

Aug. 2, 1966

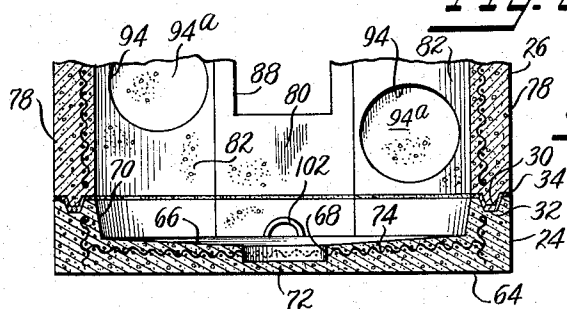
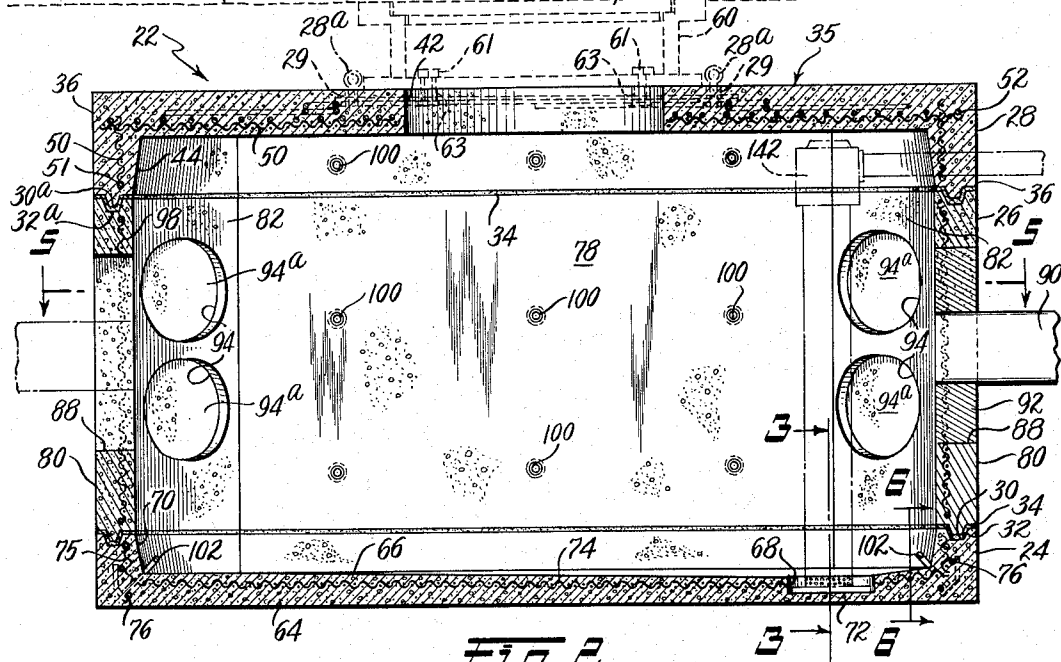
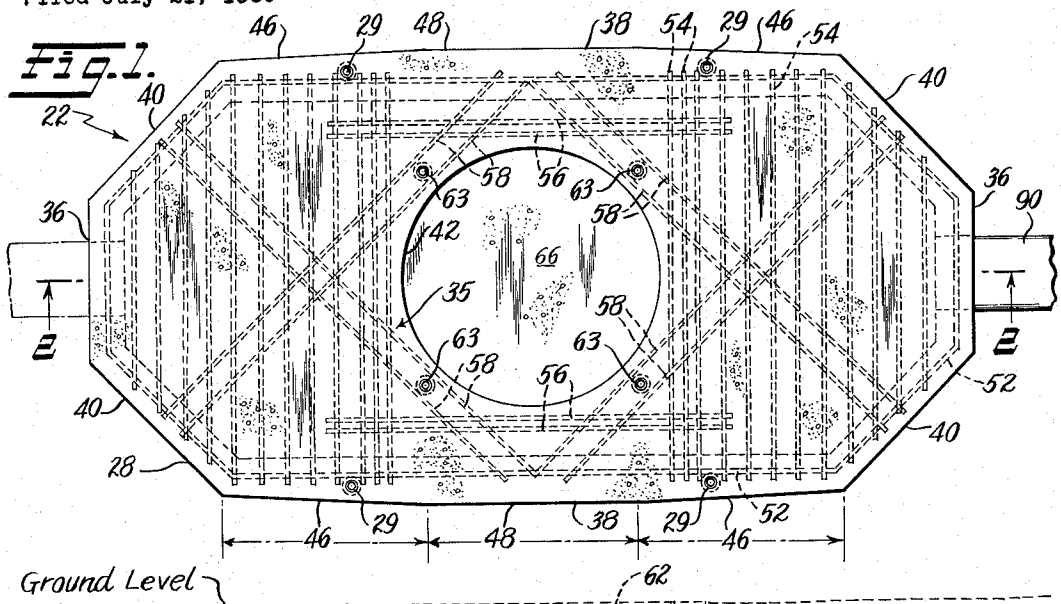
J. P. DORRIS

