Aug. 7, 1962 J. L. BOETTNER 3,047,931

FORMS FOR CONCRETE CONSTRUCTION

Filed April 21, 1961 4 Sheets-Sheet 1

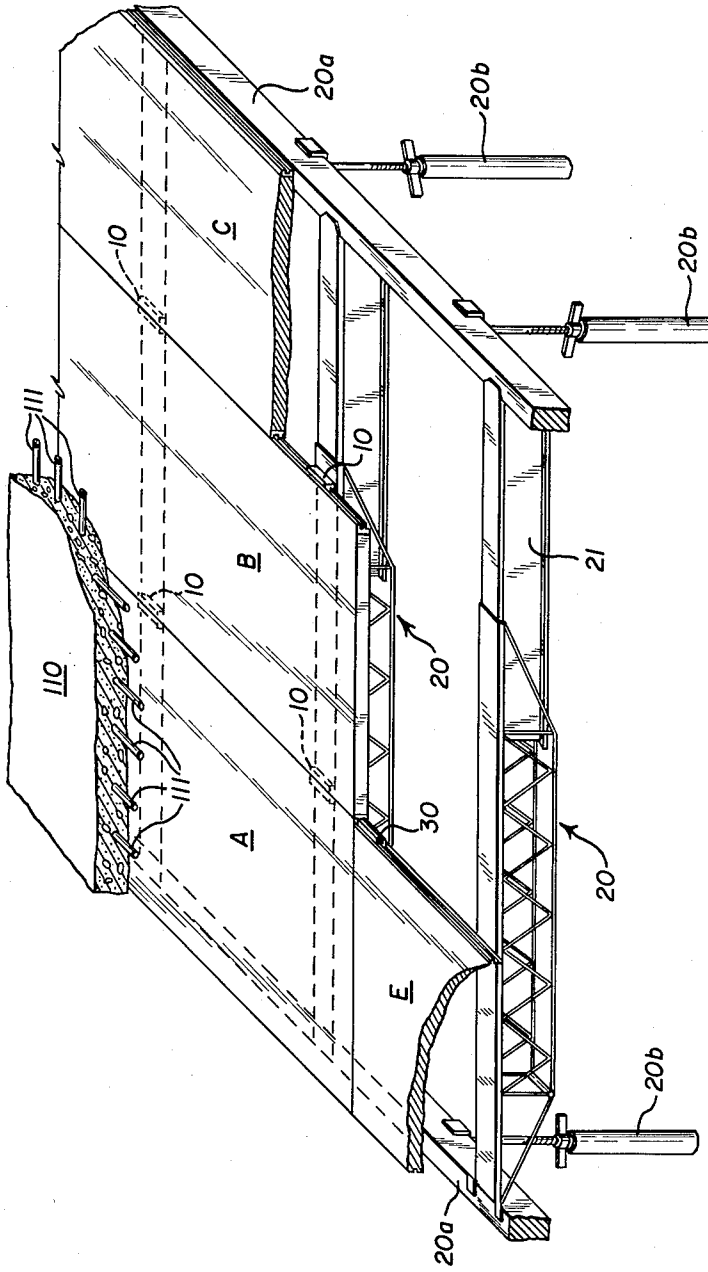


Fig. - 1

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Aug. 7, 1962 J. L. BOETTNER 3,047,931

FORMS FOR CONCRETE CONSTRUCTION

Filed April 21, 1961 4 Sheets-Sheet 2

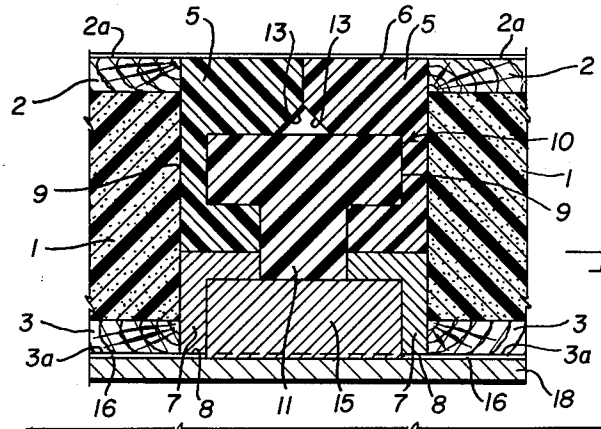


Fig. - 2

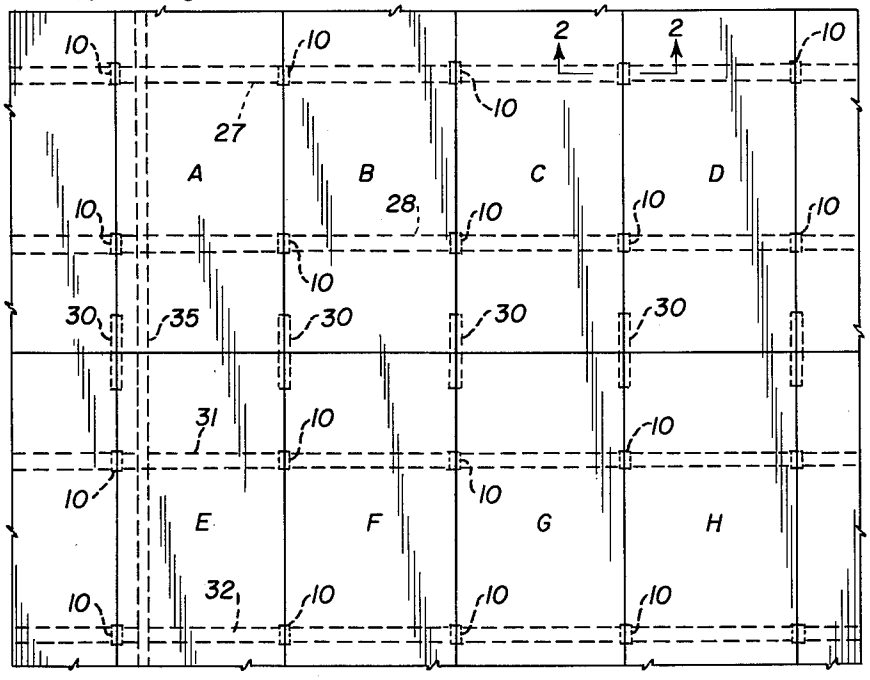


Fig. - 3

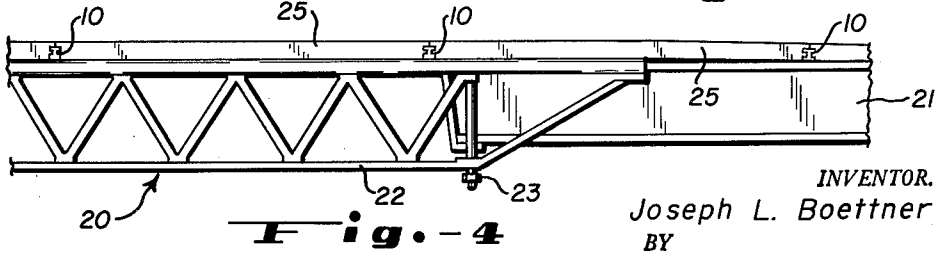


Fig. - 4

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FORMS FOR CONCRETE CONSTRUCTION

