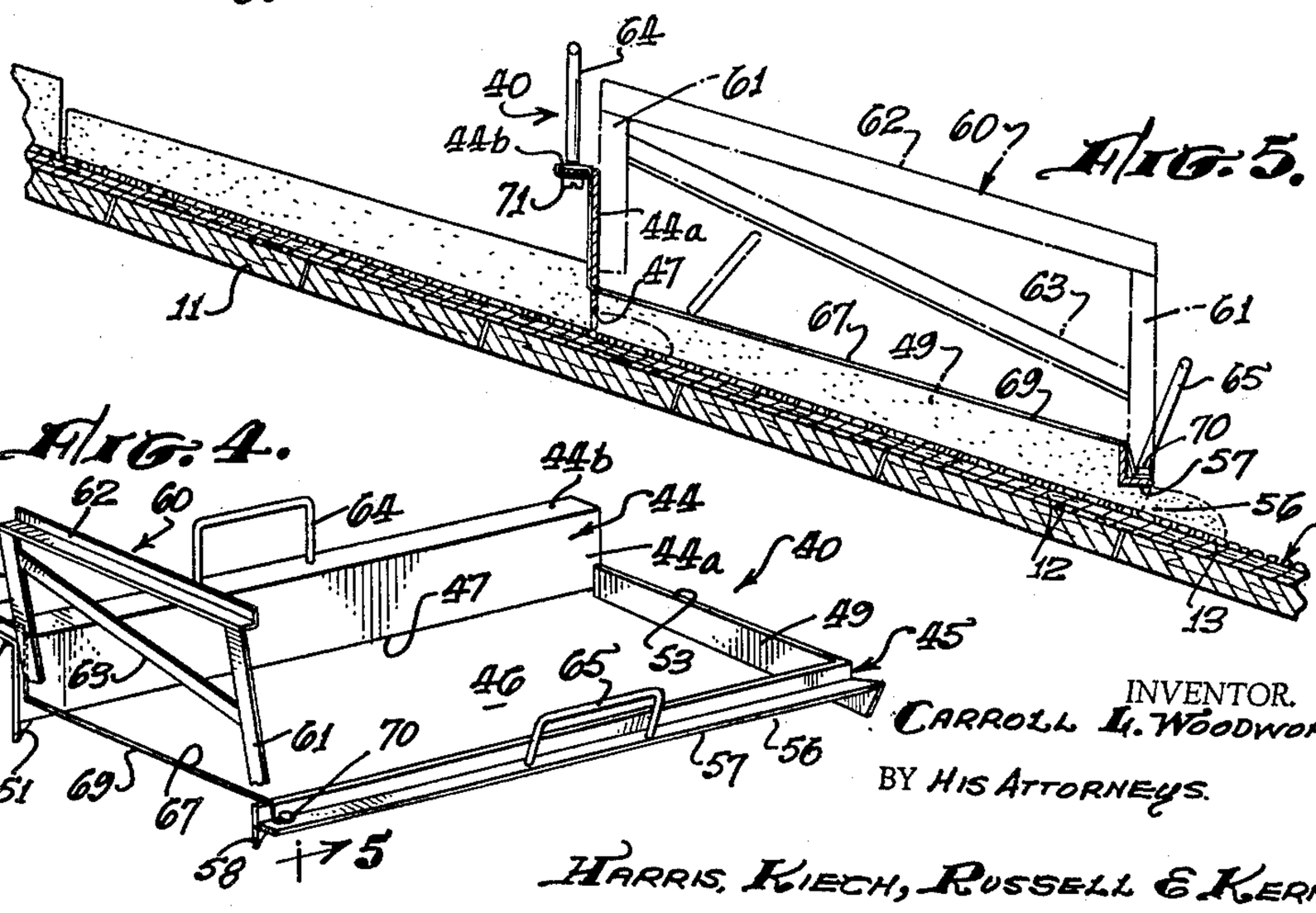

FIG. 4.

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PORTABLE CASTING FORM FOR ROOF TILES

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My invention relates to a method and apparatus for forming a roof surface on a sloping support surface by casting roof tiles of cementitious material in situ on such support surface in adjacent positions. It relates also pouring forms which can be shifted from position to position to form such tiles in sequence.

It is an object of the invention to cast in place a lateral series of cementitious tiles on adjoining areas of a lateral band of the support surface, starting at an upper elevation and progressing to bands at lower elevations; also to provide a pouring form which can be easily moved along a band to form the successive tiles of a lateral course and which can be easily lifted after filling without tearing or damaging the freshly cast tile.

