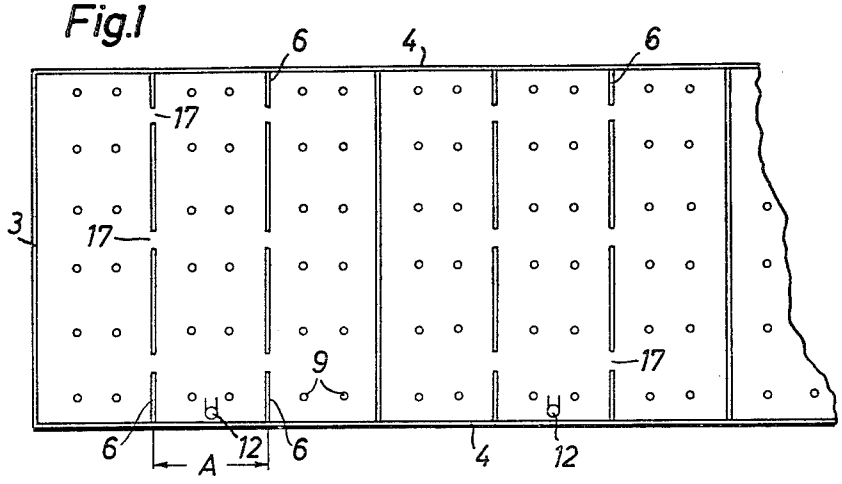
Dec. 30, 1969 K. HUESKER-STIEWE ET AL 3,486,341

FORM FOR CONCRETE OR THE LIKE

Filed Oct. 11, 1966 4 Sheets-Sheet 1

Fig.1



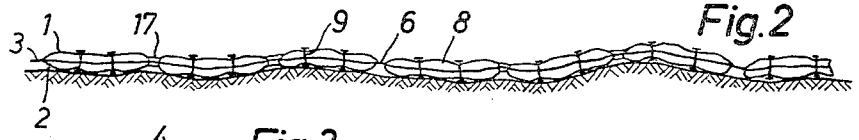
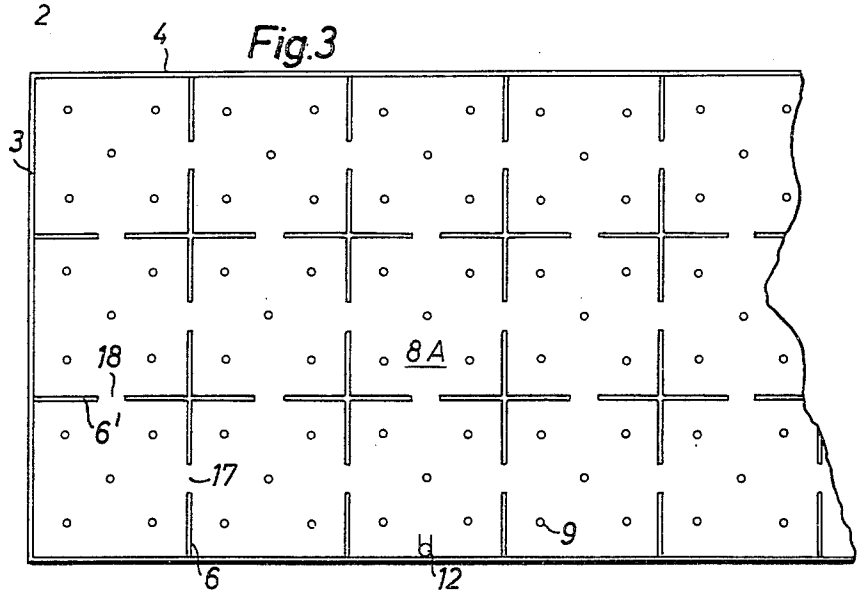