Filed April 21, 1961 4 Sheets-Sheet 3

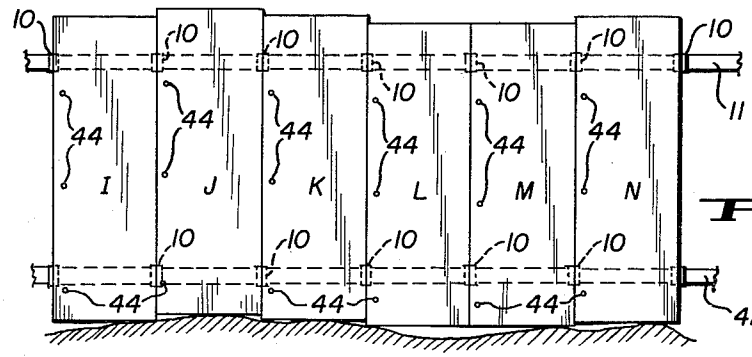


Fig.-5

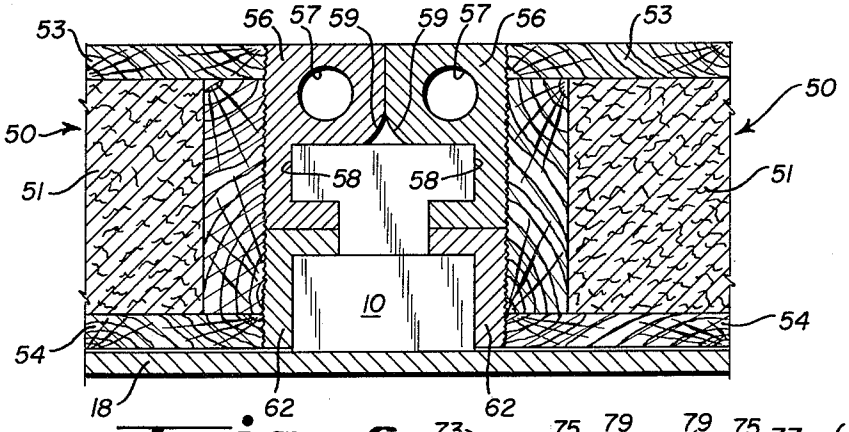


Fig.-6

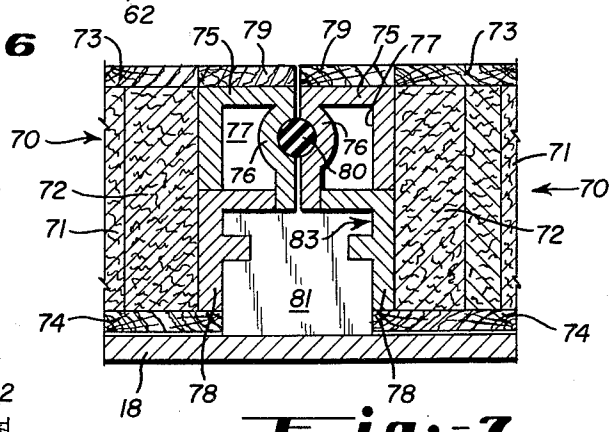


Fig.-7

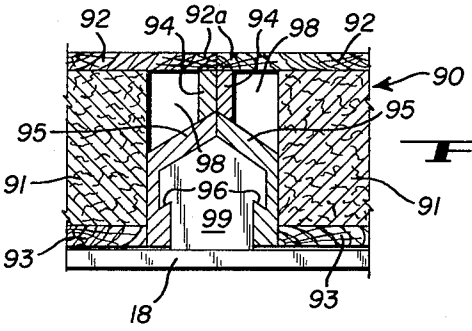


Fig.-8

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FORMS FOR CONCRETE CONSTRUCTION

Filed April 21, 1961 4 Sheets-Sheet 4

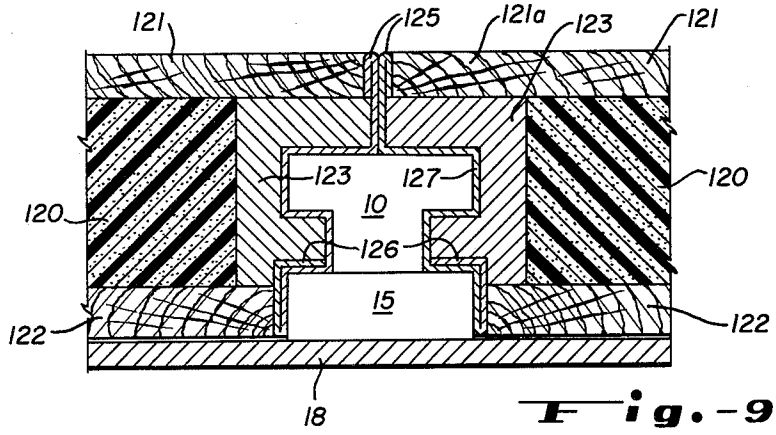


Fig.-9

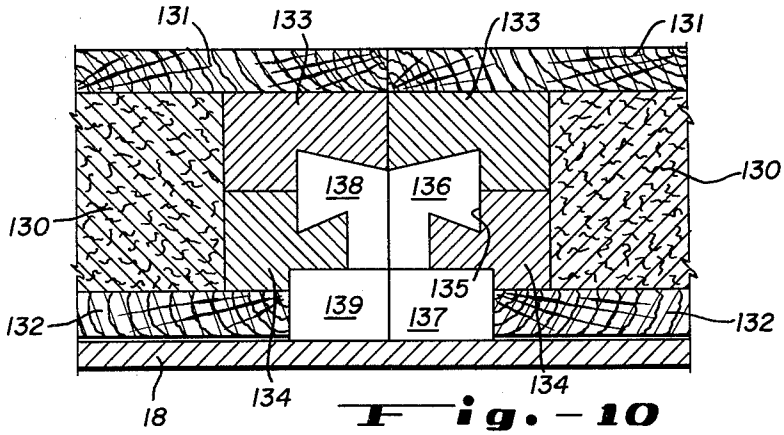


Fig.-10

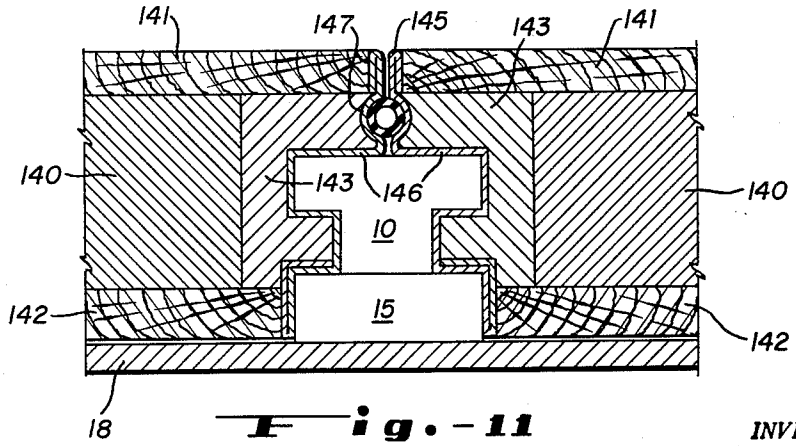


Fig.-11

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3,047,931

FORMS FOR CONCRETE CONSTRUCTION

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Filed Apr. 21, 1961, Ser. No. 104,676
25 Claims. (Cl. 25—131)