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PRECAST SUBTERRANEAN UTILITY VAULT STRUCTURES

Filed July 21, 1960

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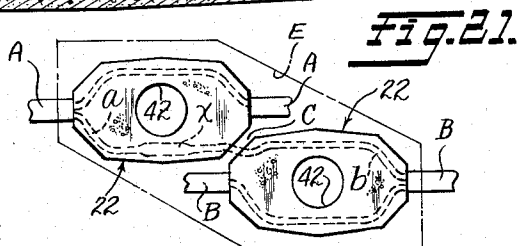
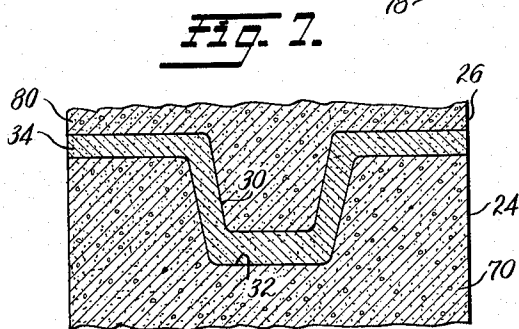
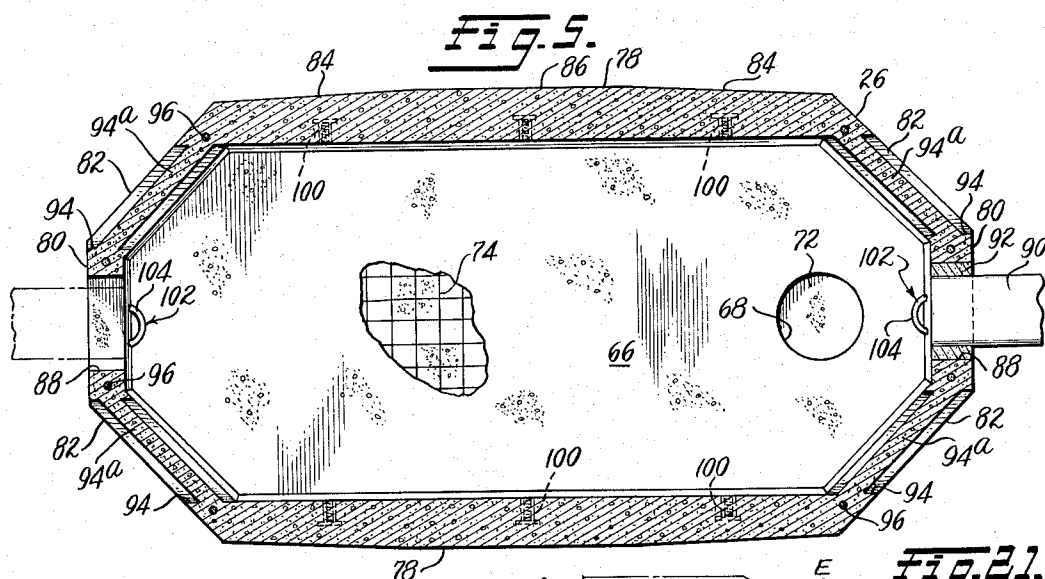
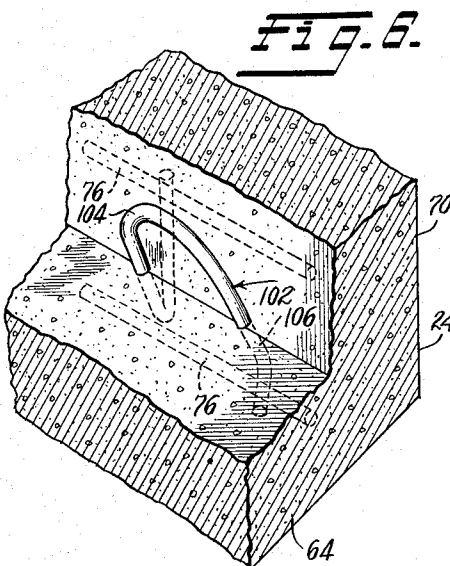


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PRECAST SUBTERRANEAN UTILITY VAULT STRUCTURES

4 Sheets-Sheet 2



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3,263,378

PRECAST SUBTERRANEAN UTILITY VAULT STRUCTURES

Filed July 21, 1960

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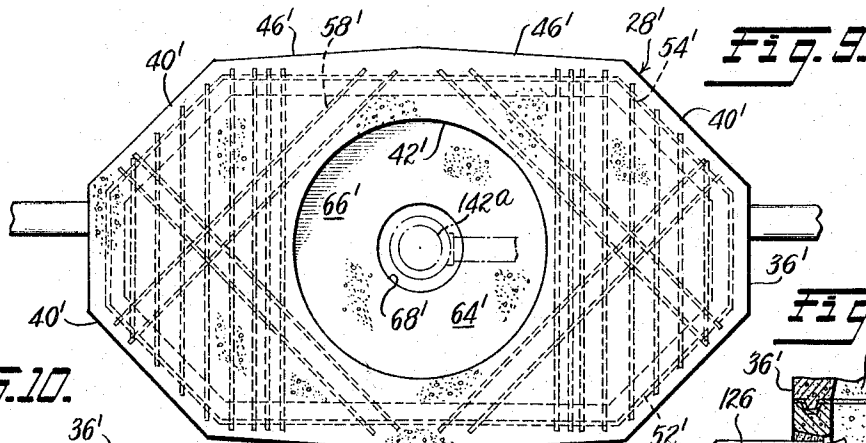
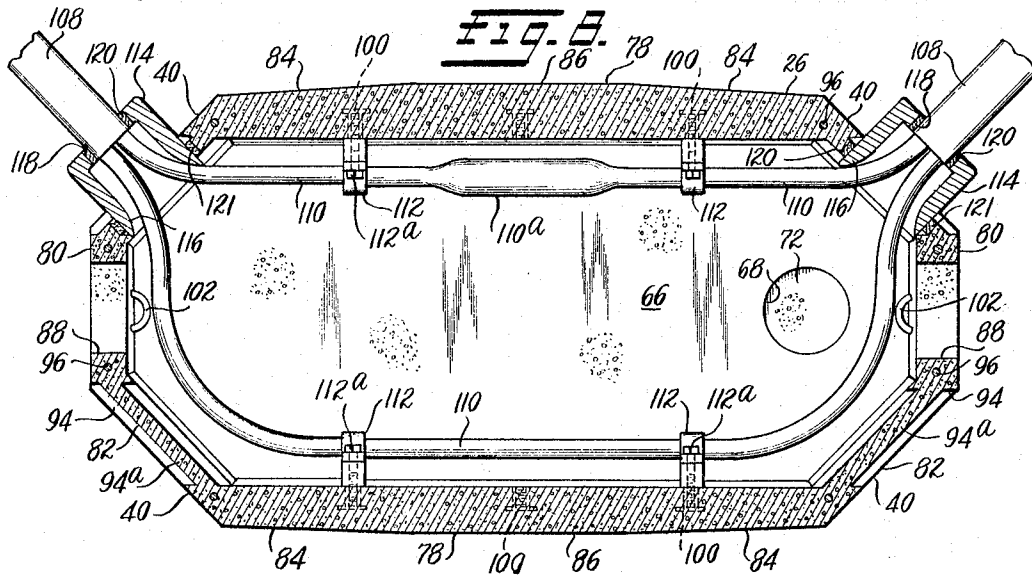
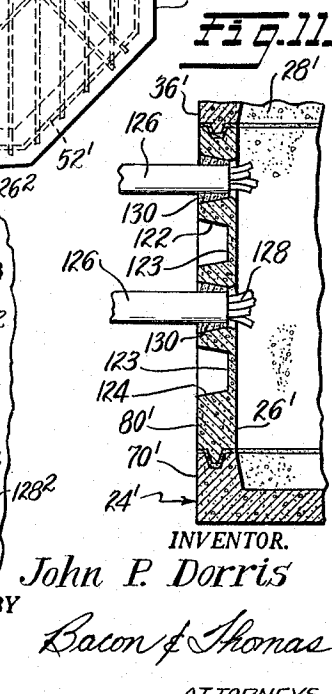
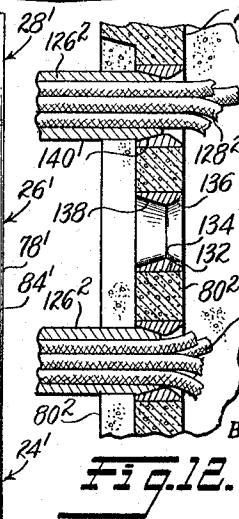
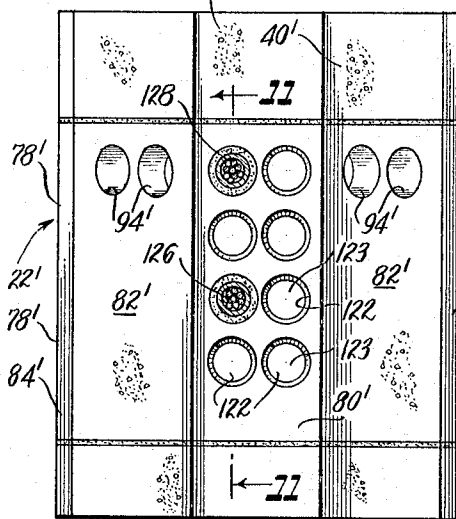


FIG. 10.