Fig.2

Fig.3



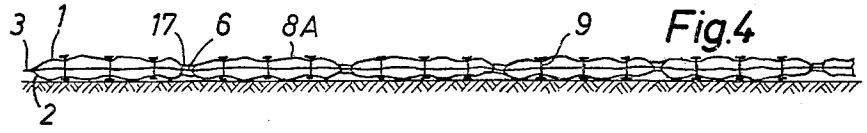


Fig.4

INVENTORS:
KARL HUESKER-STIEWE
OTTO WAGNER
BY Michael S. Striker
their ATTORNEY

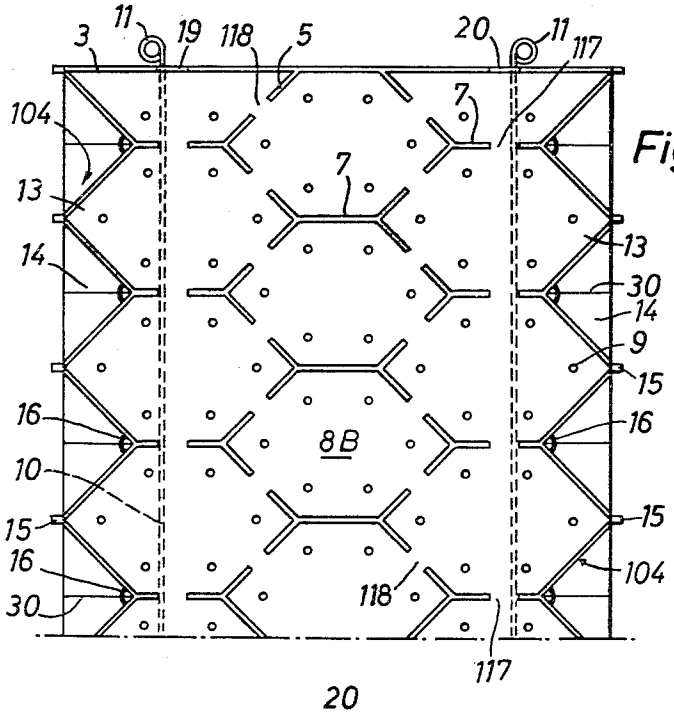


Fig.5

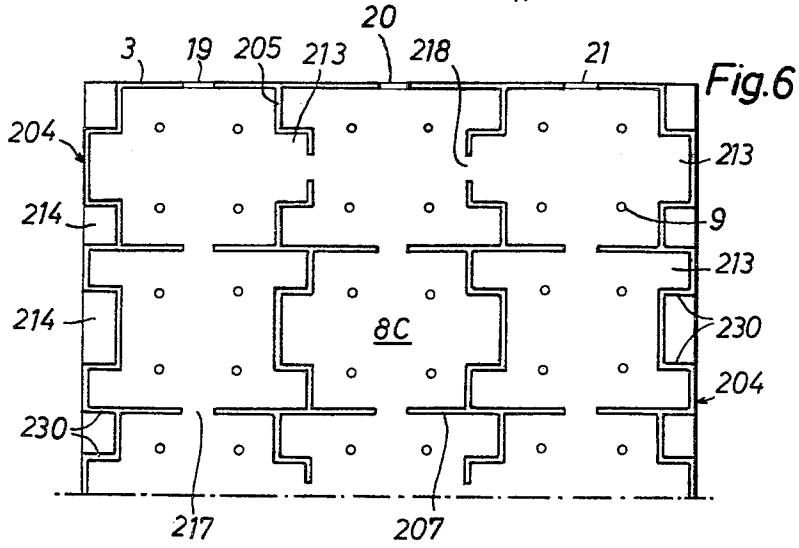


Fig.6

INVENTORS:
KARL HUESKER-STIEWE
OTTO WAGNER
BY
Michael S. Striker
their ATTORNEY

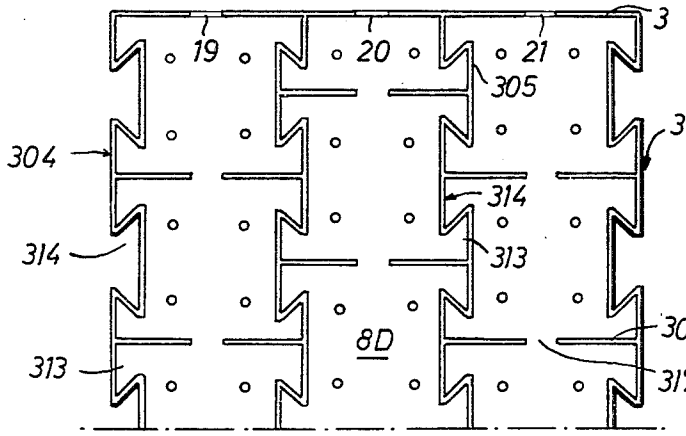


Fig.7

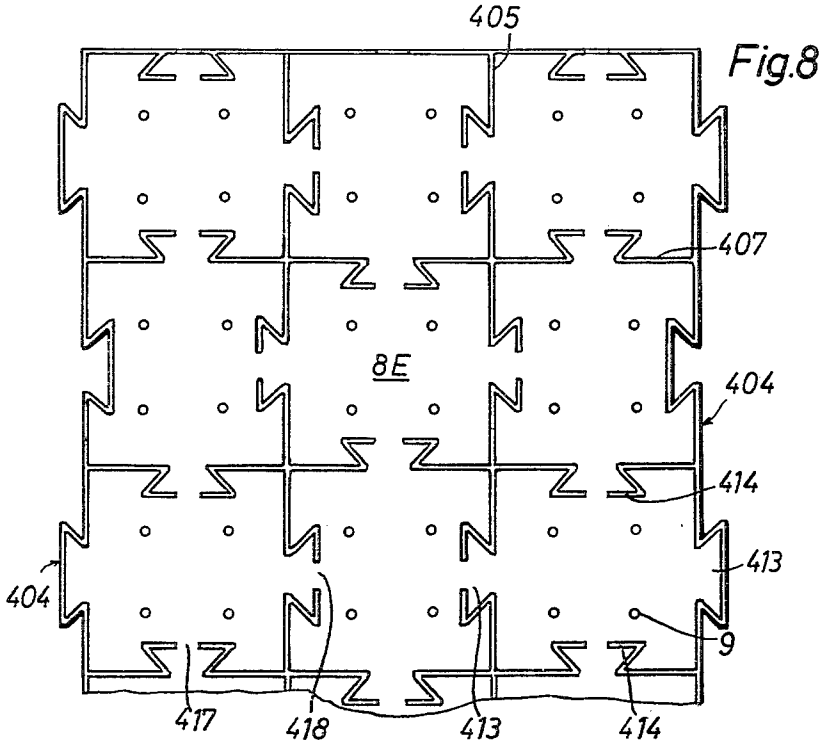


Fig.8

INVENTORS:
KARL HUESKER-STIEWE
OTTO WAGNER
BY Michael S. Striker
their ATTORNEY

Dec. 30, 1969 K. HUESKER-STIEWE ET AL 3,486,341

FORM FOR CONCRETE OR THE LIKE

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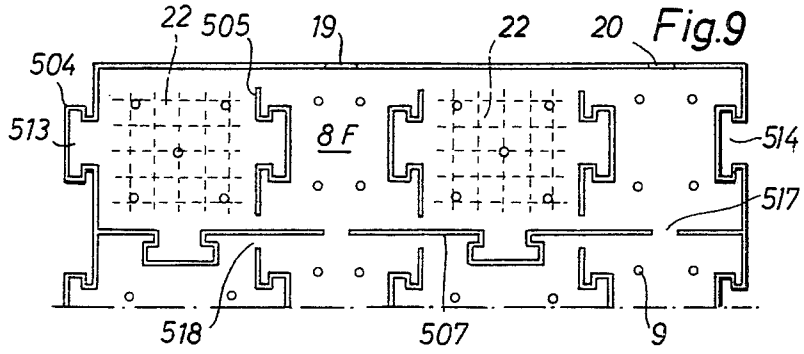

Fig.9

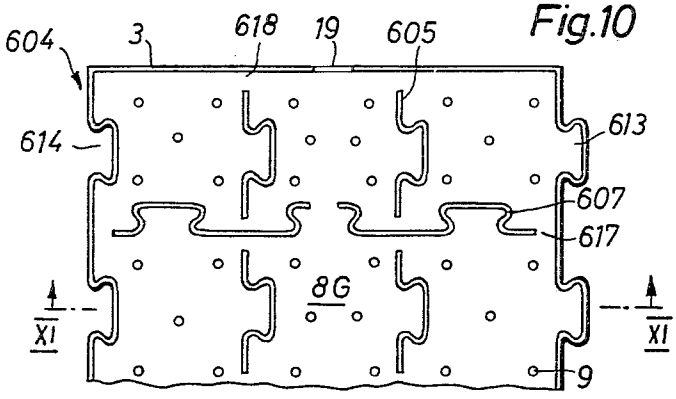

Fig.10

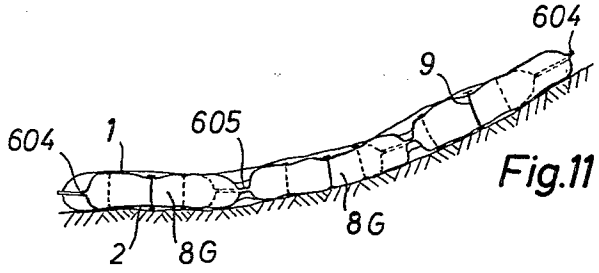

Fig.11

INVENTORS:
KARL HUESKER-STIEWE
OTTO WAGNER
BY Michael S. Striker
their ATTORNEY

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FORM FOR CONCRETE OR THE LIKE

Karl Huesker-Stiewe, Haupstr. 30, Gescher, Germany, and
Otto Wagner, Taubenstr. 26, Dinslaken, Germany

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Int. Cl. E02b *3/12;* E04g *11/00*
U.S. Cl. 61—38 14 Claims

ABSTRACT OF THE DISCLOSURE

A form for concrete or like hardenable material including an envelope of flexible sheet material adapted to be filled with a mass of hardenable material. The overlapping sheets of the envelope are directly connected by a plurality of seams so as to subdivide the interior of the envelope into a plurality of compartments and tie members provided in the compartments limit the expansion of the envelope during filling of the compartments with hardenable material. At least some of the seams are interrupted to provide openings communicating with the respective compartments through which the hardenable material may flow during filling of the compartments.