This invention relates to forms for concrete construction and more particularly to temporary forms for building structures of concrete including the reinforced type which includes walls, slab floors, slab ceilings, roofs, and the like.

Traditionally, forms for concrete structures are custom made by constructing a framework of supporting beams and the like with covering members having the concrete contacting surface, which may be plywood, board, planks, or the like. Such covering members are generally nailed to the supporting beams. Tie rods and reinforcing steel are placed in the forms, either during or after completion of the structure. Such structures are still widely used for walls, slabs, and the like.

In making custom forms for walls, the concrete supporting members are nailed to upright beams which are supported by braces and cross-members to maintain the wall upright and prevent the form from sagging under the weight of the concrete. In slab construction, especially pan-type construction, planks or plywood panels are laid on horizontal joists which are in turn supported by columns and other shoring for support. Following pouring of concrete in the forms, sufficient time is allowed so that the retained concrete may harden. After hardening, the forms are stripped from the set concrete by complete dismantling. For economical construction it has been the practice to use low-grade lumber, as in dismantling the forms a substantial amount of the lumber is ruined. Further, in making such forms the cutting and fitting of the lumber increases the cost.

In recent years, to overcome the high cost of forms built specifically for a particular job, a number of systems have been developed having reusable form parts. For this purpose most of the different developments have been made with the intention of providing simplified construction. Such so-called simplified systems include panels of metal and plywood, a plurality of form ties, panel clamp and bracket hardware, some of which provide a means for a connection between wooden and metal parts, etc. In some of these systems, the panels contacting the concrete are custom fabricated on the job, although the hardware, that is, the various brackets and clamps for putting the forms together, speeds up form assembly and somewhat reduces the cost. Since such units are custom made, they are of limited applicability.

In another concrete form system, pre-fabricated panels which consist of a metal frame having a replaceable plywood face on one side are provided. In this system, connecting bolts extending through holes in the metal frames are used to secure panels together. A wedge or similar locking piece placed in a slot in the bolts is intended to releasably secure such panels together. The panels may be made in different widths, but in each instance the holes in each frame must be accurately formed so as to match the holes in an adjacent panel. When connected together, the panels have a straight, aligned top and bottom. When seated on a footing, such panels can only be supported from peak to peak of the variations in the footing itself. It is to be noted that a footing cannot normally be economically made with a smooth, level top which is accurately on grade. Also, with the system wooden aligning waler members are needed for alignment of the joined panels. Normally such waler members are two-by-four timbers which must be interconnected with the metal forms by means of additional hardware pieces. The wedges used for securing the panel frames together are deemed to be expendable, since the cost of recovery of the wedges normally exceeds the cost of the wedges themselves.

In a somewhat similar system, steel forms made of steel frames and steel panels are used. Again the same problems occur in that each frame must have a plurality of holes along its edges which must register and mate with the holes of an adjacent panel. Thus, the same problems of accurate machining to provide the mating holes occurs whether the form is all steel or steel-reinforced plywood. Both sets of forms are heavy and cumbersome, requiring additional labor costs in the construction of the form, and the panels are bulky, creating a storage problem. In such systems, also, the form ties seat in grooves spaced along the edge of each of the panels. This requires accurate alignment of such grooves. In some cases the pins or bolts used for holding the panels together also hold the ties together, which again requires accurate alignment of the grooves with other holes of the forms.

Thus, it is apparent many problems are encountered with the use of custom-built forms, including those nailed together and destroyed on dismantling, and prefabricated forms. With the prefabricated forms, various pieces of hardware, including ties, clamps, wedges, bolts, and the like are necessary for assembling the components together. Thus, the maintenance and replacement of the hardware necessary for the prefabricated forms is a costly and continuing job.

Recently, a reasonably economical slab floor construction system for commercial buildings has become available. In this system, expandable steel girders are placed substantially at their ends on shoring columns. After this assembly, plywood panels are placed on the metal expandable girders. No means are provided for attaching the plywood panels to the girders, and the girders must be accurately spaced as to have one fall at each joint of the plywood panels so as to support the plywood panel ends under the weight of the concrete. Being loose, however, the panels, at times, may be blown from the structure by even comparatively light winds. In other cases, from warping, not aligned shoring, etc., the plywood panels do not match at their joints, leaving ridges, creases, and the like, called offsets, in the finished concrete.

In accordance with one embodiment of the invention there is provided a form system which may be made as a modular system for making structures of various shapes. The form includes a light-weight internally braced panel provided with a metal raceway on at least two opposed edges. An internal clamping device or fastener is arranged for mating with and seating in the raceway along the edges of the panel, thereby holding the panels together in correct alignment with a smooth, substantially unbroken surface facing the concrete. The internal clamping device is arranged for temporarily holding the aligned forms on a structural supporting member. In a modified embodiment, the clamping or fastening member is arranged to secure the panels together in edge-wise alignment without regard to end-wise alignment, that is, regardless of whether the ends of the panels are in a straight line alignment or not. Thus, one panel may be at a higher level than the other. The system requires a minimum of bolts, pins, holes, or other devices for securing the panels together or for securing the panels to the supporting members. In a preferred embodiment each raceway secured to the edges of each panel is provided with at least a portion of a magnetizable material, and the clamping device includes a magnet. Thus, the clamp-

ing device is arranged to magnetically hold the panels together and to also magnetically hold to a magnetizable structural member supporting the panel system. The clamping device includes, in addition to the magnet device, means for conjointly seating in adjacent raceways of the panels to secure the panels in accurate edgewise alignment, forming a smooth joint between the panels for facing the concrete.