Another object is to provide a roof surface composed largely of tiles cast in place on an irregular or knobby support surface so as to lock thereto and require no other attachment to the sloping support surface. In this connection it is an object to form relatively large tiles, usually rectangular, of sufficient thickness to be held in place substantially exclusively by their weight and their interlock with the knobby support surface.

A further object is to provide a roof in which the tiles as cast or as subsequently scored are substantially independent of each other in the sense that each tile can expand and contract independently of adjoining tiles whereby expansion and contraction will not tear or destroy the waterproof support surface therebeneath.

Another object is to provide a pouring form that provides a spill-out space producing a spill-out portion of the cementitious material extending into the zone of a subsequently cast tile. A further object is to cast the subsequent tile over such spill-out portion.

Still another object is to provide a pouring form which has one or more scoring edges that dip into previously-cast but yet-unset cementitious material to score the material at one or more positions adjacent the periphery of each tile, this scoring being to a depth near or to the support surface.

A further object is to provide such a pouring form that will cast Bermuda-type tiles thicker at their lower edges than at their upper edges so as to expose a portion of the former to the weather along the common boundary of two lateral courses and provide a lateral shadow line.

Another object is to cast tiles in areas of a support surface adjoining precast peripheral tiles at the ends of a lateral course. A further object is to make possible, if desired, the pouring of cementitious material in covering relationship with a precast peripheral tile.

Further objects and advantages will be apparent to those skilled in the art from the following description of exemplary embodients of the invention.

Referring to the drawing:

FIG. 1 is a perspective view of a small roof area showing the precast peripheral tiles in position;

FIG. 2 is a perspective view of a pouring form of the invention used in casting a majority of the tiles in a course;

FIG. 3 is a sectional view of a roof showing the pouring form of FIG. 2 in use in casting the tiles of a second course below a previously-cast course, the pouring form being shown in section as taken along the lines 3—3 of FIG. 2;

FIG. 4 is a perspective view of another pouring form

of the invention, usually employed at the end of a course; and

FIG. 5 is a view similar to FIG. 3 showing the pouring form of FIG. 4 in use in casting the end tile of a second course, the pouring form being shown in section as taken along the lines 5—5 of FIG. 4.

The invention can be applied to produce a weather-exposed roof surface overlying any sloping support surface 10 but finds greatest applicability in forming gently sloping roofs having pitches within the general range about 6 to 12. It will be described as applied to the production of tiles forming a Bermuda-type or shingle-effect roof, usually over conventional roof sheathing 11 suggested in FIGS. 3 and 5.

The roof should be made waterproof before casting the tiles as the latter are not relied upon for water tightness. Referring particularly to FIG. 3 it is preferable to coat the roof sheathing 11 with several layers of asphalt mopped roofing felt 12 for waterproofness. The surface is then preferably lightly coated with aggregate 13 applied to an asphalt-, pitch- or plastic-mopped surface of the roofing felt 12 to provide a knobby support surface for the tiles. In the preferred practice somewhat flat particles of ore or light-weight material are used, desirably particles that will not puncture the felt 12 when walked upon before the tiles are cast. Pea-size gravel may be employed as the aggregate but in all instances it is desirable to employ generally round gravel particles as distinct from particles having sharp edges which might tend to cut the roofing felt 12. The aggregate particles are sprinkled on the soft asphalt so that the lower portions of the particles embed therein and the upper portions remain exposed. It should be understood however that the invention comprehends the pouring of the tiles on any knobby surface whether made in this manner or whether containing other undulations made for example by scratching, scoring or serrating a surface. The later-cast cementitious material adheres to the knobby surface and the cementitious material at the bottom of the tile will have crests and valleys conforming to the valleys and crests of the knobby surface. This anchoring aids the weight of the cast tiles in maintaining same in position without other attachment.

In the preferred practice of the invention precast peripheral tiles 15 are suitably attached in slightly spaced relationship in any conventional manner to the thus-prepared support surface 10 along its sides and bottom. Some of these tiles are designated by the letters *a*, *b*, *c* and *a'*, *b'*, and *c'* for later reference. A row of precast ridge tiles 16 can also be applied near the roof ridge between the tiles *a* and *a'* or these can be cast in place by use of the pouring forms of the invention if desired. Precast tiles are usually applied at gables, eaves and valleys of a roof.