The present invention relates to the manufacture of slabs or plates which consist of concrete or the like, and more particularly to improvements in forms which may be utilized to receive mortar, flowable synthetic plastic or like materials adapted to harden or set in order to form slabs.

It is often necessary to line the banks or beds of rivers, canals, and/or coastal installations with slabs of concrete or like hardenable material. A serious drawback of presently known concrete slabs is that they are fractured and fragmentized in response to shifting of the supporting surface therebelow and that the thus fragmentized slabs cannot provide a satisfactory covering.

Accordingly, it is an important object of the present invention to provide a novel form for concrete or the like which can be used in the manufacture of improved slabs adapted to form a satisfactory liner not only when intact but also after breakage into a plurality of individual sections or fragments.

Another object of the invention is to provide a form which insures that the fragments of a slab which has been formed therein continue to remain interlinked with each other so that such slab may be used with advantage on shifting or highly uneven ground and retains its usefulness even after partial or nearly complete fragmentization.

A further object of the invention is to provide forms which may be used in the manufacture of concrete or like slabs capable of forming liners or coverings along strongly inclined supporting surfaces and which also insure that the slabs formed therein can be readily interlinked with each other to form a composite mat of any desired size and/or shape.

An additional object of the instant invention is to provide a form for concrete or the like which is constructed and assembled in such a way that the direction and configuration of breaks in a slab formed therein is determined in advance and that such breaks or fissures contribute to highly satisfactory articulation of the fragmentized slab so that the latter can readily conform to the outline of uneven terrain.

Still another object of the invention is to provide a form of the just outlined characteristics which can be filled with concrete or like hardenable material by resorting to presently known pumping or injecting equipment and which can be filled in situ so that the cost of transporting it to the locale of actual use is minimal.

A concomitant object of the invention is to provide a form which insures the formation of a slab that is readily connectable with one or more additional slabs and, when fragmentized, forms sections or fragments which continue to remain connected to each other, at least indirectly and in such a way that the fragmentized slab can be readily shifted to a different locale of use if and when such shifting should become necessary.

A further object of the invention is to provide a very simple, inexpensive, lightweight and easily transportable form which can be used above ground, in underground excavations, under water and for many other purposes where coherence of fragmentized slabs is important for safety of persons or for other reasons.

Briefly stated, one feature of our invention resides in the provision of a form for concrete or other types of hardenable materials capable of forming slabs. The form comprises a pair of overlapping flexible sheaths or panels secured to each other along their edges to define an envelope having an internal space adapted to accommodate a mass of hardenable material, a plurality of regularly or irregularly distributed seams located within the confines of the edges and providing direct connections between the sheaths to surbdivide the internal space of the envelope into a plurality of rectangular, square, hexagonal or otherwise configurated compartments, and tie means provided in some or all of the compartments to limit the expansion of the envelope in response to filling of compartments with hardenable material. For example, such ties may consist of spot-welded, spot-glued or otherwise connected portions of the two sheaths or of separate metallic or other elements introduced into the compartments and having mutually spaced portions connected to the two sheaths. These sheaths may consist of nylon or other synthetic plastic or textile material.

The edges of the envelope may be toothed or serrated so that they may be interlocked with the edges of adjoining slabs. Also, the seams are preferably interrupted to provide openings for flow of plasticized material between the adjoining compartments. When such material hardens, it forms a slab which will break along the seams (i.e., across the openings between the adjoining compartments) to form a series of interconnected sections or fragments. Such interconnection is brought about by the material of the sheaths and preferably also by such configuration of the seams that the fragments have interlocking dovetailed or similarly configurated projections which prevent lengthwise and/or transversal shifting of fragments with reference to each other.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The improved form itself, however, both as to its construction and the mode of utilizing tthe same, together with additional features and advantages thereof, will be best understood upon perusal of the following detailed description of certain specific embodiments with reference to the accompanying drawings, in which:

FIG. 1 is a fragmentary schematic top plan view of a

form for concrete which embodies one form of the present invention;

FIG. 2 is a schematic sectional view of the form which is shown as being supported on an uneven base, for example, on the bed or bank of a river;

FIG. 3 is a fragmentary diagrammatic top plan view of a second form which is provided with a checkerboard pattern of square compartments;

FIG. 4 is a diagrammatic horizontal section through the form of FIG. 3;

