Oct. 2, 1945. F. S. WENDELKEN 2,386,020

SECTIONAL SURFACE DRAIN CONDUIT

Filed May 17, 1943 3 Sheets-Sheet 1

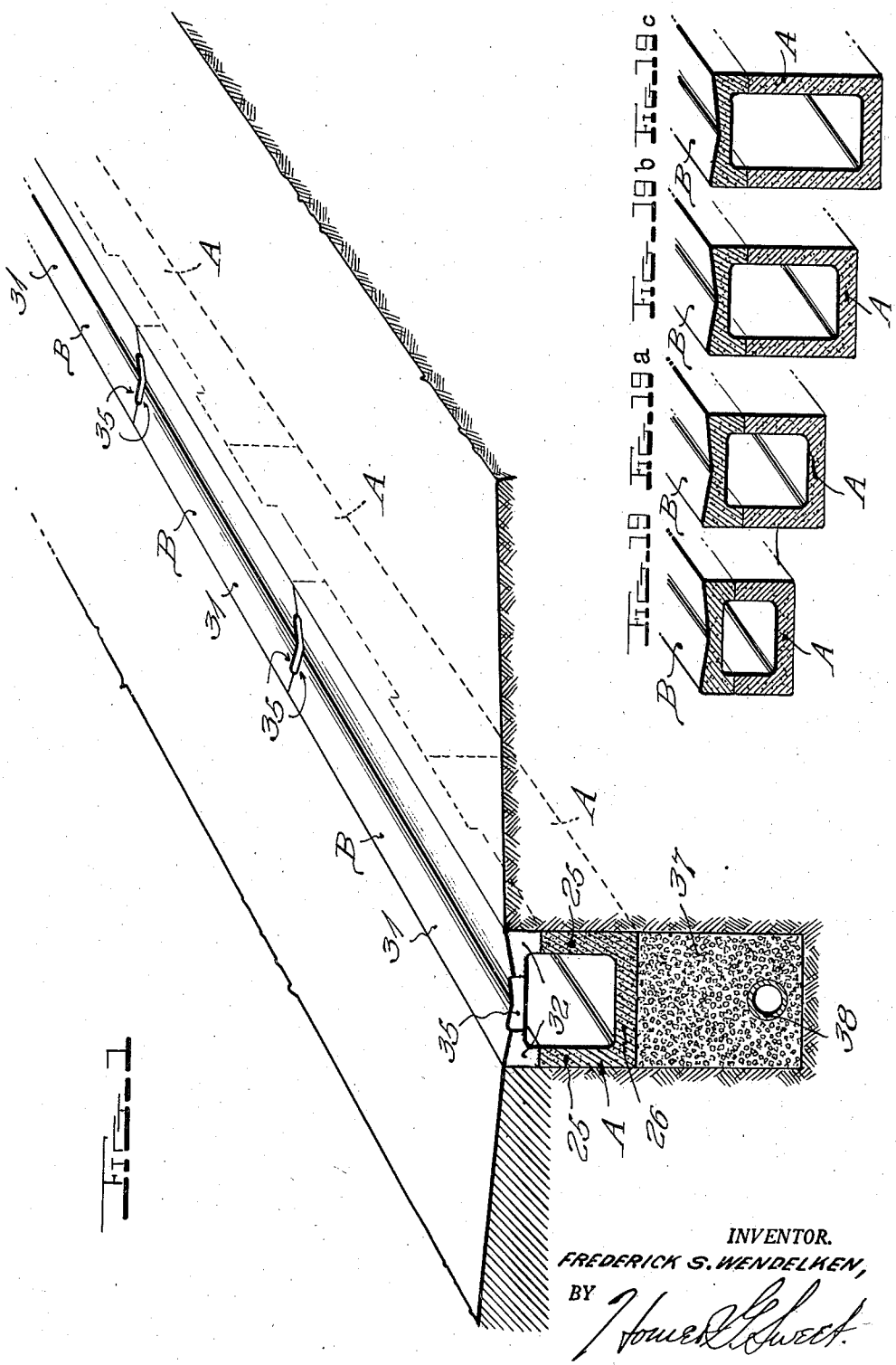