Included among the objects and advantages of the present invention is a concrete form including relatively thin panel sections which are held together in planar alignment by internal clamping means. In one form the panels are retained together by magnetic force and also retained on a supporting structure by magnetic force. The panels are provided with raceways on at least two opposed sides of the panel whereby a clamping member is arranged to seat in the raceways on the side and hold the panels in edge wise alignment for presenting a smooth, uninterrupted planar surface for facing cement. The clamping member additionally provides means for releasably securing the held panels on a supporting structure. The invention provides relatively thin, light-weight forms which are economically and easily manufactured and are easily and economically utilized for assembling forms for concrete structures. In addition, the panels have unencumbered faces providing economical storage. The clamping member provides a self-cleaning device for the raceways of the form to insure correct alignment of abutting forms, and insures that the panels are in a correct plane along their abutting edges without undue or excessive offsetting at panel joints. The clamping device releasably secures the panels in the proper planar alignment, by means of magnetic force, along both edgewise and endwise engagement with a mating panel.

These and other objects and advantages of the invention may be readily ascertained by referring to the following description and appended drawings in which:

FIG. 1 is a cut-away perspective view of a section of a form system of the invention assembled for slab construction;

FIG. 2 is a cross-sectional elevational view of one form of the device, showing a portion of two panels secured together by means of a clamping device according to the invention, and additionally secured to a supporting member;

FIG. 3 is a top plan view of a section of a slab form, utilizing the system of the invention including the clamping devices of the invention;

FIG. 4 is a partial side elevation of the system of FIG. 2, supported upon metal spanning girders for the slab construction;

FIG. 5 is a side elevation of a wall form utilizing the device of the invention for forming a wall on a footing;

FIG. 6 is a cross-sectional view of a modified form according to the invention, showing a slightly modified raceway section secured to the edge of adjacent panels;

FIG. 7 is a cross-sectional view of a still further modified raceway section and holding system according to the invention;

FIG. 8 is another modified holding section showing, in cross-section, modified raceways secured to the panel edges and illustrating an undercut system for holding the panels against sidewise movement thereof when clamped to a building support;

FIG. 9 is a modified key and raceway assembly mounted on a pair of panels;

FIG. 10 is another modified arrangement showing a split key with interlocking segments for a panel raceway; and

FIG. 11 is a still further modified raceway with a sealing gasket and an H-key.

A panel constructed according to my invention may be of any modular unit size, which includes variation in widths and lengths, and it is preferable that the panel be constructed of what may be called a "sandwich" type.

In such a construction, the panel consists of two facing members or coverings over a light-weight core. Preferably, the facing members are highly waterproof and resistant to deleterious material in concrete. These facings provide wearing surfaces and are tightly secured to a core, preferably by adhesive, etc. The core may be such material as: honeycomb construction, foamed plastic, or braced construction where a series of lateral braces are run internally of the panels leaving large cells internally of the wearing surfaces, or other construction which provides lightness with substantial strength. It is desirable for some conditions to provide, in addition, an increase of the insulating value of the panel itself, as by the foamed plastic, or a combination of the various means of construction. In a preferred form the structural panel consists of treated plywood faces, one of which is secured to one side of the core by means of an epoxy or other similar high-strength cement and a face of similar material may be provided for the opposite side of the core. The faces of the panel may, also, be of a non-porous, highly resistant material, such as sheet metal, which may be steel, aluminum, etc., treated plywood and hardboard, Fiberglas, or the like. The wearing surface of the panel, that is, the one which is in actual contact with the cement, may have an overlay or coating which may be renewable, or the like.

In one embodiment, each panel is provided with a continuous frame around the perimeter, the frame member being a raceway, described in full below. The frame or raceway of the panel is composed of one or more elements, one of which may be a magnetic or magnetizable substance, while the other may be a non-magnetizable material, preferably an aluminum extrusion, or, under some conditions, a tough, resilient plastic, or the like.

In the illustration of FIG. 1, the use of the panel system is shown, where panels are mounted side by side and edge to edge for slab construction. These panels are temporarily secured together, as described in detail below, and are arranged to support a slab of concrete for setting and curing. Each panel, as shown in one embodiment, FIG. 2, includes a core 1 having a wearing face 2 secured to one surface thereof by means of a resin or other high-strength adhesive and a face 3 on the opposite side thereof. The face 3 may be relatively non-wearing i.e., not metal or treated cellulosic material since it is not normally in contact with concrete. As illustrated in FIG. 2, the covering materials 2 and 3 are indicated as wood; however they may be of any suitable material. The panel core may be of any convenient size, both as to length and width, and edging strips may be used to support a raceway 5. The raceway portion 5 is secured to the edges of each of the panels with the exterior surface 6 of the raceway 5 flush with the surface 2*a* of the panel. The raceway 5 is secured to the panel by means of an epoxy resin adhesive or other high-strength bonding material or it may be fastened in any suitable means. The raceway section 5 may be made of any non-magnetizable material, for example aluminum, magnesium, high impact resin, or the like. A biased surface 13 on the raceway 5 mates with a similar surface on the adjacent raceway to form a triangular shaped void for expansion and the like of the members. Secured to the raceway 5 is an angle member 7 which is steel, other ferrous iron, or other material which is magnetizable. This piece includes a surface 8 on one leg which is flush with the surface 3*a* of the face material 3. The channel 7 may be initially secured to the raceway member 5 by means of an epoxy resin or similar adhesive and then both secured to the edge of the panel. It is specifically noted, in a preferred arrangement, that the channel 7 is in flush alignment with the edge 3*a* of the panel and at the opposite end the raceway 5 has its edge 6 in flush alignment with the surface 2*a* of the opposite side of the panel.

An H-shaped key, shown in general by numeral 10, is arranged to seat in the raceway formed by adjacent

panels by means of a T-shaped member 11 which may be made of a non-magnetizable material, such as aluminum, high impact plastic, other synthetic resin, or other material. The shape of this member provides a relatively close fit in the mating raceways 9 of the members 5. Where the T-shaped member is deformable plastic, any foreign matter lodged in the raceway obviously tends to deform it. The triangular void provides a space into which the plastic material may deform if forced by said foreign matter.

A bar magnet 15 is secured to the T-shaped member, substantially centrally aligned thereof, by means of an epoxy or other high-strength resinous adhesive or the like, completing the H-shaped key. The bar magnet 15 is preferably thicker than the groove formed by the mating angles 7 so that it protrudes beyond the surface 8 of the channel 7, which leaves a small space 16 between the surfaces 3*a* and 8 and a supporting member 18. The supporting member 18 is of a magnetizable material, generally steel as it is an economical material for the purpose. This thickness of the magnet insures actual contact and seating against the support member 18 for maximum magnetic holding.

The key or clamping device 10, therefore, by means of the magnet and the magnetizable channels, temporarily secures the two panels together. The magnet, in addition, temporarily secures the held panels to the magnetizable support, or to at least the magnetizable portions of the support where it is made of a non-magnetizable material and a magnetizable material, e.g., wooden beams or timbers with a sheet steel face. The structure provides, in effect an internal key which holds the panels with their wear faces 2*a* in flush, planar alignment.