These precast tiles may be of the same cross-sectional shape as the tiles to be cast but for uniformity of texture it is preferred that the precast tiles be thinner and later covered by a layer of the cementitious material. The invention will be described with reference to the casting of tiles that are about 2" thick at the lower edge and about 1" thick at the upper edge although it should be understood that these dimensions are merely exemplary and that tiles of various uniform or tapering thicknesses can be cast by use of the invention. With tiles of such exemplified height the precast peripheral tiles 15 and 16 may be of a thickness at least ¼" less, providing a rough overlay surface on which the cementitious material can be poured and adhered to build up the height of the peripheral tiles to that of the cast tiles. The peripheral tiles 15 may be of uniform length but are staggered in length in the embodiment of FIG. 1.

The cast tiles of the invention are progressively cast in lateral courses, starting at or near the top of the roof. A straight or closed-end pouring form **18**, illustrated in FIG. 2, is used to form most of the tiles in a course starting at either end, the last tile of the course being formed by a pouring form of the type suggested in FIG. 4. The invention will be described with reference to a sequence in which the pouring is started in a lefthand area **19** of a lateral band **20** just below the peripheral tiles **16** and progressing through areas **21**, **22**, etc. to a right-hand area **23** of the band **20**. Lower courses are cast in the same direction as the first or upper course.

Various cementitious materials can be employed in casting the tiles depending upon the desired weight, texture, porosity, etc. of the ultimate tile. It is preferred that the cementitious material should assume an initial set or become form retaining in a relatively short period of time so that the pouring form can be lifted rather promptly and moved to an adjoining area of the band being covered. A cementitious material that has been found very satisfactory is made by mixing one bag of Portland cement, four pounds of asbestos floats, and about two bags of aggregate. The latter may be a conventional sand-rock aggregate if heavy tiles are desired or may be light-weight aggregate such as perlite, shale, vermiculite, etc. for tiles of lesser weight. The asbestos floats (finely subdivided asbestos) serve to give the mixture more body and ability to maintain its shape when the pouring form is removed. They also permit pumping of the cementitious material at stiffer consistency if this type of displacement is desired. It should be understood however that binders other than Portland cement can be used, e.g. foam concretes alone or with other aggregates, plastics alone or with other aggregates, etc.

Referring particularly to FIGS. 2 and 3, the pouring form **18** includes an upper upright right form member **24** and a lower upright form member **25** held in parallel spaced relation by means to be described and providing casting spaces **26** therebetween. The form **18** is somewhat foreshortened in FIG. 2 for purpose of illustration. Commonly each casting space **26** will be of a length substantially greater than its width, e.g. a form **18** may be of a length of 48–72" or more with a width of about 10–14".

The upper form member **24** is shown as formed of heavy sheet metal bent to form an upright portion **24***a* and a flange portion **24***b*. This upper form member provides a downwardly facing scoring edge **27** which may be straight or serrated to contact the knobby surface of the sloping support surface **10** but which is preferably spaced a slight distance thereabove by suitable support means spaced from each other along the length of the upper form member **24** as suggested in FIGS. 2 and 3.

Functioning for this purpose and to space the members **24** and **25** and outline the casting spaces **26** are two transverse end form members **28** and **29** and one or more intermediate form members **30** welded to or otherwise joining and spacing the form members **24** and **25**. At least the upper and lower ends of the lower edge of each of the form members **28**, **29** and **30** engage the knobby surface to support the form **18** with the scoring edge **27** slightly above the knobby surface for a purpose to be described. In the illustrated embodiment the lower edge of each of the form members **28**, **29** and **30** is in a straight line to engage the knobby surface throughout the length of such form member. The form members **28**, **29** and **30** bound the lateral sides of the casting spaces **26** and are of a shape substantially corresponding to the cross-sectional shape of the desired tile. The top of each such form members **28**, **29**, **30** provides a screed surface **33**.

The lower form member **25** is shown as a length of angle iron welded or otherwise secured to the end form members **28** and **29** so that its lower flange is angled slightly with respect to the screen surfaces **33** and the support surface **10**, see FIG. 3. Support means are provided spaced from each other along this flange to hold it above

the surface **10** to provide a spill-out space **36** between a spill-out edge **37** of the flange and the support surface **10** for a purpose to be described. The end and intermediate form members **28**, **29** and **30** function as such a support means. The spill-out space **36** is of uniform height throughout its length, preferably about half or somewhat less than half the thickness of the desired tile at its lower or thicker end. Handles **38** and **39** may be respectively welded to the upper and lower form members **24** and **25** the handle **39** preferably angling forwardly of the lower form member for better operation of a screed utilized in a manner to be later described.