FIG. 1

FIG. 19 FIG. 19a FIG. 19b FIG. 19c

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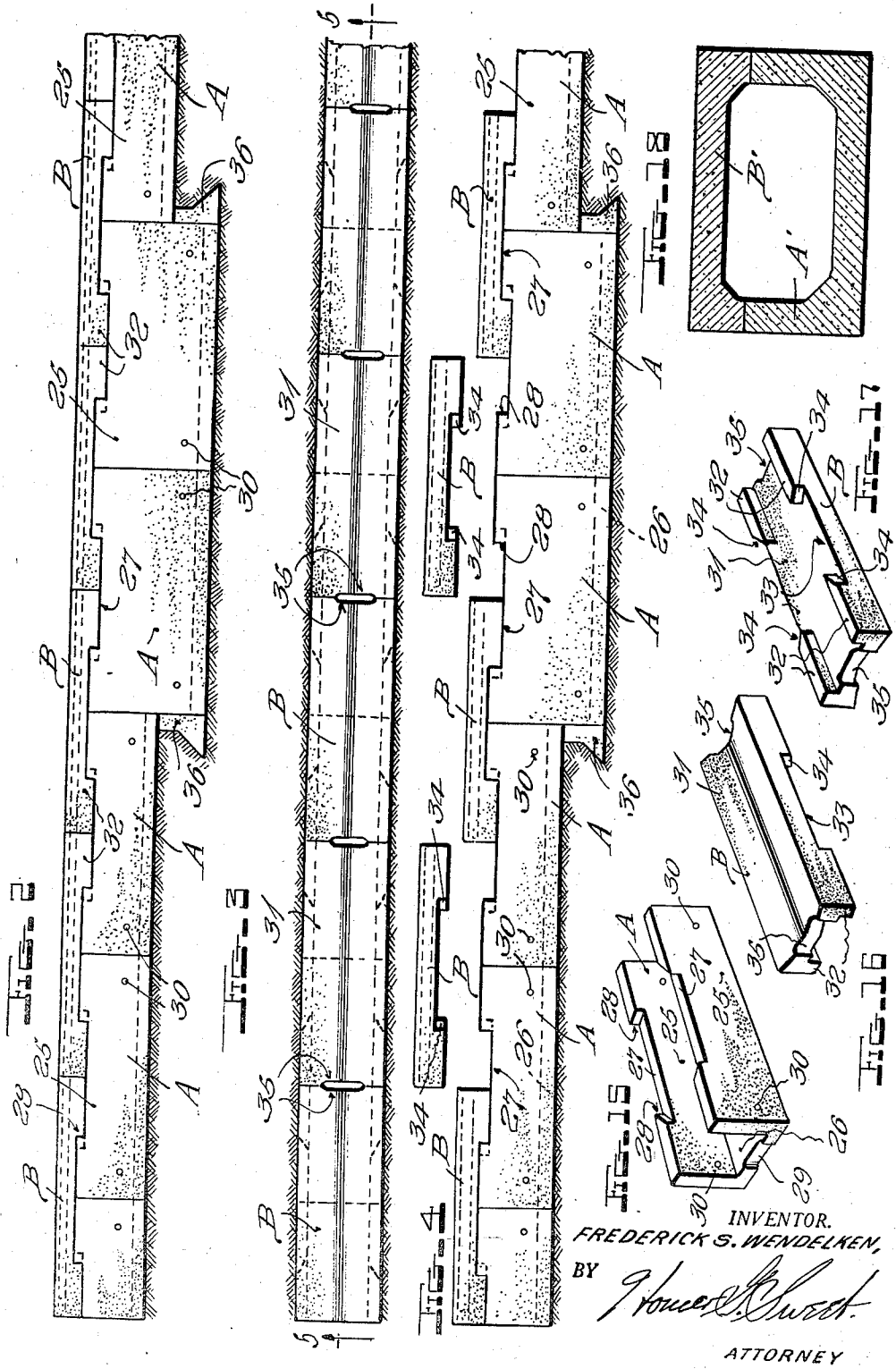