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Filed July 21, 1960

4 Sheets-Sheet 4

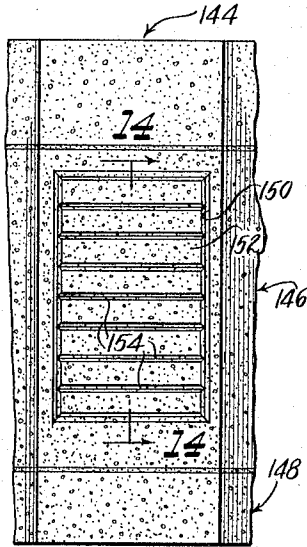


Fig. 13.

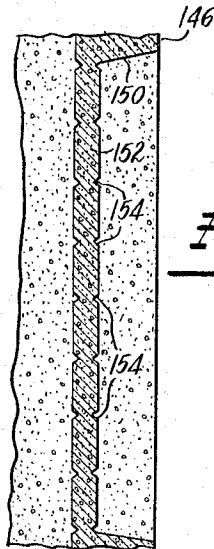


Fig. 14.

Fig. 15.

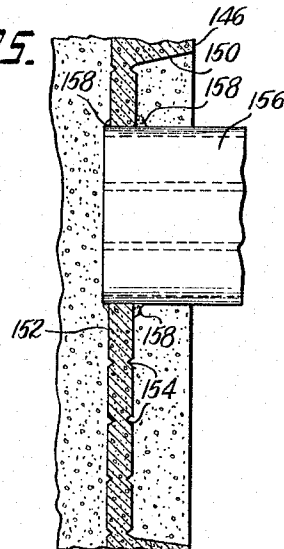


Fig. 16.

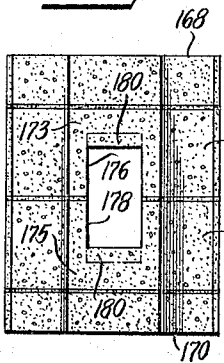


Fig. 16.

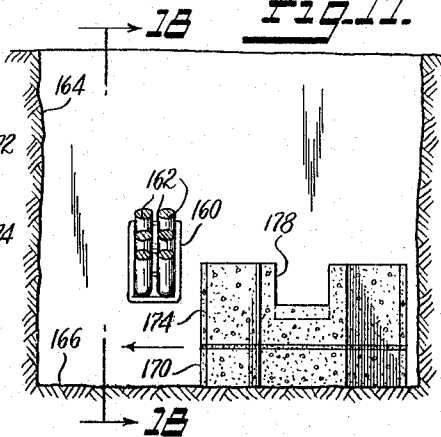


Fig. 17.

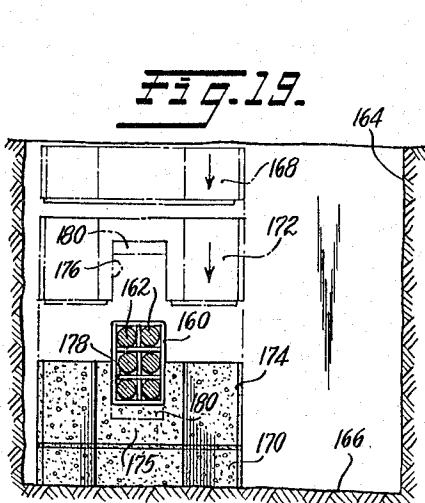
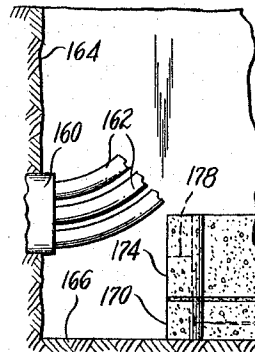


Fig. 19.

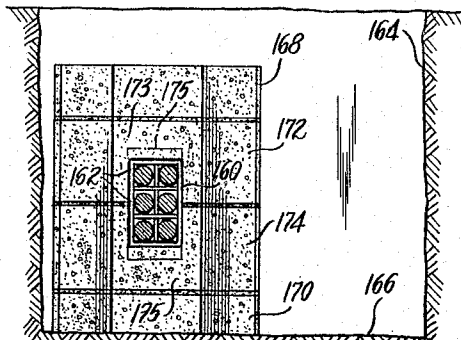


Fig. 20.

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PRECAST SUBTERRANEAN UTILITY VAULT STRUCTURES

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25 Claims. (Cl. 52-20)

The present invention relates generally to underground utility vault structures and, more particularly, to cable splicing vaults comprising precast, reinforced concrete sections.

More specifically, the present splicing vaults comprise only three sections namely, a base, an intermediate section and a cap. Each of these sections weighs less than four thousand (6,500) pounds, so that they can be loaded and unloaded from a truck equipped with a relatively small boom. The sectional construction avoids the disadvantage of precast monolithic structures by eliminating the need for the large crane normally required to handle such structures.

In installing a splicing vault embodying the principles of the invention, the component parts may be hauled by truck to the installation site. An excavation larger than the vault is dug in the ground and prepared to receive the vault by compacting and leveling the bottom thereof. The base section is then lifted from the truck by its own boom and lowered onto the bottom of the excavation. The intermediate section and cap are then successively removed from the truck and assembled with the base. The entire assembly of the vault can be completed in about one-half hour, including trowelling of the joints between the sections. By way of comparison, a splicing vault that is cast in situ requires careful and accurate digging of the excavation, the construction and placement of suitable forms and reinforcing material, and pouring of the concrete, taking several days' time. In addition, the concrete must be allowed to set for several days before the forms can be removed and the vault covered with earth. With the vault of the present invention, the vault can be earth-covered and trenching or other equipment run over the vault immediately.

One of the principal features of the present invention resides in cast each of the component parts of the vault in the shape of an elongated octagon, whereby the sides and ends function as arches or trusses that resist compressive stress and reduce the amount of reinforcing metal that would otherwise be required in a rectangular vault structure having equal resistance to compression.

A unique feature of the present octagonal vault is that a plurality of the vaults can be set in the same excavation in adjacent, but longitudinally offset relation to receive cables from different cable lines and to enable the cables of one line to be spliced with cables of the other line.

Another important feature is that the vault can be readily adapted to various installation requirements by making the intermediate section of any height necessary.

Still another important feature of the present vault structure is that the intermediate section may embody various types of knockout openings for cooperating with various types of cable conduits, thereby adapting the same for general use with telephone and electric power transmission cables.

The invention further contemplates the design of a special two-part intermediate section, which adapts the vault for installation in an existing underground cable line.

The invention still further embodies novel methods for quickly installing the sectional vaults for use in new and/or existing cable lines.

It is an object of the invention, therefore, to provide a precast vault of sectional construction which can be built up to any desired height.