FIG. 5 is a fragmentary diagrammatic top plan view of a third form which is provided with substantially hexagonal compartments and comprises reinforcing hardware in the form of steel wires;

FIG. 6 is a fragmentary diagrammatic top plan view of a fourth form which is provided with substantially rectangular compartments and whose longitudinal edges are formed with substantially rectangular teeth and recesses;

FIG. 7 is a fragmentary diagrammatic top plan view of a fifth form whose longitudinal edges and longitudinally extending seams are provided with dovetailed teeth and recesses;

FIG. 8 is a similar fragmentary diagrammatic top plan view of a sixth form wherein not only the longitudinal but also the transverse seams comprise dovetailed teeth;

FIG. 9 is a fragmentary diagrammatic top plan view of a seventh form which is similar to the form of FIG. 8 but comprises nettings of steel wire or the like to facilitate proper anchoring of the slab on an inclined supporting surface;

FIG. 10 is a fragmentary diagrammatic top plan view of an eighth form which constitutes a further modification of the form shown in FIG. 8; and

FIG. 11 is a schematic section as seen in the direction of arrows from the line XI—XI of FIG. 10 and further illustrates a sloping concave surface, for example, the bank of a river or canal, on which the form is placed.

The form shown in FIGS. 1 and 2 comprises an envelope composed of two overlapping flexible sheaths or panels **1**, **2** which are secured to each other along transverse edges **3** and longitudinal edges **4**. The envelope resembles an elongated rectangle and the edges **3**, **4** are preferably formed by interweaving the material of which the sheaths **1** and **2** consist. Of course, the sheaths **1**, **2** may form part of a single panel which is folded over itself and whose overlying edges are secured to each other by interweaving or interlacing whereby the resulting envelope defines an internal space which can receive a mass of concrete or other hardenable material.

The form further comprises a group of parallel seams or connections **6** which subdivide the internal space of the envelope into a series of compartments **8** each having the same width A. The seams **6** provide direct connections between the sheaths **1** and **2** and may be obtained by interweaving the material of which the sheaths consist. Each compartment **8** accommodates one or more so-called ties **9** having mutually spaced portions connected to the sheaths **1** and **2** to determine the maximum distance between such sheaths when the respective compartments are filled with hardenable material. Thus, the function of ties **9** is to limit the expansion of the envelope and to determine the thickness of the slab which is obtained when the material filling the compartments **8** is allowed to set. By appropriate selection of the length of ties **9**, the manufacturer of the form can limit bulging of walls which surround the compartments **8**. Such ties may consist of steel wire, nylon cord or other suitable material.

At least some of the seams **6** are interrupted in that they consist of aligned portions or sections which provide openings **17** for flow of hardenable material between the adjoining compartments **8**. As shown in FIG. 1, each third seam **6** is continuous but the intervening seams are interrupted so that groups of three adjoining compartments **8** are free to communicate with each other. Each such group of three compartments **8** can receive concrete or other suitable hardenable material through one of the inlets **12** provided in the sheath **1**. It is clear, however, that each of the seams **6** may consist of several sections and/or that each of the seams can provide a continuous connection between the longitudinal edges **4**; in the latter instance, the sheath **1** or **2** must be provided with at least one inlet **12** for each compartment **8**. The inlet or inlets **12** may be connected with hoses, lances or similar material-admitting or injecting devices. It is often preferred to provide the inlet or inlets **12** with self-sealing one-way valves which can be opened by the nozzle of a lance or hose.

The sheaths **1** and **2** preferably consist of woven material, for exemple of nylon threads. Instead of forming the edges **3**, **4** and seams **6** by weaving, the sheaths **1** and **2** may be glued, welded or otherwise bonded to each other. Concrete slabs which are obtained by filling the improved form with concrete are particularly useful as liners for beds or banks of rivers, canals, coastal installations, and for like purposes. The form is placed onto a flat or uneven, horizontal or inclined base or supporting surface and its compartments **8** are thereupon filled with flowable plastic material which, after hardening, forms a rigid slab. During pouring or injection of concrete, the lower sheath **2** follows closely the outline of the supporting surface so that, after hardening, the slab conforms to the configuration of its support. Should the supporting surface shift, for example, due to removal of its material by flowing water or for another reason, the slab is likely to fracture along the seams **6**, namely, across the openings **17**, so that it forms a series of hingedly connected slab sections or fragments which can be tilted with reference to each other and again follow closely the new outline of the supporting surface. When used as a liner for river banks or the like, the slab may consist of colloidal mortar, for eaxmple, concrete mortar. However, it is equally possible to fill the envelope with a hardenable mass of bituminous or synthetic plastic material with or without filler substances.