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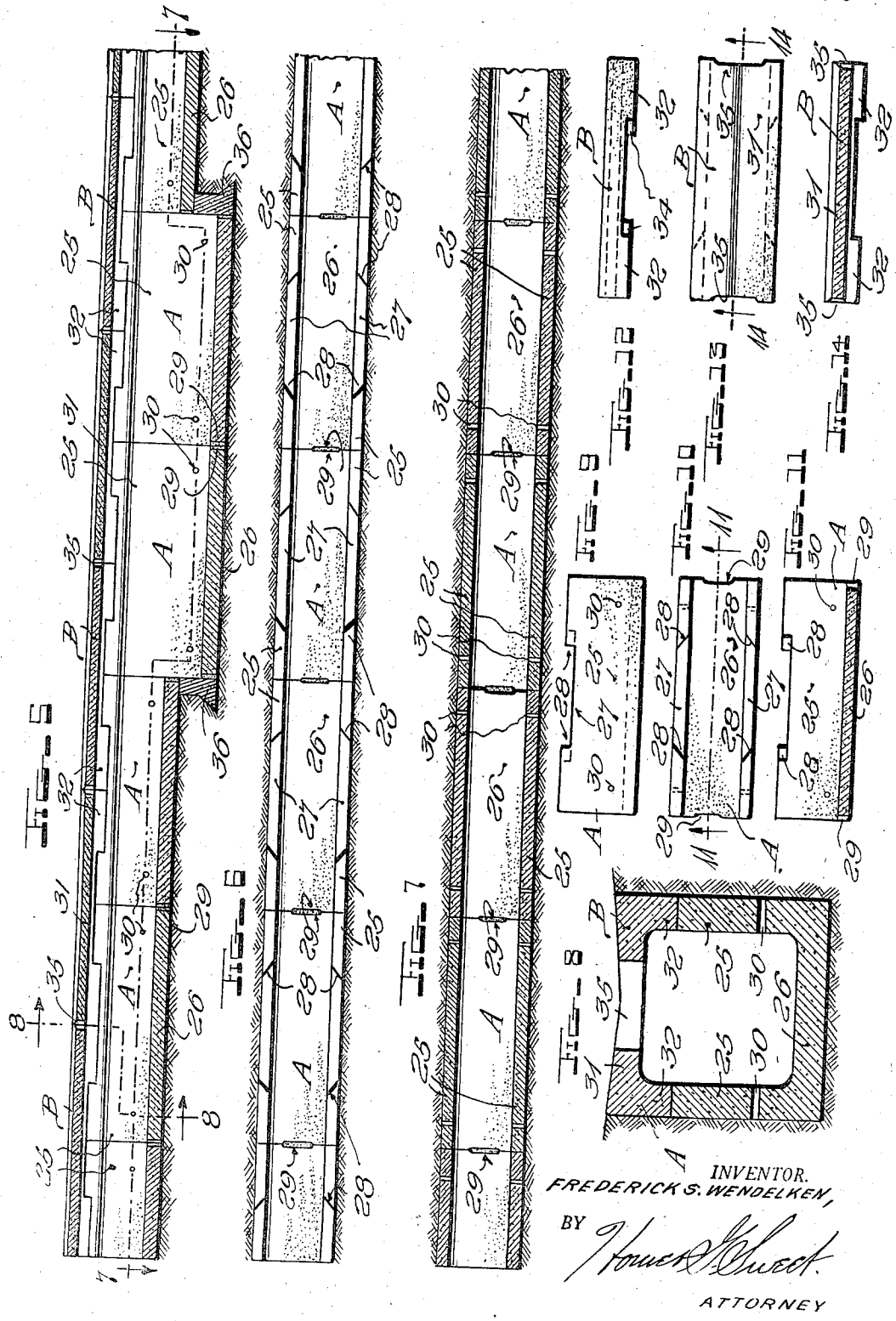

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Patented Oct. 2, 1945

2,386,020

UNITED STATES PATENT OFFICE

2,386,020

SECTIONAL SURFACE DRAIN CONDUIT

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Application May 17, 1943, Serial No. 487,213

2 Claims. (Cl. 94—33)

This invention relates to drains for the collection and removal of surface water from airport runways and aprons, highways, and the like, and has as an object the provision of an improved drain construction, of sectional, conduit type, particularly adapted for such purpose.