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A further object is to provide a precast splicing vault of elongated, generally octagonal form having knockout sections in a number of its walls permitting use thereof in installations where the cables enter the vault from different directions, and enabling the use of two or more vaults closely adjacent each other and requiring a minimum of space.

A still further object is to provide an underground vault in which the walls are constructed to resist given external stresses with a minimum amount of reinforcing steel.

Another object is to provide a precast splicing vault in which the pulling irons or lifting hooks are located so as to distribute the stress to the bottom and sides instead of entirely to the sides.

A still further object is to provide a splicing vault which may be precast in sections at a molding plant under controlled conditions, and which may be assembled on a compacted area in an excavation prepared by an excavating machine.

A still further object is to provide a precast splicing vault in which the side walls are formed to facilitate the securing of the lead-in cables to the inner side thereof, thereby effecting a saving in material and labor requirements.

A still further object is to provide a precast splicing vault in which the base can be modified for drainage purposes, if required, with a minimum of effort, and wherein a sump pump can be installed, if desired.

A still further object is to provide a precast splicing vault of sectional construction which can be installed in an existing underground cable line, and requiring a minimum of cutting of the cables and replacing of conduit.

A still further object is to provide a precast splicing vault including knockout portions adapted to afford connection thereto of conduits at different underground levels.

A more specific object is to provide a precast splicing vault in which knockout openings allow the use of tapered sleeves to form a seal with a connecting conduit.

With the foregoing and other objects in view which will be apparent, the invention resides in the novel method and combination and arrangement of parts and/or the details of construction hereinafter described and claimed, and illustrated in the accompanying drawings, in which:

FIG. 1 is a plan view of a splicing vault constructed in accordance with the principles of the present invention;

FIG. 2 is a vertical sectional view through the splicing vault taken on the line 2-2 of FIG. 1;

FIG. 3 is a fragmentary sectional view through the base or bottom section and a portion of the intermediate section, taken on the line 3-3 of FIG. 2;

FIG. 4 is a left end elevational view of the splicing vault shown in FIG. 1;

FIG. 5 is a horizontal sectional plan view through the intermediate section taken on the line 5-5 of FIG. 2;

FIG. 6 is an enlarged fragmentary perspective view of a portion of the base section, particularly illustrating the manner in which one of the pulling irons is cast therein;

FIG. 7 is an enlarged fragmentary sectional view taken on the line 7-7 of FIG. 4, particularly illustrating the details of the joint employed between the base and intermediate section;

FIG. 8 is a horizontal sectional view similar to FIG. 5, but showing cables extending into the vault through knockout openings in two of the diagonal corner portions of the splicing vault, and means on the side wall of the vault supporting the cables within the vault;

FIG. 9 is a plan view of another form of vault embodying the principles of the present invention;

FIG. 10 is a left end elevational view of the vault shown in FIG. 9;

FIG. 11 is a fragmentary vertical sectional view taken on the line 11—11 of FIG. 10, particularly illustrating the knockout sections in the end of the vault and the manner in which the ends of conduits may be grouted in the openings at the knockout sections;

FIG. 12 is a fragmentary vertical sectional view similar to FIG. 11, but showing tapered bushings precast in the end section of the vault and the manner in which they cooperate to form a joint with the tapered ends of cable conduits;

FIG. 13 is a fragmentary end elevational view of a modified vault structure including an array of horizontal knockout panels;

FIG. 14 is a fragmentary vertical sectional view taken on the line 14—14 of FIG. 13;

FIG. 15 is a view similar to FIG. 14, but showing three of the panels removed and one end of a rectangular tile conduit mounted in the opening produced thereby and internally and externally grouted relative to the adjoining panels to form a seal around the conduit;

FIG. 16 is an end elevational view of still another form of vault wherein the intermediate section consists of two parts, particularly adapted for installation along an existing underground cable;

FIGS. 17–20 diagrammatically illustrate successive steps in the method of excavating and installing the vault of FIG. 16 around an existing underground cable; and

FIG. 21 is a diagrammatic view showing two octagonal vaults set in a single excavation in longitudinally offset relation.

Referring to FIGS. 1 to 8, the reference numeral 22 generally designates a splicing vault comprising precast sections of steel reinforced concrete, namely, a base 24, an intermediate section 26, and a cap 28 adapted to be arranged in superimposed relation as shown in FIGS. 2 and 4. The lower faces of the intermediate section 26 and of the cap 28 each include a continuous, depending tongue 30 and 30a, respectively, adapted to be received within continuous, outwardly tapered grooves 32 and 32a, respectively, in the upper faces of the base 24 and intermediate section 26. The grooves 32 and 32a are adapted to be filled with a sealing material, such as a suitable grout 34, as will be explained more fully hereinafter.

The cap 28 (FIGS. 1, 2 and 4) comprises an elongated, multi-sided slab 35 of generally octagonal shape having two opposed end walls 36 and two opposed side walls 38 interconnected by four corner or diagonal side walls 40. A circular manhole opening 52 extends through the center of the slab. The walls 36, 38 and 40 are at the peripheral edge of the slab 35 and are formed by a downwardly extending flange 44, the thickness of which is reduced or tapered one inch per foot toward the end having the tongue 30, to stiffen the aforesaid walls and provide the strength necessary to resist the loads imposed thereon.

The side walls 38 of the flange 44 are otherwise not of uniform thickness, but, as is shown in FIG. 1, are each made up of two end portions 46 of gradually increasing thickness and a middle portion 48 of uniform thickness, each portion having substantially the same length, as represented by the dimension lines along the lower part of FIG. 1. It is to be understood, however, that the relative lengths of the end and middle portions 46 and 48, respectively, may be varied to suit the length of vault desired. This side wall arrangement, together with the diagonal wall portions 40, form, in effect, an outwardly bowed arch or truss at each side and end of the cap 28. Since the forces to which the side walls 38 and 40 and end walls 36 of the cap are subjected are principally compressive, the particular arch forms described above are ideal to resist the horizontal stresses and at the same time reduce the amount of reinforcing material required in the side and end walls to resist a given load.

The slab 35 and the flange 44 of the cap 28 are reinforced with woven wire mesh 50. A peripheral steel bar 51 additionally reinforces the lower end of the flange 44. The slab 35 includes a peripheral steel reinforcing bar 52, to which is welded a grill comprising a series of spaced transverse bars 54 disposed on opposite sides of the manhole opening 42. The three transverse bars 54 nearest the manhole opening 42 are spaced closer together than the others, to provide increased strength adjacent said opening. The area around the manhole opening 42 is further strengthened by two pairs of longitudinal bars 56 welded to at least four of the transverse bars 54 on opposite sides of said opening, and by four pairs of diagonal bars 58 welded to the peripheral bar 52, the longitudinal bars 56 and the transverse bars 54. The diagonal bars 58 extend from about the midpoint of the diagonal walls 40 to about the midpoint of the side walls 38 to provide maximum rigidity in the slab.

A manhole casting 60, shown in dotted lines in FIG. 2, surrounds the opening 42, and may be secured in place by bolts 61 passing through a flange at the lower end of said casting and into inserts 63 in the slab 35. A manhole cover 62 closes the upper end of the casting 60 and lies flush with the ground or street level.