FIGS. 3 and 4 show a second form which comprises a first group of interrupted parallel seams **6** extending transversely of the envelope and a second group of interrupted parallel seams **6'** which extend lengthwise of the envelope and intersect the seams **6** to subdivide the internal space of the envelope into a checkerboard pattern of rectangular compartments **8A**. All of these compartments are in communication with each other via openings **17**, **18** respectively provided by interruptions in the seams **6** and **6'** so that a single inlet **12** sufficies to introduce hardenable material into each such compartment. The walls bounding each compartment **8A** are connected to each other by ties **9** which determine the maximum permissible expansion of the envelope. While FIG. 3 shows that the seams **6** are substantially normal to the seam **6'**, this is not a must because the interior of the envelope including the sheaths **1** and **2** could be divided into rhomboidal or otherwise configurated compartments without departing from the spirit of our invention. It is further clear that the number of openings **17** and/or **18** can be reduced or further increased and that, if necessary, the envelope can be provided with one or more additional inlets **12**.

FIG. 5 shows a portion of a third form for concrete or the like whose envelope comprises two straight parallel transverse edges **3** (only one shown) and two serrated longitudinal edges **104** each provided with projections or teeth **13** which alternate with complementary recesses or valleys **14**. The material of the sheaths **1** and **2** in the recesses **14** is slitted, as at **30**, so that such recesses can receive the teeth **13** of a longitudinal edge **104** on the adjoining form. In this way, and when filled with hardened concrete, the two adjoining forms are automatically held against lateral movement with reference to each other, namely, against movement in directions substantially at right angles to the transverse edges **3**.

The form of FIG. 5 comprises a first group of interrupted seams **7** which are staggered with reference to each other, always by half the distance between the adjoining transversely aligned seams **7**. A second group consisting of serrated seams **5** extends lengthwise of the form and the seams **5, 7** subdivide the interior of the envelope into a plurality of interengaging hexagonal compartments **8B** each of which accommodates one or more ties **9**. Such ties need not necessarily consist of separate bodies which are attached to the sheaths **1** and **2**; for example, they can be formed by spot-welding or interlacing small portions of the two sheaths to each other. It is also possible to form the ties by resorting to a suitable adhesive and/or by utilizing staples or analogous clamping and connecting devices.

At least one longitudinal edge **104** is provided with a set of male coupling elements **15** which are mounted at the tips of the teeth **13** and can engage complementary female coupling elements **16** provided in the deepmost zones of recesses **14** in the edge **104** of an adjoining form. For example, the male coupling elements **15** may resemble hooks and the female coupling elements **16** then resemble eyes or loops. It is preferred to provide each of the longitudinal edges **104** with male and female coupling elements which are distributed as shown in FIG. 5 so that the adjoining forms are more securely coupled to each other which is of particular importance when the slabs obtained upon hardening of concrete in the compartments **8B** are laid on a sloping base.

The form of FIG. 5 further comprises reinforcing hardware, for example, sections **10** of steel wire which extend lengthwise and have looped or similarly configurated end portions **11** disposed outwardly of the transverse edges **3** to receive stakes, posts or analogous anchoring members driven into the ground to hold the form on a sloping base. The wires **10** may be provided with knots or the like (not shown in FIG. 5) which are located in the compartments **8B** and, when surrounded by hardened concrete, prevent extraction of wires from the slab. Instead of or in addition to such knots, the sections **10** may be provided with ties **9** and/or additional ties to insure that each thereof is properly anchored in hardened concrete. Also, the sections **10** may be connected with the ground by suitable distancing elements (not shown).

The edge **3** is provided with inlets **19** and **20** which can admit plasticized material whereby such material spreads by flowing through the openings **117, 118** and fills each of the compartments **8B**.

The form of FIG. 6 is analogous to the form which was described in connection with FIG. 5. It comprises transversely extending seams **207** which are parallel with the edges **3** and define openings **217**, and longitudinally extending serrated staggered seams **205** having rectangular projections or teeth **213** and rectangular recesses or valleys **214**. The seams **205** provide openings **218** so that the adjoining compartments **8C** are free to communicate with each other. The material of the sheaths **1, 2** must be removed in the recesses **214** of the serrated longitudinal edges **204** so that the teeth **213** of an edge **204** on one form can enter the recesses **214** in the edge **204** of an adjoining form. The numerals **230** denote the lines along which the material of the sheaths **1** and **2** is removed before the form is laid on a base, for example, on the bank or bed of a river or canal. The edge **3** is provided with a series of inlets **19, 20, 21** which can admit concrete into the compartments **8C**.