A further object of the invention is to provide an improved construction for sectional conduit elements adapted for interrelation to form a continuous drain adapted to either marginally parallel or longitudinally intersect highways and airport runways and aprons for the collection and removal of surface water therefrom.

A further object of the invention is to provide an improved construction for sectional conduit elements adapted to interlock in the formation of continuous drains susceptible of association with surfaced strips and areas for the collection and removal of surface water therefrom.

A further object of the invention is to provide an improved sectional conduit element construction susceptible of development in various related sizes for assembly as complete surface drainage systems fitted to the specific needs of given surfaced installations.

A further object of the invention is to provide an improved sectional conduit element construction susceptible of development in preformed units arranged for interlocking assembly to form drainage systems of such capacity and incorporating such sand traps and cross connections as may be necessary in a given installation.

A further object of the invention is to provide an improved construction and arrangement of preformed base and cover sections adapted to interlock in cooperating, end-abutting relation, without the use of ties, clamps, or other connections, to form a continuous drain adapted to receive, collect and remove surface water from adjacent areas.

A further object of the invention is to provide an improved sectional surface drain conduit which is convenient and inexpensive of manufacture and installation, which permits of ready access to any section of its length for cleaning and maintenance, which provides inlets for surface water at uniformly and closely spaced intervals such as will preclude undesirable accumulation of surface water on the areas to be drained, and which is adapted for recovery from one location and reinstallation with a minimum of effort and full salvage value.

My invention consists in the construction, arrangement and combination of elements hereinafter set forth, pointed out in my claims, and illustrated by the accompanying drawings, in which—

Figure 1 is a fragmentary perspective view, partly in section, of a typical drain constructed in accordance with the principles of the invention and as installed marginally along a surfaced strip or area in cooperation with a typical subdrain. Figure 2 is a side elevation of a typical drain developed from the sectional elements comprised in the invention to incorporate a sand trap. Figure 3 is a top plan view of the showing of Figure 2. Figure 4 is a view similar to Figure 2 illustrating the convenient removability of cover elements to permit access to the interior of the drain and sand trap. Figure 5 is a longitudinal vertical section taken on the indicated line 5—5 of Figure 3. Figure 6 is a plan view of the assembled base elements of Figures 2, 3, 4 and 5 with the cover elements omitted. Figure 7 is a transverse longitudinal section taken on the indicated line 7—7 of Figure 5. Figure 8 is a cross section, on an enlarged scale, taken on the indicated line 8—8 of Figure 5. Figure 9 is a side elevation of a typical conduit base element. Figure 10 is a top plan view of the showing of Figure 9. Figure 11 is a longitudinal vertical section taken on the indicated line 11—11 of Figure 10. Figure 12 is a side elevation of a typical conduit cover element. Figure 13 is a top plan view of the showing of Figure 12. Figure 14 is a longitudinal vertical section taken on the indicated line 14—14 of Figure 13. Figure 15 is a perspective view of the base element shown in Figures 9, 10 and 11. Figure 16 is a perspective view of a structurally modified cover element functionally similar to that shown in Figures 12, 13 and 14. Figure 17 is a perspective view of the showing of Figure 16 as inverted. Figure 18 is a cross section, on an enlarged scale, of a conduit assembly proportioned for sub-surface cross connection between standard surface drain installations. Figures 19, 19*a*, 19*b* and 19*c* are typical cross sections through drain conduits of differing capacities illustrating the development of such drains from like cover elements associated with base elements of varying depths.

The development and extensive use of relatively large, surfaced areas exposed to the weather, such as modern highways, airport landing strips, airport aprons, and the like, has accentuated the need for suitable means, other than open gutters, for the reception, collection and removal of surface water from such areas, and the instant invention is directed to the provision of such means in novel, practical and advantageous form.