The base 24 comprises a slab 64, of the same peripheral shape and size as the slab 35 of the cap 28. The base 24 has a bottom 66 whose top surface slopes toward a sump 68 adjacent one end of the base, as is best shown in FIGS. 2 and 3. The slab 64 is provided with an upwardly extending marginal flange 70 having, on its upper face or edge, the groove 32 to receive the tongue 30 on the lower end of the intermediate section 26 (FIG. 7). The flange 70 is tapered and arched in the same manner as the flange 44 of the cap 28 to carry the loads to which it is subjected.

The bottom wall at the sump 68 is relatively thin to form a knockout panel 72 adapted to be removed, if desired, for the connection of the vault to a drain, or to allow drainage from the vault to a bed of gravel or loose rock below the base 28.

A woven wire mesh 74 is embedded in the slab 64, and a woven wire mesh 75 is embedded in the flange 70 and serve to reinforce these parts. In addition, the flange 70 includes a series of spaced, circumferentially continuous, octagonal reinforcing bars or rings 76.

The intermediate section 26 is also of elongated octagonal form, conforming to the peripheral shape and dimensions of the cap 28 and the base 24. The section 26 comprises four confronting side walls 78 (FIGS. 2, 4, 5 and 8), two confronting end walls 80, and four corner or diagonal side walls 82, joining the end walls and the side walls. The side walls 78 are formed with an arch-like construction, similar to that of the cap 28, including end portions 84 and a middle portion 86. The middle portion 86 is of uniform thickness, being thicker than the end walls 80 and the corner walls 82. The end portions 84 gradually increase in thickness from the ends thereof adjoining the corner walls 82 toward their juncture with the middle portion 86.

Each end wall 80 is provided with a large rectangular opening 88 adapted to receive one end of a conventional, rectangular, multi-core conduit 90 (FIGS. 2 and 5). The opening 88 is of a height several times that of the conduit 90 to permit laying said conduit at various depth levels. The space between the outside of the conduit 90 and the walls defining the opening 80 is filled with a suitable sealing material 92, such as, for example, grout. The diagonal or corner walls 82 have large circular openings 94 containing thin knockout walls 94a, adapted to be broken out to enable said openings to receive short, circular adapters 114 (FIG. 8), as will be explained more fully hereinafter. The knockout openings 94, on either side of the ends 80, may be staggered, as shown in FIG. 4. The end, corner and side walls 80, 82 and 78,

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respectively, may be reinforced throughout by woven wire mesh 98. Steel bars 96 are positioned about the openings 88 and 94 for reinforcing purposes, as shown in FIG. 4.

The interior side wall surfaces of the flange 44 of cap 28, and the interior surface of the side walls 78 of the intermediate section 26, are provided with a series of spaced, internally threaded inserts 100, arranged in rows at selected levels, for a purpose to be set out hereinafter.

A pair of pulling irons 102 (FIGS. 1, 5 and 6) is partially embedded in the base 24 at the opposite ends thereof, extending on an angle of about 45° from the base along the line of juncture of the flange 70 with the slab 64. The pulling irons 102 are generally of U-shape form, including a loop 104 (FIG. 6) extending into the vault space, and a pair of legs 106 embedded in the base. The extremities of the legs 106 are bent in opposite directions, one on an angle of 45° and the other vertically, and are welded to the reinforcing bars 76 in the slab 64 and in the flange 70, respectively. The pulling irons 102 serve a dual purpose. Thus, they are used during installation by connecting chain hooks thereto (not shown) to remove the base 24 from a truck (not shown) and lower it to the ground or onto the bottom of an excavation, and are used after installation of the vault by connecting a pulley thereto, to aid in pulling cables into the vault.

The three-part vault structure, i.e., the base 24, intermediate section 26, and the cap 28, described above, can be precast at a molding plant under controlled conditions following conventional concrete casting procedures. The precast parts can be readily loaded onto a truck and transported to the installation site. A suitable excavation is provided at the site and the bottom compacted, and graded or leveled to receive the vault structure. The base 24 can be readily lifted from the truck by hooking a chain to the pulling irons 102 and lowered into position in the excavation, whereupon the chains are unhooked. Suitable grout or mortar 34 is then poured into the groove 32 in the upper face of the flange 70 until the groove is full.

A suitable number of bolts (not shown) are screwed into the threaded inserts 100 in the side walls 78 of the intermediate section 26, to which metal strips and chains (not shown) are connected to lift the intermediate section off the truck and lower it into place above the base 24. The tongue 30 on the lower face of the intermediate section is received within the groove 32, forcing the excess grout out of the groove 32 over the edges thereover and into the space between the flange 70 and the intermediate section 26. The consistency of the grout 34 is such that a layer thereof about 1/2 inch thick remains in the groove 32 between the bottom of the groove and the lower edge of the tongue 30. The joint is subsequently trowelled smooth interiorly and exteriorly to provide a waterproof joint. The bolts, metal strips and chains (not shown) are then disconnected from the intermediate section 26. The groove 32a in the upper end of the intermediate section is next filled with grout 34 in the same manner as the groove 32. Chains (not shown), are then connected to eye bolts 28a (FIG. 2), temporarily threaded into inserts 29 cast in the cap 28, to lift it from the truck and lower it into position on the intermediate section 26, whereupon the chains are disconnected from the eye bolts 28a. The joint between the intermediate section 26 and cap 28 is then trowelled smooth, both internally and externally, and the assembly of the vault sections is then complete. The casting 60 can then be secured to the upper surface of the cap 28 by threading bolts 61 into the inserts 63, and the manhole cover 62 put in place.

The above-described assembly of a precast vault at the installation site obviously avoids the necessity of building forms and positioning reinforcing steel therein, and

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the subsequent pouring of concrete to form the splicing vault in situ. As has been indicated hereinabove, the present vault can be assembled at the site within a period of thirty (30) minutes, as compared to the several days' time required to construct a vault in situ. The present invention also has the advantage that the excavation to receive the vault does not have to be carefully dug so that it is dimensionally exact, as is required when a vault is cast in place. Instead, the excavation can be quickly made with a trenching machine and refilled after vault installation. This provides the further advantage that the precast vaults can be placed in position along a proposed cable line prior to digging the trench for the cable conduits, and the trenching machine, in the process of excavating a trench for the conduits, can be run over the installed vault without damage to the buried vault.