In addition to the straight or closed-end pouring form described above the invention preferably includes a terminal pouring form **40**, shown in FIG. 4, used to pour the terminal tile of a course adjoining one of the perimeter or peripheral tiles such as *b'*. This terminal pouring form includes upper and lower form members **44** and **45** spaced to define a casting space **46** therebetween which is here not divided.

The upper form member provides an upright portion **44***a* and a flange portion **44***b* the former terminating in a downwardly facing scoring edge **47**. Like the scoring edge **27**, the edge **47** may contact the knobby surface of the sloping support surface **10** but is preferably spaced a slight distance thereabove by suitable support means spaced from each other along the length of the pouring form **40** as suggested in FIGS. 3 and 4. Functioning for this purpose at one end of the pouring form is a transverse end form member **49** welded to or otherwise joining and spacing the form members **44** and **45**. At least the upper and lower ends of the lower edge of the end form member **49** engage the knobby surface to support the scoring edge **47** a small distance thereabove. In the illustrated embodiment the lower edge of the member **49** lies in a straight line to engage the knobby surface throughout its length. Functioning to support the other end of the scoring edge is a leg **51**.

The end form member **49** closes one end of the casting space **46** and is of a shape substantially corresponding to the cross sectional shape of the desired tile. The top of this member **49** provides a screed surface **53**.

As before, the lower form member **45** is shown as a length of angle iron with its lower flange angled with respect to the screed surface **53**. Suitable support means provide a spill-out space **56** between a spill-out edge **57** of the flange. The form member **49** functions as such a support means at one end of the pouring form **40**. At the other or open end of this form a leg **58** serves as a support and is of such height as to make the spill-out space **56** of uniform height throughout its length.

Toward the open end of the pouring form **40** the upper and lower form members **44** and **45** are secured to and spaced by a transverse spacing structure **60** comprising uprights **61** joined by an angle iron member **62** and a member **63**. The spacing structure **60** is preferably disposed completely above the casting space **46** so as not to obstruct the open end thereof. It preferably angles away from the end form member **49**, e.g., leftward from the left end of the form members **44** and **45**, although this is not absolutely essential. The angle iron member **62** may serve as a handle to aid in the lifting and moving of the pouring form **20** as may also handles **64** and **65** respectively welded to the upper and lower form members **44** and **45**.

Between the end form member **49** and the spacing structure **60** is a screed member having an upper screed surface **67** parallel to and of the same height above said support surface as the screed surface **53** of the end form member **49**. This screed member is preferably in the form of a taut wire **69** having one end anchored to the lower form member **45** by a screw **70**. The other end extends through an opening of the upper form member **44** drilled at the appropriate height and is maintained taut by being threaded through an opening of the flange portion **44***b* around which it is looped to be secured by a screw **71**.

The wire 69 is strongly tensioned in its section traversing the casting space 46 and is easily replaced if broken.

In operation the straight or closed-end pouring form 18 of FIG. 2 is first positioned over the left-hand areas 19, 21 and 22 of the lateral band 20. If desired it can straddle the perimeter tile *b* to cast a cap or surface layer thereon. The upright portion 24*a* of the upper form member abuts against and is aligned by the lower edges of the previously laid upper course of tiles, here the peripheral tiles indicated at *a* and by the numeral 16.

In this position an amount of cementitious material is poured, pumped or otherwise placed in the casting spaces 26, preferably to a localized level above the screed surfaces 33. A flat screed, indicated by the dotted lines 75 of FIG. 3, is then drawn downward along the screed surfaces 33. This determines the top surface of the three tiles and applies pressure to the cementitious material forcing the excess through the spill-out space 36 to form a spill-out portion 77 extending downwardly into the next lower lateral band with irregular but progressively decreasing thickness. This spill-out portion 77 aids in supporting the thick ends of the tiles when the form is later lifted and serves other desirable functions. The tiles in the lower or second band are subsequently cast over the spill-out portion 77. The tiles will be divided by the members 30 and the right-hand end of the last tile will be shaped by the end form member 29. If some of the cementitious material exudes between the lower edge of the end form member 29 and the support surface 10 or if this member provides a spill-out space similar to the space 36, the next cast tile will overlay the spill-out portion.