The structural support 18, as pointed out above, must include at least a portion, available for contact with the magnet, of a material capable of accepting the influence of the magnet of the clamping device. The support member should include a magnetizable portion of such a shape to provide adequate surface area for the exposed area of magnet to insure effective clamping action and, obviously, the support member must be of such strength as to sustain the loads which are placed upon it when the concrete is poured into the form. Such a structural support may be a steel beam, or a wooden beam with a steel seating surface or other magnetizable surface, either along its full length or discontinuous thereon. When used horizontally as a "horizontal shore" this member supports such panels for floor construction. When used in connection with panels erected vertically and in conjunction with form tying devices it supports the panels for wall form construction.

The clamping device 10 may be nominally a device between one and six inches long, since most of the supports on which it rests will be essentially no wider than six inches. To take advantage of and to provide an economical clamping device, the magnet and attached member should not be essentially greater than the width of the supporting member. In one form the magnet may be only a portion of the one side of the H key, providing a still further economy of construction. To provide structural continuity between endwise abutting panels, a clamping member of substantially the same cross-sectional shape may be made of considerably longer configuration to extend a substantial distance lengthwise of both endwise abutting panels. The additional length will provide a load transfer member from one panel to the other and support the ends of the panels which may not be bearing on a structural support. Since the raceway runs along the length of the panel, in addition to running along the end of the panel in one form, the clamping member may be moved substantially any place along the length of the panel to a position where it will contact the magnetizable portions of the support member. For the load transfer member, it may be made of a non-magnetizable material along its length, which may be greater than about six inches, including the T-shaped portion 11, FIG. 2, as well as part of the lower portion except that a short magnet, i.e., shorter than the full length of the transfer member, may be mounted in the lower portion in order to provide a temporary clamp means for a support and to clamp onto the magnetizable portion of the panel raceway.

In the form shown in FIG. 1, the panels with the clamping member are used for a horizontal slab construction wherein a series of panels A, B, C, etc. are arranged edgewise and endwise, abutting other panels to form a bed on which a concrete slab 110 is poured. Such a slab usually includes reinforcing steel 111, as is common practice. The panels must obviously be adequately supported, and for this purpose an expandable beam 20, illustrated in FIGS. 1 and 4, may be used. Such beams have been used heretofore and are not considered part of the invention. The beams or girders are effective for use with the invention as they are metallic and provide a magnetizable surface on which the magnets of the keys may grip. Such a member, shown in general by numeral 20, includes an I-beam or plate member 21 which is arranged for mounting on a ledger 20*a* which is supported on a vertical shoring 20*b*, such shoring being normally adjustable, as a jack screw and are commonly used devices. The plate member 21 is releasably mounted in a slot in a lattice beam or girder member 22 and is adjustably secured in place by a bolt and nut clamp arrangement 23. The lattice member 22 is, likewise, supported at its end on a ledger 20*a* which is supported on vertical shoring, which is normally adjustable. The plate 21 and the lattice 22 and their upper surfaces are metal, normally steel, and are magnetizable. In this case, panels 25, made in accordance to the description of the device of FIG. 2, are mounted on the horizontal support members and clamping members 10 are arranged between the panels and in position to magnetically clamp on the metal top of the beams. As illustrated in FIGS. 1 and 3, a series of panels, which includes panels A through D, inclusive, are joined side by side and these positioned end to end to panels E through H, thereby to provide a form for the slab. In this case, the panels A–D rest, adjacent one end, on a beam member 27, and at each intersection of the panel joints and a beam a clamping member 10 is placed. Another beam 28 is spaced from the beam 27, nominally two feet, although with the clamping arrangement of the invention it is not necessary to be accurately placed since the clamping devices 10 may be positioned any where in the raceways of the panels. The ends of these panels are interconnected with the endwise abutting panels E–H by means of an elongated transfer clamp member 30, explained above, which is similar to the clamp member 10 although of longer dimensions. The panels E through H similarly rest on beams 31 and 32 and at the intersection of each panel joint and the beam a clamping member 10 is provided which, as pointed out above, not only clamps the panels together, but also clamps the held panels on the beam. It is noted in this configuration that the transfer member 30 interconnects four panels, the interconnection being at the corners of the four panels. Thus, it is apparent it is not necessary to provide a beam directly under the endwise joints of the panels, since the transfer members provide a load transfer from one panel line to the other, and prevent deflection of the unsupported panel ends. In certain innstances where a very long span is necessary, it may be desirable to provide a longitudinal support member 35 for the horizontal shoring which may be any type of a supported beam held against the horizontal shoring.

After the beams, which are to support the panels, are placed in horizontal position, the panels are mounted on the beams with the clamping members 10 in position above, and in magnetic clamping arrangement with, the beams so as to clamp the held-together panels onto the beam, the reinforcing steel 111 may be placed on the panels and with necessary dams the pouring of the cement

is completed. Subsequent pourings, where necessary, are completed. After the concrete has hardened sufficiently, the panels are very easily removed by merely loweding the shoring which lowers the panels from the concrete. The panels are easily released from the beams and each other either by twisting the panels, which reduces the magnetic force of the magnet, or by any type of a pry which will pry the magnet away from the magnetized material. Since there are no mechanical fasteners to unfasten, the dismantling of the form is readily and easily accomplished with essentially unskilled labor. In a similar vein, since the panels need not be mechanically fastened to the beams, they are easily placed in position, only making certain that the magnetic clamping devices are in position to contact the magnetizable material of the beams. The panels are, thereby, temporarily held on the supporting members.

The same panels and clamping devices are readily adaptable for construction of vertical walls, columns, piers, battered walls, pilasters, etc., and one such a system is illustrated in FIG. 5. In this vertical wall system, a series of panels I through N are arranged in edgewise alignment and rest on a footing **40**. In the illustration the uneven surface of the footing is shown somewhat exaggerated; however, it illustrates how the panels may be effectively utilized with such uneven footings without the necessity of blocking up the panels to form smooth upper and lower edges. The panels are held in edgewise configuration by means of the clamp devices **10** mounted in the raceway of each of the panels, and these in turn clamp against a support waler **41** at the upper end and a support waler **42** at the lower portion. Obviously, other such walers may be used. The wall must be braced in some manner, normally by biased shoring, to maintain the panels vertical during support of the wet cement. Since the raceways extend completely along the edgewise length of the panels, it is not necessary that the panels be perfectly horizontally aligned, with respect to their upper and lower edges; therefore, as illustrated, the panels may be arranged to conform as nearly as possible to the contour of the footings **40**. This leaves an uneven top; however, this is readily taken care of by the finisher who can smooth off the top by troweling the wet concrete to proper height. This arrangement provides adequate support for each of the panels on the footings, and prevents slop-out or running of the cement from the large cracks which would otherwise be found between the panels and the footing.