The three-section assembly described above can be made in different sizes for different installations. For a given size vault, the same cap and base can be used with intermediate sections of different height to meet different installation requirements. As an example, the intermediate sections can be made in heights varying from 4 ft. to 6 ft. or more. In a typical installation, the following principal measurements may be used: overall length of base, intermediate section and cap 11'-6"; maximum width at midpoint of side walls, 5'-9"; length of end walls, 25"; length of corner walls, 30"; thickness of cap slab 35, 7"; depth of cap flange 44, 12"; maximum thickness of base slab 64, 6", minimum 4 1/2"; diameter sump opening 68, 12"; height of base flange 70, 6"; diameter of manhole opening 42, 38"; spacing of steel reinforcing bars 54, 4" except adjacent the manhole opening 42 where the spacing is 2"; spacing of diagonal bars 58, 4"; thickness of end walls of intermediate section 26 and upper and lower ends of flanges 70 and 44, respectively, 6"; depth of grooves 32 and 32a, 1 5/8"; width of grooves at bottom, 2"; width of grooves at top 2 1/2"; axial length of tongue 30 and 30a, 1 1/2"; width of tongues at end 1 3/8"; width of tongues at base 1 7/8"; distance from the outer ends of the grooves 32 and 32a to the inner and outer surface of the adjacent upright walls, 1 3/4"; distance of the base of the tongues 30 and 30a to the outer and inner surfaces of the adjacent upright walls, 2 1/16"; and thickness of mortar 34 at joints, 1/2".

The above dimensions are only representative and not intended as limiting.

FIG. 8 illustrates an adaptation of the above-described vault structure to an installation in which the cable conduits are offset at different angles relative to the length of the vault. In this case, the walls 94a in the knockout openings 94 in the two corner walls 82 at one side of the vault have been removed to receive the conduits 108 and the cables 110. The cables are positioned along the inner walls of the vault, and one may be spliced at 110a, as shown, and supported by a series of wall brackets 112, which may be mounted by bolts 112a received in the threaded inserts 100. Adapters 114, of general cuplike form having a beveled rim 116, are inserted into the knockout openings 94. One end of the conduits 108 is received within an opening 118 in the outer end of the adapters 114. Sealing material 120 and 121 between the conduit 108 and the opening 118, and between the adapter 114 and the opening 94, respectively, provides watertight joints at these places. This construction, in which the corner walls 40 permit 45° bends in the cables 110, as shown, allows the cables to follow the contour of the vault walls much easier than in the case of a vault having rectangular walls and requiring 90° bends. Code requirements for suspending cables within a vault usually call for a 4 1/2" spacing between the center of the cable and the wall. The provision of an octagonal structure, as disclosed, permits the flexing of even the largest conventional cables to follow the wall contour without bending the cables on a radius anywhere near the code minimum

of 18 inches. This results in a substantial saving of space and material. In such an installation, the openings 88 in the end walls 80, if not used, may be plugged up or closed by any suitable means.

FIGS. 9, 10 and 11 illustrate an embodiment particularly adapted for power lines employing circular conduits. The vault in this embodiment is generally similar in construction to that described above, but is shorter, and corresponding elements are designated by the same reference numeral with the addition of the superscript "prime" ('). As, in the first embodiment, the structure includes a base 24', an intermediate section 26', and a cap 28', which are assembled with the tongue, groove, and mortar joints, as in the first embodiment. The contour of this embodiment is similar to that of the first embodiment, but a notable exception lies in the arched construction of the side walls, best shown in FIG. 9. In this construction, the side walls of the cap 28', the intermediate section 26', and base 24', do not include a mid-portion of uniform width corresponding to the portion 48 in FIG. 1, for example. Rather, such portions are omitted, the side wall of the cap 28' comprising two similar portions 46', which increase in thickness from their point of connection with the corner walls 40' to their point of meeting at the middle of the vault. The corresponding side wall portions are also omitted from the intermediate section 26' and the base 24', so that the overall length of the vault is less than that of the vault of FIG. 1.

The end walls 80' of the intermediate section 26' include a number of knockout openings 122 of circular cross section. Each opening includes a thin knockout wall 123, FIG. 11. Any suitable number of openings may be provided, and in the particular embodiment disclosed, eight openings 122 are arranged in vertical tiers with 4 openings in each tier. Any number of knockout openings 94' can be provided in the corner or diagonal side walls 82', two such openings being shown by way of example in each corner wall (FIG. 10). In this embodiment, the sump 68' is preferably located at the center of the base slab 64', immediately below the manhole opening 42' in a position to conveniently receive the lower end of a sump pump 142a (shown in dot-and-dash lines), as will be described later.

With reference to FIG. 11, the knockout openings 122 have frusto-conical walls 124, with the apex end innermost. When the bottom 123 of a knockout opening 122 is removed, a conduit 126 can be inserted in the opening, and the cable 128 extended within the vault. This arrangement provides an annular space between the exterior of the conduit 126 and the frusto-conical wall 124, which space increases in width toward the exterior of the wall. Sealing material, such as grout 130, is packed in the space between the conduit 126 and the frusto-conical wall 124 to form a watertight connection.

FIG. 12 illustrates a modified arrangement of openings in an end wall 80² in an intermediate section 26², in which openings 132 of uniform cross section contain bushings 134 that are cast in place. These bushings may be made of any appropriate material, and are constructed to have a thick section intermediate their ends, with an inner tapered portion 136 and an outer tapered portion 138, the latter being longer and flatter than the former. A conduit 126², having a complementary tapered end 140, tightly engages the outer tapered end 138 of the bushing 134, to form a waterproof seal. The inner tapered portion 132 avoids a sharp edge that might damage the cable 128².

Portable or permanent sump pumps 142 and 142a (FIGS. 2 and 9), may have the inlet end thereof connected with the sumps 68 and 68', respectively, to pump out any water collected therein.

FIGS. 13, 14 and 15 illustrate a vault in which the rectangular openings in the end walls of the intermediate section include novel knockout panels. The vault as-

sembly includes a cap 144, an intermediate section 146, and a base 148, which are assembled as in the previously-described embodiments, and are of the same octagonal contour and generally similar in construction. Each end wall of the intermediate section 146 has a knockout opening 150 of rectangular form, having overall dimensions sufficient to receive any conventional multi-way rectangular conduit. The knockout opening 150 is closed by a thin wall consisting of a number of knockout panels 152, which are partially separated from each other and from the body of the intermediate section 146 by weakened areas or V-shaped grooves 154, the separate panels 152 having a vertical dimension corresponding approximately to the vertical dimension of the individual passages in a multi-way conduit 156. The length of the panels 152 is greater than the width of the conduit 156. The panels 152 may be 2 inches thick and the grooves 154, ½ inch deep, so that the panels are connected along a weakened line only 1 inch thick. This construction makes it possible to remove only sufficient panels 152 to accommodate the particular conduit to be connected with the vault. As is shown in FIG. 15, three adjacent panels 152 have been broken out along their associated grooves 154 to provide an opening sufficiently large to receive one end of a three-row, multi-way conduit 156. The conduit end is connected to the adjacent edges of the retained panels 152, both interiorly and exteriorly, by sealing material 158. It is evident that this arrangement makes it easy, in the case of substituting larger conduits, or even adding another conduit below the conduit 156, to merely knockout additional panels 152 to accommodate such change. It is also apparent that the array of panels 152 extends over a considerable height vertically, so that selected panels can be removed to receive a conduit disposed in a trench of any depth within the range of the opening 150.