Several of the pouring forms 18 can be positioned end-to-end along the course and can be filled in sequence, the first-filled form being lifted first and placed in a succeeding position. In this way the entire course can be progressively cast up to the last or right hand area 23, which is cast by use of the pouring form 40 of FIG. 4. This pouring form permits casting of the last tile to fill the area 23 which is usually of a length greater or less than the previously cast tiles. It can be positioned with its end form member 49 abutting the perimeter tile *b'* and with its legs 51 and 58 straddling a previously cast tile. The casting space 46 is then filled, the left hand end of the resulting tile being formed against the end of the last cast tile produced by the pouring form 18 of FIG. 2. In casting the last tile of the course the end form member 29 may abut the precast peripheral tile *b'* either at its inner edge (if no cap is to be poured thereon) or its outer edge (if such cap is to be poured simultaneously with the last cast tile of the course). Irrespective of the space between the previously cast tile and the peripheral tile *b'* the intervening space will be spanned by the form members 44 and 45 which can straddle any portion of such previously cast tile. The last cast tile of any course may thus be of any length and will fill the remaining space up to the peripheral tile *b'*.

When the pouring form 40 is lifted after casting of the last tile of a course the end form member 49, if adjacent the inner edge of the precast tile *b'*, will leave a narrow space or score line separating the cast material and the precast tile. It is desirable to form similar narrow spaces or score lines at the junction of such last-cast tile and its predecessor. In this connection at a suitable time after pouring a suitable scoring tool may be pressed into the cast material to the depth of the support surface 10 or slightly thereabove. This may also be done at the junctions of earlier-poured tiles of the course. If desired each unitarily cast tile may be similarly scored at intermediate positions along its length to provide a desired pattern.

In forming the next lower course of tiles the pouring form 18 abuts or straddles the precast tile *c*, the tiles being cast in sequence as before. The upper form member 24 abuts against the lower edge or edges of the tile or tiles of the previously-cast course. The scoring edge 27 of this upper form member automatically penetrates the spill-out portion 77 of the previously-cast tiles of the adjacent upper course, thus automatically scoring this junction to a position slightly above the support surface 10. If scoring is not completely to the support surface the shrinkage of the cementitious material when hardened will crack any joining portion of the tiles of the two courses so that they remain independent of each other in use.

The tiles of a previously cast course thus align the form of the next course so that when the lowest course of the roof is poured adjacent the peripheral tiles 15 at the eave line all courses will have parallel and straight shadow lines. If the height of the spill-out spaces 36 and 56 is made equal to or less than the height of the precast eave tiles 15 at their narrow sides there will be no spill-out portion 77 on such peripheral eave tiles 15. However the pouring form 18 can be used to pour a cap of the cementitious material on these precast eave tiles if they are of substandard height.

The roof may be capped by a ridge cap 8 shown in FIG. 1. This may be cast in sections by conventional forms.

The resulting roof is in effect composed of a plurality of independent tiles having lower surfaces corresponding to the undulations of the knobby surface on which they are poured. They need not be otherwise secured to the support structure of the roof as their weight and their adhesion to the knobby surface suffices to maintain them in position. These tiles can independently expand and contract without danger of tearing the waterproof layer formed by the felt 12. They can be left in their natural state or they can be painted. The finished roof will have distinct shadow lines in view of the fact that the thinner upper edge of each tile is adjacent the thicker lower edge of the tiles of an adjacent upper course. The resulting roof has excellent insulation properties because of the thickness of the cementitious material. It is as permanent as the waterproof felting 12 and greatly increases the life of the latter in protecting it from the sun.

Various changes and modifications will be apparent to those skilled in the art from the foregoing description and are within the scope of the appended claims.

I claim:

1. A portable pouring form manually movable from casting location to casting location for sequentially casting flat tiles of cementitious material on a sloping support surface in end-to-end relationship in lateral courses, said form including in combination: parallel upper and lower upright form members forming at least one casting space therebetween, said upper form member having a lower, downwardly facing, thin scoring edge, and said lower form member having a lower, spill-out edge; support means spaced from each other along said spill-out edge and disposed exclusively at the ends of said casting space and engaging said sloping surface to support said edge a distance thereabove to provide a spill-out space free of obstructions; and additional support means spaced from each other along the length of said upper form member and engageable with said sloping support surface to position said scoring edge slightly thereabove.

2. A portable pouring form as defined in claim 1 in which the two support means recited include at least one transverse form member connected to said upper and lower upright form members and forming an end of said casting space, said transverse form member having a portion depending to a level below said spill-out edge and depending to a level below said scoring edge, whereby said portion of said transverse form member constitutes parts of said two support means.