The moldings or raceways around the perimeter of each of the panels may be of substantially any shape so long as each is arranged to mate with a key or clamping device, preferably of a configuration which does not require the exact placing of the clamping device in the raceway. Such raceways may be of the tongue and groove type, convex-concave configuration, shiplap or overlap, reverse or ogee moldings, slides within guides, etc. In all such cases the key mates with the raceways of the abutting panels and holds the panels with their concrete contacting surfaces flush. In addition each of the moldings and raceways must provide an opening so that the magnet may extend beyond the panel surface for contact with a magnetizable supporting member.

A modified device is illustrated in FIG. 6 wherein a panel, shown in general by numeral **50**, includes a core **51** (which may be of various materials, as pointed out above) having secured thereto a wearing surface **53** and a non-wearing surface **54**. A trimmer piece **55** is, likewise, fastened to the core members **51** to provide a box-like panel construction. To the peripheral edges of this panel is mounted a molding or raceway member **56** which extends along each edge of the panel. This molding includes a tubular hole or passage **57** and a groove **58**. The molding section is provided with an arcuate surface **59** arranged to be juxtaposed with a similar surface **59** forming a groove or void therebetween. In this configuration, saw-tooth grooves or knurling are provided on the raceway so that a sufficient amount of an adhesive will be present to securely hold the members together. Again the outer surface of the raceway **56** is flush with the surface of the wear face **53**. The member **56** may be plastic or the like, generally an extruded form for economy. An angle **62** is secured to the molding or raceway **56** by a high-strength adhesive and the assembly in turn is secured to the trimmer member **55** and the edegs of the faces **53** and **54**. The raceway **56** may, also, be of a non-ferrous metal, while the angle **62** must be of a magnetizable material. An H-section clamping member **10**, described above, is arranged to seat in the grooves **58** of the raceways and to magnetically seal against the angle members **62**. By making the raceways **56** of a synthetic plastic or other deformable material, the tubular voids **57** extending lengthwise therethrough provide means for making the members slightly oversize so that they will be in compression against one another when the panels are clamped by the key. These, therefore, form a tight seal for the joint facing the concrete.

Another modified form is shown in FIG. 7 wherein the panel, illustrated in general by numeral **70**, includes a core material **71** and trimmer portions **72** having facings **73** and **74** secured thereto by suitable means forming a unitary panel. Seecured to the edges of such a panel are molding sections **75** which include a hollow, lengthwise groove **77** and a rounded groove portion **76** which, when mating with an adjacent similar portion, provides a tubular hollow therealong. A wear face **79** is secured to the molding **75** by any suitable means. The completed molding section may be secured to the panel as by means of a high-strength adhesive or the like, with the wear face flush with the surface of face **73**. The molding section **75** and the wear face **79** may be of non-magnetic material, such as aluminum, high impact strength plastic, or the like. An F-section member **78** is secured to the molding **75** and is also secured to th panel by means of an adhesive or the like to form the raceway section. The F-section member is a magnetizable material capable of being influenced by the magnetic effect of an H-shaped magnet **81** which secures the panels together, in a manner set forth above. A soft, flexible gasket **80**, which may be a tubular gasket or a cylinder, is inserted in the void formed between the portions **76**. This gasket prevents the entrance of cement and other foreign matter during concrete pouring. The held-together panels are then secured on support form **18** in a manner similar to that above wherein the magnetic force of the magnet **81** secures the held-together panels against the structural member. It is to be noted in this case that the wear faces **79** of the molding section **75** are made flush with the face **73**. The magnet **81** dimensioned so as to extend slightly beyond the other face **74** for contact with the magnetizable portion of the support beam **18**. In this case, also, the magnet may be a somewhat distorted H-section magnet without a non-magnetic portion, as in the device of FIG. 2. The groove **83** of the F-section provides means for accurately aligning the panel so that the wear faces of adjacent panels are flush and present a smooth planar surface to the cement.

In a further modified device shown in FIG. 8, an undercut principle is demonstrated wherein there is a positive interlock between the panel members when the magnetic clamping device is placed between a pair of panels and on the supporting beam. In this case the panel, illustrated in general by numeral **90**, includes a core member **91** and a face member **93** secured thereto in any suitable manner essentially having its edge flush with the edge of the core. On the opposite side a wear face **92** is secured to the core with an end portion **92***a* extending beyond the edge of the core **91**. A distorted channel member **95** is secured to the edge of the core and its lower edge is flush with the face **93**. A connecting member **94** is secured between the face **92** and the leg of the

channel member 95 by any convenient manner, preferably by an epoxy or other high-strength adhesive, leaving a void 98.

The channel member 95 has an undercut groove 96 which is arranged to match a modified T-magnet 99 having a matching undercut cross-bar. The channel member 95 is a magnetizable material so that it is securely held to the key 99 by magnetic force. When the magnet 99 is magnetically clamped to the support 18, the panel members are securely locked together by means of the undercut, which prevent free lateral movement from the magnet. It is, also, noted that the member 94 leaves a hollow space 98 in the molding section, and by making the connector 94 and the extending portion 92*a* of a resilient material, the panels may be provided with a seal which is retained in accurate planar alignment with the wear surface.

The modification illustrated in FIG. 9 shows versatility of the construction. In this instance a lightweight reinforcing core 120 has attached thereto a wear face 121 on one side and another face 122 on the other. A distorted V-shaped trimmer piece 123 is secured to the core, in any convenient manner, so that the edge 121*a* extends over one leg. The face 122 extends partly over the other leg. A light gauge, magnetizable sheet metal strip is formed in the shape shown. The edges 125 are folded back tightly, forming a slightly rounded edge on the corner of the face 121. At the lower portion the edge 126 is turned back and folded into the V-shaped portion 127.

The strip is separately made and secured to the trimmer piece by nails, adhesive, or the like. The trimmer piece may be a wooden strip which has been run through a shaper. The trimmer piece is affixed to the core and the facings attached to the core by the desired means. The sheet metal strip may be very light gauge, e.g., 26 gauge, and after folding and creasing provides a strong member. There is sufficient metal to provide an adequate magnetic seal with the magnet 15 of the key member 10. It is apparent that the assembly of such a unit is simple and inexpensive.

A split key may also be utilized wherein a split magnet is used to hold the adjacent panels together and on a support. As illustrated in FIG. 10, the panels include a core 130 having a facing 131 secured thereto on one side and a facing 132 secured to the other side. A split raceway with a dovetail groove is secured to the core, and the parts 133 and 134 jointly form a dovetail groove 135. The raceway may be a wooden member (the two parts permit the use of a conventional shaper) secured to the core and to the facings in a convenient manner. A dovetail section 136 is secured to a bar magnet 137 to form one-half of the key. The dovetail part is introduced into the groove 135 at the ends of the raceway and moved to the desired position. The opposed half of the key is mounted in the groove in the adjacent panel and it is moved to mate with the other key half. The magnets, when properly aligned as to poles, magnetically clamp together, holding the panels together, and incidentally holding against a magnetizable beam 18. This arrangement provides a captive key, which may be moved along the panel, but is captive since it must be removed from the ends of the raceway. Also, the only clamping arrangement between panels is magnetic force.