FIGS. 16 to 20, inclusive, illustrate a splicing vault structure, designed especially for installation in an existing underground cable line. The figures also illustrate the method steps involved in installing such vault in the line. Referring to FIGS. 17 and 18, an excavation 164 is shown which has been dug to intercept an existing conduit 160 carrying cable 162, the excavation being larger than the size of the vault to be installed. The splicing vault, in this embodiment, preferably comprises four sections, namely a cap 168, a base 170, and a divided intermediate section consisting of an upper section 172, and a lower section 174. The cap, base, and the intermediate sections are preferably of generally elongated octagonal form, as in the previously-described embodiment, and preferably contain the various construction features described above, including a tongue and groove connection between the two intermediate sections. The end walls 173 of the upper intermediate section 172 include a recess 176, and the end walls 175 of the lower intermediate section 174 include recesses 178, these recesses being adapted to register when the upper section 172 is placed in position over the lower section 174, as shown in FIGS. 16 and 20, to form an opening to accommodate a multi-way conduit 160. The recesses 176 and 178 may contain a series of knockout panels 180, similar to the knockout panels 152 in the embodiment of FIGS. 13, 14 and 15.

Referring to FIGS. 17 and 18, after the excavation 164 has been made, a sufficient portion of the conduit 160 within said excavation is removed to permit the cables to be elevated, as shown in FIG. 18, to clear the upper edge of the lower intermediate section 174, for a purpose explained later. The bottom 166 of the excavation 164 should be tamped smooth, and be of such level as to place the bottom of the recess 178 at about the same elevation as the bottom of the conduit 160. The base 170 and the lower intermediate section 174 are assembled at the bottom of the excavation 164, at the desired location laterally of the cables 162. That is to say, the width of the excavation (FIG. 17), is sufficient to accommodate

the assembly of the base 170 and lower intermediate section 174 at one side of the cables 162. In this position, with the cables 162 raised (FIG. 18), the assembly of the base 170 and the lower intermediate section 174 are slid sideways, in the direction indicated by the arrow in FIG. 17, into the position shown in FIG. 19, in which the recess 178 is directly below the cables 162. The cables can then be lowered into the recess 178, as shown. The cables 162 can be cut, if this has not previously been done, and a section of multi-way conduit 160 can be passed over the cables and connected to the existing conduit 160 to bridge the space between the end of the existing conduit 160 and the opening defined by the recess 178. This procedure is then followed at the other end of the lower section 174 to connect the buried conduit 160 thereto.

The upper intermediate section 172 is next lowered into position (FIG. 19), so that the recess 176 registers with the recess 178 and encompasses the upper portion of the conduit 160, as shown in FIG. 20. The cap 168 is then lowered into position upon the upper intermediate section 172. Prior to lowering the section 172 and the cap 168, as described above, it is understood that grout is poured into the grooves in the lower and upper intermediate sections 174 and 172, respectively, to form a seal, in the same manner as described above.

The completed vault structure is shown in FIG. 20, and after the manhole casting (not shown) is installed, the excavation 164 can be filled. If desired, the base and lower intermediate section may be formed as one unit, and the cap and upper intermediate section may be formed as another unit, to simplify handling and installation.

FIG. 21 diagrammatically illustrates the manner in which two of the octagonal vaults 22 can be installed adjacent to each other in a single excavation E. The diagonal corner walls 40 permit the vaults 22 to be arranged in longitudinally offset relation to accommodate different conduit and cable lines A and B, with interconnection at X of a cable a from one line with a cable b of the other, through a sleeve C disposed between knockout openings in the adjacent corner walls 40, as shown.

It is evident, from the above-described constructions, that a number of important advantages are obtainable therewith, which are not realized from the conventional monolithic, rectangular prior art structures. Some of these advantages are:

- (1) The sectional precast construction permits prefabrication of components in a molding plant under controlled conditions, thus realizing greater strength possibilities with less material;
- (2) The octagonal structure permits cables to be drawn in through the openings in the end walls or the corner walls, and to follow the contour of the walls with a minimum bending of the cables;
- (3) The tapered wall of the flanges on the cap and base provide increased strength where needed to sustain heavy loads;
- (4) The side wall structure of the base, intermediate section, and cap provides arches to give great lateral strength with a minimum of reinforcing material;
- (5) The bottom of the base slab is graded in all directions to provide gravity drainage of water towards the sump, and the bottom of the sump is capable of being broken out to connect an external drain to the vault;
- (6) The pulling irons are located in the corners of the base ends, where they can distribute the stress to the bottom and sides, and are welded to the reinforcing bars to prevent cracking of the concrete and all possibility of the pulling irons being torn loose;
- (7) The use of a prefabricated structure permits the use of excavations that do not have to be accurately dug and squared up, but which can be dug with a trenching machine;

- (8) The vaults can be placed in position prior to digging of the trench for the cable, and can be subjected to load as soon as assembled in place;
- (9) Cables can be drawn into the vault from practically any angle;
- (10) The use of an octagonal design decreases the possibility of concentration of stresses because it eliminates all sharp corner stress;
- (11) The vault sections, which do not weight over 6,500 pounds each, can be handled with a relatively light rig, and do not require the use of a large crane as in the case of a precast monolithic structure;
- (12) The vault can be made of various heights by varying the height of the intermediate section to suit any cable installation requirements;
- (13) The top opening can be readily closed by the use of a conventional, precast metal section and a manhole cover; and
- (14) The molding of the vault sections is simpler, more rapid, and cheaper than the molding of a monolithic structure even when prefabricated.

It is to be understood that various changes may be made in the details of construction and in the arrangement of the parts in the splicing vaults disclosed herein without departing from the principles of the invention and the scope of the annexed claims.

I claim:

1. A sectional, precast splicing vault, comprising: a unitary base: a unitary intermediate section mounted upon said base; and a unitary cap mounted upon said intermediate section having a top wall containing a preformed manhole opening therein to afford access to the interior of said vault, said base, intermediate section and cap, respectively, being elongated and having opposed end wall portions, and opposed side walls, the side and end walls of said cap extending downwardly a substantial distance below the plane of said top wall in the form of a circumferentially continuous flange, said base having a bottom wall and the side and end walls of said base extending upwardly a substantial distance above the plane of said bottom wall in the form of a circumferentially continuous flange, at least one of the wall portions of said intermediate section having means for the reception of a conduit and/or a cable.

2. A splicing vault, as defined in claim 1, in which the base, intermediate section, and cap have the peripheral contour of an elongated octagon, and wherein the side walls include central parallel portions and corner wall portions extending toward each other from each end of said central portions on an angle of about 45°.

3. A splicing vault, as defined in claim 1, in which the inner face of two of the side wall portions of the base, intermediate section, and cap, respectively, are parallel and said side walls increase in thickness in a direction from their ends toward their middle.

4. A splicing vault as defined in claim 3, in which the parallel side wall portions of the base, cap, and intermediate section each includes a middle portion and two end portions, the middle portion having a substantially uniform thickness greater than that of said two end portions, and said two end portions having a thickness which gradually increases in a direction toward said middle portion.

5. A splicing vault as defined in claim 4, in which the middle portion and the two end portions of each of the parallel side walls are of substantially the same length.