3. A portable pouring form manually movable from casting location to casting location for sequentially casting flat tiles of cementitious material on a sloping support surface in end-to-end relationship in lateral courses, said form including in combination: parallel upper and lower upright form members forming a casting space therebetween having an open end; a transverse spacing structure adjacent said open end of said casting space, said spacing structure spacing and being secured to said

upper and lower form members; a transverse end form member substantially closing the other end of said casting space, said end form member spacing and being secured to said upper and lower form members adjacent said other end and forming an upper screed surface; and a transverse screed member adjacent said spacing structure and above said casting space and having an upper screed surface parallel to and of the same height above said support surface as said upper screed surface of said end form member.

4. A portable pouring form as defined in claim 3 in which said spacing structure is disposed above said casting space near said open end thereof to leave such open end substantially unobstructed.

5. A portable pouring form as defined in claim 3 in which said screed member is a taut wire extending between said upper and lower form members across and above said casting space.

6. A portable pouring form as defined in claim 3 including support means disposed respectively along said upper and lower form members engageable with said support surface and dimensioned to maintain said screed surfaces closer to said support surface adjacent said upper form member than adjacent said lower form member.

7. A portable pouring form as defined in claim 3 in which said lower form member provides a lower, spill-out edge and at least two support means spaced from each other along said lower form member and disposed exclusively at the ends of said casting space and engageable with said support surface and depending below said spill-out edge to provide a spill-out space between such edge and said support surface which is free of obstructions.

8. A portable pouring form as defined in claim 7 in which one support means includes a leg member depending below said spill-out edge at said open end of said casting space, the lower edge of said end form member forming another of said support means.

9. A portable pouring form manually movable from casting location to casting location for sequentially casting flat tiles of cementitious material on a sloping support surface in end-to-end relationship in lateral courses, said form including in combination: parallel upper and lower upright form members respectively having lower edges, said form members providing a casting space therebetween; an end form member at one end of said casting space secured to and spacing said upper and lower form members, said end form member closing an end of said casting space and providing a lower edge depending below said lower edge of said lower form member engageable with said support surface and supporting said lower edge of said lower form member thereabove to provide a spill-out space therebetween, said end form member having an upper screed surface; a spacing structure adjacent the other end of said casting space and secured to and spacing said upper and lower form members; a leg member at said other end of said casting space depending from said lower form member a distance to maintain said spill-out space unobstructed and of uniform height throughout the length of said lower form member; and a screed member adjacent said spacing structure and extending between said upper and lower form members, said screed member having an upper screed surface parallel to and of the same height above said support surface as said upper screed surface of said end form member.

10. A portable casting form manually movable from casting location to casting location for sequentially casting flat tiles of cementitious material on a sloping roof surface in side-by-side relationship in lateral courses, said form including in combination: parallel upper and lower

form members forming at least one casting space therebetween, said upper form member having a thin upright portion forming at its lower portion a lower, downwardly facing scoring edge, said lower form member providing a lower, downwardly facing spill-out edge; and a transverse form member connecting said upper and lower form members at an end boundary of said casting space, said transverse form member having a lower edge having portions protruding respectively small distances below said scoring edge and said spill-out edge and engaging said sloping roof surface as a support for the casting form, said transverse form member having an upper edge determining the height of said casting space, the height of said transverse form member measured between said upper and lower edges thereof being greater adjacent said lower form member than said upper form member.

11. A portable casting form as defined in claim 10 in which said upper and lower form members having upright and substantially parallel surfaces bounding the upper and lower portions of said casting space and disposed respectively at obtuse and acute angles relative to said lower edge of said transverse form member.

12. A portable pouring form manually movable from casting location to casting location for sequentially casting flat tiles of cementitious material on a sloping support surface in end-to-end relationship in lateral courses, said form including in combination: parallel upper and lower upright form members respectively having lower edges, said form members providing a casting space therebetween; an end form member at one end of said casting space secured to and spacing said upper and lower form members, said end form member closing an end of said casting space and providing a lower edge depending below said lower edge of said lower form member engageable with said support surface and supporting said lower edge of said lower form member thereabove to provide a spill-out space therebetween, said end form member having an upper screed surface; a spacing structure adjacent the other end of said casting space and secured to and spacing said upper and lower form members; a leg member at said other end of said casting space depending from said lower form member a distance to maintain said spill-out space unobstructed and of uniform height throughout the length of said lower form member; and a screed member adjacent said spacing structure and comprising a taut wire extending between said upper and lower form members across said casting space, said screed member having an upper screed surface parallel to and of the same height above said support surface as said upper screed surface of said end form member.

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