A slightly modified panel raceway is shown in FIG. 11, using a sheet metal form with a sealing gasket. This ararngement includes a core 140 having a facing 141 on one side and a facing 142 on the other. A trimmer piece 143 is secured to the core and a sheet metal strip 145 is secured to the trimmer. This strip is folded back at both ends, it is grooved and provides a rounded groove 146 for mating with a similar groove forming a tube. A gasket 147 may be placed in the groove forming a seal.

The raceway or molding preferably includes at least one groove into which the key may mate, for forming an accurate, flush joint facing the cement. It is obvious that more than one groove could be used where desired. It is preferable to maintain the groove system so that the wear facing on one panel is in sealing relation with its neighbor (or with another sealing member therebetween), thereby forming an internal groove securing an internal key. With the captive keys, other means for securing the panels together and to a beam may be used.

While the invention has been described with reference to particular embodiments, there is no intent to limit the spirit or scope of the invention to the details so set forth except as defined in the claims.

I claim:

1. The combination of at least two panels disposed in edgewise abutment for making a concrete mold form, each panel being a planar, rectangular body having at least one surface for containing concrete thereagainst, an edging member mounted on at least two opposed peripheral edges of each said body, there being at least one raceway in each said edging member adjacent one side thereof in position to mate with the raceway in an edging member on the abutting panel cooperatively forming an outwardly opening groove therebetween, each said edging having a portion on its edge adjacent said concrete containing surface positioned to mate and seal with a similar portion on an edging member of the adjacent panel, key means arranged to fit in said mating raceways for temporarily holding the adjacent panels together, and means cooperative with said key for temporarily securing the same to supporting members.

2. The combination of at least two panels disposed in edgewise abutting relation for making a concrete mold form, each panel being a rectangular body each having at least one surface for containing concrete thereagainst, edging members mounted around the peripheral edges of each panel, there being at least one raceway in each said edging member adjacent one side thereof in a position to mate with a similar raceway in the edging member of the abutting panel cooperatively forming an outwardly opening groove therebetween, each said edging member having a portion on its edge adjacent said concrete surface positioned to mate and seal with a similar portion on the adjacent panel, there being another raceway in said edging adjacent the edge opposite said concrete contacting surface for mating with a similar raceway in the adjacent panel edging, thereby cooperatively forming a second groove communicating with said first groove and opening to the outside of said adjacent panels, key means arranged to fit in the grooves in said mating raceways, and means cooperative with said key for securing the same to supporting members.

3. The combination of at least two panels disposed in edgewise abutting relation for making a concrete mold form, each panel being a rectangular body having one planar surface for containing concrete thereagainst and an opposed planar surface encompassing a core in sandwich relation, an edging member mounted on at least two opposed peripheral edges of each said panel, there being at least one raceway in each said edging member adjacent one side thereof in position to mate with a similar raceway in an edging member on the abutting panel cooperatively forming a keyway groove opening on the side opposite said concrete containing surface, there being a projection on each panel edge adjacent said concrete containing surface positioned to mate and form a flush seal against a similar projection on the adjacent abutting panel, and each side of each panel being planar from edge to edge without projections extending beyond either surface.

4. A combination according to claim 3 in which each projection on each panel edge includes a portion of said concrete containing surface and a portion of said edging member.

5. A combination according to claim 3 in which said edging member is mounted on all of the peripheral edges of said panel.

6. A combination of at least two panels disposed in edgewise abutment for making a concrete mold form, each panel being a planar rectangular body and each having a surface for containing concrete thereagainst, an edging member mounted on at least two opposed peripheral edges of said panel, there being at least one raceway in each said edging member adjacent one edge thereof in position to mate with a similar raceway in the edging member of the abutting panel and form an outwardly opening groove, each edging member having a portion on its edge adjacent said concrete containing surface position to mate and seal against a similar portion on the adjacent panel, the material of said edging at said raceway being of magnetizable material, and a key arranged to fit in said mating raceway, a portion of said key being a magnet whereby to magnetically hold against said magnetizable material of the raceway and thereby temporarily securing the adjacent panels together, and said magnet extending a short distance beyond the panel and the edging members in position to contact a magnetizable support member.

7. A combination of at least two panels disposed in edgewise abutment for making a concrete mold form, each panel being a planar, rectangular body including a core and having on one side a wear surface for containing concrete thereagainst, a molding member mounted on at least two opposed peripheral edges of each panel, there being at least one raceway in each said molding member at one edge thereof in position to register with a similar raceway in a molding member on the abutting panel and jointly form a groove therebetween, the edge of each molding member adjacent said wear surface extending so as to mate with a similar edge of a molding member on the adjacent panel in tight sealing relation, the material of said molding member at said raceway being of magnetizable material, and a key arranged to fit in said registering raceways, a portion of said key being a magnet and positioned to seat in said raceways whereby to magnetically hold against the magnetizable material of the raceway, and said magnet arranged to extend a short distance beyond the molding member in position to contact a magnetizable support member.

8. A combination according to claim 7 wherein each said molding member includes two raceways, the other of which is spaced from the first said raceway and positioned to form an internal groove when registered with the raceway in the abutting panel, and said internal groove opening into said first said groove.

9. A combination of at least two panels disposed in edgewise abutment for making a concrete mold form, each panel being a planar, rectangular body having a wear surface for containing concrete thereagainst, a molding member mounted on the peripheral edges and framing each said panel, there being at least one raceway in each said molding member at one edge thereof opposite said wear surface and positioned to register with a similar raceway in a molding member on the abutting panel and cooperatively forming a groove facing away from said wear surface, the material of said molding member at said raceway being magnetizable, each molding member at the edge opposite said groove being arranged to mate with a molding member on the adjacent panel and form a sealed joint between the adjacent panels which is flush with said wear surface, and a key arranged to fit in said groove, a portion of said key being a magnet whereby to magnetically hold against the magnetizable material of the raceway, and said magnet extending a short distance beyond said members for contacting a magnetizable support member.

10. A combination according to claim 9 in which each said molding member includes two raceways registerable with two similar raceways in the molding of the adjacent panel conjointly forming an internal H-shaped groove with one leg open on the panel side opposite said wear surface, and said key is essentially of an H section for seating in said groove with its magnet portion extending beyond the confines of the panels.

11. A combination of at least two panels disposed in edgewise abutment for making a concrete mold form, each panel being a rectangular body having a reinforcing core and one surface for containing concrete thereagainst, a raceway member mounted around the peripheral edges of each said panel, there being at least one rabbet in one edge of the raceway and opening toward a surface of said panel opposite said cement holding surface, each rabbet being arranged to register with a similar rabbet in a raceway member in the abutting panel to conjointly form a groove, the material of said raceway adjacent said rabbet being magnetizable material, at least one key member arranged to slidably fit in said registering raceways and permit said panels to closely abut with a tight seal at the joint on at least the concrete holding surfaces, a portion of said key being a magnet whereby to hold against the magnetizable material of the raceways, and said magnet arranged to extend a short distance beyond the raceways whereby to magnetically hold against a magnetizable support member.