6. A splicing vault as defined in claim 1, in which the knockout opening has a closure wall of less thickness than the wall portion of the intermediate section in which it is located, said closure wall consisting of a plurality of panels defined by grooves providing lines of weakness to facilitate knocking out of one or more of said panels.

7. A splicing vault as defined in claim 1, in which the upwardly extending flange on the base has a continuous

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groove that receives a complementary depending tongue on the intermediate section, and wherein the downwardly extending flange on the cap has a depending tongue that is received in a continuous, complementary groove in the intermediate section.

8. A splicing vault as defined in claim 7, in which the flanges on the base and cap are tapered in vertical cross section and decrease in width toward the intermediate section.

9. A splicing vault as defined in claim 1, in which the base, intermediate section, and cap are of elongated, generally octagonal shape having opposed side walls and end walls, and having diagonal corner walls disposed on an angle relative to said side walls and end walls and joining said side walls with said end walls, and wherein knockout openings are provided in said end walls and in said corner walls of said intermediate section.

10. A splicing vault, as defined in claim 9, in which the knockout openings in the end walls are generally rectangular in outline, and in which the knockout openings in the corner walls are circular in outline.

11. A sectional, precast splicing vault, comprising: a unitary base; a unitary lower intermediate section mounted upon said base; a unitary upper intermediate section mounted upon said lower intermediate section; and a unitary cap mounted upon said upper intermediate section having a top wall containing a preformed manhole opening therein to afford access to the interior of said vault, said base, intermediate sections and cap, respectively, being elongated and having opposed end wall portions, and opposed side walls, the side and end walls of said cap extending downwardly a substantial distance below the plane of said top wall in the form of a circumferentially continuous flange, said base having a bottom wall, and the side and end walls of said base extending upwardly a substantial distance above the plane of said bottom wall in the form of a circumferentially continuous flange, each of said intermediate sections having openings formed therein, the openings in said upper intermediate section being disposed at the bottom edge thereof, and the openings in said lower intermediate section being disposed at the top edge thereof and confronting the openings in said upper intermediate section for forming therewith spaces for the reception of a conduit and/or a cable, whereby the base and the lower intermediate section can be moved into position below an existing underground cable with the openings in said lower intermediate section disposed below the cable, and said upper intermediate section and said cap can be installed with the openings in said upper intermediate section aligned with the conduit and/or cable and with the openings in said lower intermediate section.

12. A splicing vault as defined in claim 1, wherein the base, intermediate section and cap are made of reinforced concrete and respectively contain integral, circumferentially continuous reinforcing bars in addition to reinforcing mesh.

13. A splicing vault as defined in claim 11, in which each recess includes a series of knockout portions of less thickness than the wall of the intermediate sections contiguous thereto, and wherein said knockout portions are of generally rectangular form, are horizontally disposed and defined by grooves providing weakened lines separating the same.

14. In a splicing vault, a base, comprising: a bottom wall having an upwardly extending flange forming an upright marginal wall, said base and flange being made of concrete containing reinforcing metal; and a plurality of pulling means partially embedded in the concrete at substantially the intersection of the flange with the bottom wall and including anchoring portions embedded in said bottom wall and in said flange, respectively.

15. A splicing vault as defined in claim 14, in which the base is elongated and the pulling means are disposed

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at opposite ends of the base and on an angle of about 45°.

16. A splicing vault as defined in claim 14, in which the pulling means are of generally U-form, and wherein the legs of the U are welded to the reinforcing metal in the bottom and flange.

17. A splicing vault as defined in claim 14, in which the pulling means are of generally U-form and wherein the legs of the U are bent in opposite directions, one leg being welded to the reinforcing metal in the bottom, and the other leg being welded to the reinforcing metal in the flange.

18. In a precast, sectional splicing vault, a multi-sided intermediate section having at least one perforated opening in one side thereof; and a sleeve of substantially uniform outside diameter disposed in said opening, said sleeve having an opening extending therethrough and being of varying radial thickness and having a maximum thickness in a region intermediate its end and gradually decreasing in thickness from said region toward said ends, whereby said opening tapers inwardly from the opposite ends of said sleeve.

19. A splicing vault as defined in claim 1, wherein the bottom wall of the base section has a recess forming a sump, the upper surface of said bottom wall sloping toward said recess, said recess being closed by a relatively thin wall that can be readily knocked out to provide a drain for the vault.

20. A cap section for an underground vault, comprising: an elongated generally octagonal slab; a marginal flange depending from said slab and providing a circumferentially continuous wall portion, said slab having a manhole opening formed therein; and a reinforcing grill embedded in said slab comprising a continuous, generally octagonal reinforcing bar embedded in said slab adjacent the outer periphery thereof, a plurality of spaced, transverse reinforcing elements disposed on opposite sides of said opening, longitudinally extending reinforcing elements disposed on opposite sides of said manhole opening and overlapping with a plurality of said transverse reinforcing elements, and diagonally disposed reinforcing elements disposed about said opening and arranged on an angle of about 90° relative to each other and on an angle of about 45° relative to said longitudinal and transverse reinforcing elements.

21. A cap section as defined in claim 20, wherein the octagonal slab has parallel ends, parallel sides of substantially greater length than the length of said ends, and corner portions disposed on an angle of about 45° relative to said ends and sides, and wherein said diagonally disposed reinforcing elements extend from a diagonally disposed portion of one side of the slab to approximately the midpoint of a side portion on the opposite side of said slab.

22. A precast splicing vault as defined in claim 1 wherein the intermediate section has a cable opening and wherein the base is made of reinforced concrete and comprises a bottom wall having an upwardly extending flange forming an upright marginal wall and wherein a plurality of pulling means are partially embedded in the concrete at substantially the intersection of the flange with the bottom wall including an anchoring portion embedded in said bottom wall and in said flange, respectively, whereby said pulling means may be utilized to pull a cable through said cable opening in said intermediate section.

23. A sectional splicing vault as defined in claim 1 wherein the intermediate section is multi-sided and has at least one opening in one side thereof, and wherein a sleeve is disposed in said opening, said sleeve being of varied radial thickness and having a maximum thickness in a region intermediate its end and gradually decreasing in thickness from said region toward said ends.

24. A sectional splicing vault as defined in claim 1 wherein the base has a bottom wall including a recess

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forming a sump, the upper surface of said bottom wall sloping toward said recess, said recess being closed by a relatively thin wall that can be readily knocked out to provide a drain for the vault.

25. A precast splicing vault as defined in claim 1 wherein the cap comprises an elongated generally octagonal slab; a marginal flange depending from said slab and providing a circumferentially continuous wall portion, said slab having a manhole opening formed therein; and a reinforcing grill embedded in said slab comprising a continuous, generally octagonal reinforcing bar embedded in said slab adjacent the outer periphery thereof, a plurality of spaced, transverse reinforcing elements disposed on opposite sides of said opening, longitudinally extending reinforcing elements disposed on opposite sides of said manhole opening and overlapping with a plurality of said transverse reinforcing elements, and diagonally disposed reinforcing elements disposed about said opening and arranged on an angle of about 90° relative to each other and on an angle of about 45° relative to said longitudinal and transverse reinforcing elements.

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