It will be noted that the seams **207** of the form shown in FIG. 6 are straight but that the longitudinally extending seams **205** are toothed or serrated. If the slab breaks along the seams, i.e., if the hardened material filling the openings **217, 218** breaks in response to shifting of the supporting surface or for another reason, the teeth **213** of slab sections in the adjoining compartments **8C** remain interlaced and prevent the broken-up slab from falling completely apart.

In the embodiment of FIG. 7, the transversely extending seams **307** are staggered in the same way as the seams **7** of FIG. 5 but the seams **305** are serrated and comprise dovetailed teeth **313** alternating with complementary dovetailed recesses **314**. Similar dovetailed teeth **313** and recesses **314** are provided in the longitudinal edges **304**. The numerals **317** denote openings which are provided only in the seams **307** and allow plasticized material to flow between the longitudinally aligned compartments **8D**. The seams **305** are without openings; therefore, the edge **3** is provided with three inlets **19–21**, one for each row of longitudinally aligned compartments **8D**.

An important advantage of dovetailed teeth **313** and recesses **314** is that they hold the slab sections against relative movement longitudinally as well as transversely of the slab even if the material filling the individual compartments **8D** happens to break along the seams **305** and even if the material of the sheaths is destroyed, either by tearing or due to corrosive influence of its surroundings. The teeth **313** of the longitudinal edges **304** are introduced into the recesses **314** in the edges **304** of adjoining slabs to thus prevent lengthwise and/or transverse shifting of such slabs with reference to each other. Dovetailed teeth are very useful on inclined supporting surfaces because they prevent relative movement of slab sections upon fragmentizing of the slab and also because they interlock the edges of adjoining slabs to hold them against sliding as long as one of the slabs is properly secured to the base.

The form of FIG. 8 is similar to that of FIG. 7; however, the internal space of the envelope including the sheaths **1** and **2** is subdivided into a checkerboard pattern of substantially rectangular compartments **8E** by two groups of serrated seams **405, 407** each of which is formed with dovetailed teeth **413** alternating with complementray dovetailed recesses **314**. Similar teeth and recesses are provided in the longitdinal edges **404**. It will be seen that the teeth **413** of each seam **405** or **407** extend alternatively in opposite directions so that each slab section which fills an inner compartment **8E** (i.e., a compartment which is not adjacent to one of the edges) has two recesses **414** and two teeth **413** and is interlocked with each of the four adjoining slab sections. The numerals **417, 418** denote openings provided in the seams **407, 405**. The inlet or inlets are not shown.

FIG. 9 illustrates a further form which is quite similar to the form of FIG. 8 with the main distinction that the teeth **513** and recesses **514** defined by the seam **505, 507** and longitudinal edges **504** are of modified dovetailed shape, i.e., each tooth **513** is undercut from both sides in the region adjacent to its root. Some of the substantially rectangular compartments **8F** defined by the seams **505, 507** accommodate networks **22** of steel wire or like material which are embedded in concrete and may be utilized to hold stakes which are driven into the base for the form prior to setting of concrete. This is another way of holding the slab against sliding along a sloping supporting surface, especially when such slabs are used to cover steep banks of rivers or canals and do not extend all the way to the bed. In such instances, the networks **22** will be provided in some or all of the upper compartments **8F**. Stakes driven through a network **22** are not likely to cause breakage of concrete slab sections which fill the respective compartments. The number of compartments **8F** which accommodate wire nettings **22** will be selected at will and depends on the inclination of the supporting surface. The recesses **514** in the longitudinal edges **504** can receive the teeth **513** of edges **504** on the adjoining slabs to prevent shifting of interlocked slabs in directions longitudinally as well as transversely of the edges **504**. Openings in the seams **505, 507** are shown at **518** and **517**.

Referring finally to FIGS. 10 and 11, there is shown a further form for concrete or the like wherein the seams **605**, **607** and longitudinal edges **604** form teeth **613** and recesses **614** which are similar to the teeth **513** and recesses **514** of FIG. 9. The seams **605**, **607** are interrupted at **618**, **617** so that a single inlet **19** in the transverse edge **3** sufficies to fill all of the substantially rectangular compartments **8G** with pasticized material. It will be noted that, contrary to the showing of FIG. 8, all of the teeth **513**, **613** formed by the seams **505**, **507** of FIG. 9 and **605**, **607** of FIG. 10 extend in the same direction. The result is the same as in FIG. 8, i.e., each inner slab section is interlocked with all of the four surrounding slab sections by means of a substantially dovetailed tooth **513** or **613**.

An advantage common to the forms shown in FIGS. 6 to 11 is that the corner portions of the finished slab are weakened less than the corner portions of the slab which is obtained by concrete filling the form of FIG. 5 wherein the tips of teeth **13** are more likely to break off. In each of the forms shown in FIGS. 7–11, the material of the sheaths **1**, **2** is already removed from the recesses in the edges **304**, **404**, **504** and **604**.