12. A combination according to claim 11 wherein each key member is substantially shorter than each raceway, and at least two such keys are spaced along the raceway of abutting panels.

13. A combination according to claim 11 wherein a series of key members are arranged in the raceways at least one such key member is longer than the others and is arranged as a load transfer clamp for end to end abutment of adjacent panels.

14. The combination of at least two panels disposed in edgewise abutment for making a concrete mold form, each panel being a planar, rectangular body having a wear surface for contacting and containing concrete thereagainst, a raceway member extending along at least two opposed edges of each said panel, each said raceway member being essentially of an F-section with the top of the F mounted flush with the wear surface of the panel and projecting therefrom to a position for sealing relation with the top of an F-section on the adjacent panel, the leg portion of the F-section having its end flush with the opposite surface of the panel and including a magnetizable portion, an H-section magnetic key arranged to seat in the grooves of mating F-sections of abutting panels and extend a short distance beyond the said opposite surfaces for contact with a magnetizable support section, said H-section key including an upper T-shaped portion of non-magneitc material, and a lower bar magnet secured thereto arranged to seat in the F-section and magnetically hold against said panel by means of the magnetizable material and whereby abutting panels are magnetically held together and secured against a magnetizable support member.

15. A combination of at least two panels disposed in edgewise abutment for making a concrete mold form, each panel being a planar, rectangular body having a wear surface for contacting and containing concrete thereagainst, a raceway member extending around the peripheral edge of each said panel, said raceway member being essentially of an F-section with the top of said F being mounted flush with the wear surface of said panel and projecting laterally therebeyond to a position for close sealing relation with the top of the F-section on the adjacent panel, the leg portion of said F-section having its end flush with the opposite surface of said panel and including a magnetizable portion, an H-section magnetic key arranged to seat in the grooves of the mating F-sections of the abutting panels and extend a short distance beyond the said opposite surfaces for contact with a magnetizable support section, said H-section key including an upper T-shaped portion of non-magnetic

material, and a lower bar magnet portion secured thereto arranged to seat in the F-section and magnetically hold against each said panel by means of the magnetizable material and whereby the abutting panels are magnetically held together and secured to a magnetizable support member.

16. A combination according to claim 15 wherein the raceway members are secured together and to each said panel by a high-strength adhesive.

17. A key member for securing magnetizable panel members together and to a magnetizable support structure, comprising an H-section member having a T-section portion of non-magnetizable material secured to a bar portion, and at least a portion of said bar portion being a magnet having an exposed bottom opposite said T-section and two exposed sides.

18. A key member according to claim 17 in which said T-section is essentially dovetailed for slidably mounting in a mating groove.

19. A key member according to claim 17 wherein the bar portion is wholly a magnet.

20. A form system for molding concrete structures comprising a plurality of panels arranged to mate edgewise in side by side relation and provide a flush surface for facing concrete, the mating edges of each panel having a raceway for accommodating a key member and cooperatively hold adjacent panels in planar alignment, each set of mating raceways cooperatively forming a groove facing oppositely away from said flush surface, where said key member is at least partially exposed, each raceway having a magnetizable portion in said groove, a plurality of key members arranged to seat in said raceways and extend a short distance therebeyond, each key member having an exposed magnet portion positioned to seat against said magnetizable portion and having an exposed portion in said extending short distance, and a plurality of shoring members arranged to support said panels in concrete holding position, each said shoring member having at least a magnetizable portion positioned for contact with the exposed magnet portion of said key members whereby to temporarily secure adjacent panels together and to said shoring members.

21. A form system for molding concrete structures comprising a plurality of panels arranged to join edgewise in side by side relation and provide a flush surface for facing concrete, the adjoining edges of each panel including a raceway for admititng a key member so as to cooperatively hold adjacent panels in a common plane, each set of adjoining raceways cooperatively forming a groove facing oppositely away from said flush surface so as to at least partially expose a key member disposed therein, each raceway including a magnetizable portion in said groove, a plurality of key members seated in said raceways and extending a short distance therebeyond, each key member including an exposed magnet portion positioned to seat against said magnetizable portion and extend into the extended portion, and a plurality of shoring members supporting said panels in concrete holding position, each said shoring member having a magnetizable portion positioned for contact with the exposed magnet portion of said key members whereby to secure adjacent panels together and to said shoring members.

22. The combination of at least two panels disposed in edgewise abutment for making a concrete mold form, each panel being a planar rectangular body having at least one surface for containing concrete thereagainst, there being at least one raceway on two peripheral edges of each panel in position to adjoin with the similar raceway on the abutting panel cooperatively forming an outwardly opening groove therebetween and including a projecting portion disposed on the edge adjacent the concrete containing surface and arranged to mate with and seal against the similar projection on the adjacent panel, key means in said mating raceways for holding the adjacent panels together, and means cooperative with said key for securing the same to at least one supporting member.

23. A form system for molding concrete structures comprising a plurality of panels arranged to join edgewise in side by side relation and provide a flush surface for facing concrete, the adjoining edges of each panel including a raceway for accommodating a key member so as to hold adjacent panels in a common plane, each set of adjoining raceways cooperatively forming a groove facing oppositely from said flush surface so as to partially expose a key member disposed therein, each raceway including a magnetizable portion in said groove, a plurality of key members arranged to seat in said raceways, each key member including a magnetized portion positioned to seat against said magnetizable portions of the raceways and arranged to extend beyond said panels a short distance, and a plurality of shoring members arranged to support said panels in concrete holding position, each said shoring member including a magnetizable portion positioned for contact with the exposed magnetized portion of said key members whereby to secure adjacent panels together and to said shoring members.

24. A combination of at least two panels disposed in edgewise abutment for making a concrete mold form, each panel comprising a four-sided planar body having at least one surface for containing concrete thereagainst, there being one lengthwise elongated recess in two sides of each said body in position to adjoin with a similar recess in the abutting panel to cooperatively form an outwardly facing opening therebetween, means on each panel adjacent the concrete contacting surface arranged to mate with and seal with similar means on the abutting panel, key means disposed in said opening for holding abutting panels together, and means associated with said key means for holding the abutting panels to a support member.

25. A combination of at least two panels disposed in edgewise abutment for making a concrete mold form, each panel being a four-sided planar body having at least one surface for containing concrete thereagainst, there being one lengthwise elongated recess on opposed sides of each panel in position to adjoin with a similar recess in the abutting panel to cooperatively form an outwardly faced opening therebetween, means on each panel adjacent the concrete contacting surface arranged to mate with and seal with similar means on the abutting panel, key means slidably disposed in said opening for holding the abutting panels together, and means associated with said key means extending outwardly through said opening for securing the panel to at least one supporting member.

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