The means for introducing concrete or like plasticized material through the inlets **12**, **19**, **20**, **21** may comprise flexible hoses, lances or analogous feeding devices of known design. The number of inlets in a form will depend on the number and distribution of openings between the adjoining compartments, on the characteristics of hardenable material, on the type of apparatus which is used to force the material through the inlet or inlets, and on certain other factors.

Each form may have a width of 1.5–2.5 meters and a length of 10–20 meters. The distribution of the seams may be such that the length and/or width of the compartments is in the range of 50–70 centimeters. However, it is clear that the above dimensions are given by way of example only and should not be construed in a limitative sense. Any desired number of forms may be assembled into a large mat. This is preferably done in such a way that one of the forms is laid first and is filled with plasticized material. A second form is then placed next to it and, if necessary, interlocked therewith. This second form is then filled with material, and the same procedure is repeated as often as necessary to form a mat of desired size. The forms may be assembled end-to-end and/or side-by-side.

The seams take up only a small surface area of the respective envelope and are preferably narrow to insure that the slab sections in adjoining compartments are close to each other.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features which fairly constitute essential characteristics of the generic and specific aspects of our contribution to the art and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be protected by Letters Patent is:

1. A form for concrete and like hardenable materials, comprising a pair of overlapping flexible sheaths secured to each other along the edges thereof to define an envelope having an internal space adapted to accommodate a mass of hardenable material; a plurality of seams providing direct connections between said sheaths and subdividing said space into a plurality of compartments, at least some of said seams including dovetailed portions between the adjoining compartments and being discontinuous to thereby establish openings communicating with the respective compartments so that the hardenable material may flow into said compartments through such openings; and tie means provided in said compartments to limit the expansion of said envelope in response to filling of said compartments with hardenable material.

2. A form as defined in claim **1**, wherein said seams include a first group of substantially parallel seams and a second group of substantially parallel seams intersecting said first group of seams to form therewith a checkerboard pattern of compartments.

3. A form as defined in claim **1**, wherein said dovetailed portions include substantially dovetailed teeth alternating with complementary dovetailed recesses.

4. A form as defined in claim **1**, further comprising reinforcing hardware provided in said compartments.

5. A form as defined in claim **4**, wherein said hardware includes sections of metallic wire extending between the edges of said sheaths.

6. A form as defined in claim **5**, wherein said seams include a first group of seams extending lengthwise of said envelope and a second group of seams extending transversely of the envelope and intersecting said first group of seams.

7. A form as defined in claim **1**, wherein said seams include a first group of seams extending substantially lengthwise of the envelope and a second group of seams extending transversely of the envelope, the seams of at least one of said groups comprising sections staggered with reference to each other.

8. A form as defined in claim **1**, wherein each side of each compartment is bounded by a dovetailed seam portion and wherein the dovetailed portions of each seam alternately extend in opposite directions.

9. A form as defined in claim **5**, wherein said sections have looped end portions extending beyond the edges of said sheaths.

10. A form as defined in claim **5**, wherein said sections comprise knots located in said compartments.

11. A form as defined in claim **5**, further comprising distancing elements connecting said sections with the base for said envelope.

12. A form as defined in claim **1**, further comprising wire netting provided in at least one of said compartments.

13. A form for concrete and like hardenable materials, comprising a pair of overlapping flexible sheaths secured to each other along the edges thereof to define an envelope having an internal space adapted to accommodate a mass of hardenable material, at least some of the edges of said sheaths being provided with alternate projections and recesses and the material of said sheaths being slitted between said projections so that the projections of an adjoining envelope can enter such recess; a plurality of seams providing direct connections between said sheaths and subdividing said space into a plurality of compartments, at least some of said seams being discontinuous to thereby establish openings communicating with the respective compartments so that the hardenable material may flow into said compartments through such openings; and tie means provided in said compartments to limit the expansion of said envelope in response to filling of said compartments with hardenable material.

14. A form for concrete and like hardenable materials, comprising a pair of overlapping flexible sheaths secured to each other along the edges thereof to define an envelope having an internal space adapted to accommodate a mass of hardenable material, at least some of the edges of said sheaths being provided with a plurality of projections and with recesses located between successive projections and formed by removal of sheet material between such successive projections; a plurality of seams providing direct connections between said sheaths and subdividing said space into a plurality of compartments, at least some of said seams being discontinuous to thereby establish openings communicating with the respective compartments so that the hardenable material may flow into said compartments through such openings; and tie means provided in said compartments to limit the expansion of said envelope

in response to filling of said compartments with hardenable material.

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J. SPENCER OVERHOLSER, Primary Examiner

J. S. BROWN, Assistant Examiner

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