As is clearly shown in the drawings, the improved drain conduit is of sectional type and is designed for assembly as an operative unit in the desired relation with a surfaced area from a supply of suitably-sized, preformed cover and base elements arranged to interlock for the production of a continuous, covered pipe or gutter which functions as a usable part or extension of the surfaced area and is provided with inlets wherethrough surface water from such area may enter for collection within and removal through the assembly. The cover and base elements of the improvement may be formed in any convenient or desired manner from any suitable material, but are preferably, for reasons of economy and convenience, cast or moulded as heavy-walled units from concrete, cement, mortars, and like initially-plastic materials, in such sizes, weights, and relative proportions as will meet the strength and capacity requirements of a given installation. The preformed cover and base elements may be reinforced by means of metal bars, lattice, mesh suitably embedded therein at the time of their fabrication, as is common practice, such structural details in themselves forming no part of the present invention, and it is within the contemplation of this disclosure that said cover and base elements may themselves be formed of metal, vitreous materials, clays, and the like.

Whatever be their specific material or method of manufacture, size, or relative proportions, the base elements of the improvement are alike in that each of said elements is in the form of an integral, longitudinally-channeled block A, U-shaped in cross section, whereof the side walls **25** rise in spaced, parallel relation perpendicularly from the opposite long margins of a flat bottom web **26** to define with their uppermost free margins a plane parallel with that of said base web. The blocks A adapted to cooperate in a given drain conduit assembly may vary in depth of their side walls **25**, as hereinafter described, but are of the same widths and wall thicknesses, and are of equal lengths, save for the terminal half blocks hereinafter to be described, ends of said blocks being formed as planes perpendicular to the side walls **25** and base web **26**, so that successive blocks may engage in end-abutting relation to form a straight, longitudinally-continuous, upwardly-opening trough of uniform width and coplanar upper margins. The upper margin of each block side wall **25** is interrupted intermediate its ends by a downwardly-directed offset or notch of considerable longitudinal extent equal to perhaps one-half the length of the block and equally spaced between the block ends, which notch defines a bearing face **27** on the intermediate portion of each side wall upper margin parallel with and offset somewhat below the plane of the adjacent side wall portion upper margins and end walls or shoulders **28** perpendicular to said bearing face and side wall upper margin planes. The notches interrupting the side wall upper margins of each block A in a given assembly are of equal length and depth, and each shoulder **28** at the ends of said notches is formed with a flat face inclined at an angle with the block side wall faces to provide a bevel. The angular inclination of the faces of the shoulders **28**, relative to the block side wall faces, may be of such degree as is deemed convenient or feasible within a practical range of perhaps from forty-five to sixty degrees, and the direction of such inclination is immaterial, so long as the inclined shoulder faces in each block are arranged and interrelated in the following manner. To accomplish the purposes of the invention, the inclined shoulder faces defining the opposite ends of each block side wall notch are disposed in non-parallel, oppositely-inclined relation and tend to converge laterally of the block so that the notch limited thereby opens through one face of its block side wall as an area longer than that provided by the notch intersection with the other face of said side wall, and the respective side wall notches are disposed in opposed relation of their inclined shoulder faces so that corresponding sides of the spaced notches, either longer or shorter as the case may be, are adjacent, diagonally-opposite shoulder faces are parallel, and the shoulder faces in each pair at a corresponding end of the block tend to converge longitudinally and inwardly of the block. As shown in the drawings, particularly in Figures 6, 11, and 15, the shoulder faces are each inclined from outer to inner face of their respective side walls along lines which, when projected inwardly of the block, pass through the open block ends, though it is within the contemplation of the invention that the shoulder face inclination might be reversed so that the inwardly-projected lines of said faces would intersect centrally of the block. Whatever be the degree or direction of shoulder face inclination, such shoulder face characteristics as may be adopted are adhered to uniformly throughout the base blocks of a given installation and hence provide that successive blocks may be end-engaged without the necessity for longitudinal reversal of any block to provide a repetitious, uniform pattern of similarly-disposed notches intersecting the upper margins of the block series. To facilitate handling of the blocks A, which may be of considerable weight in the larger sizes, and to provide convenient means for locating said blocks in end-abutting succession within a trench, the opposite ends of the block bottom webs **26** are formed with laterally-extended recesses **29** perpendicularly intersecting their midportions, which recesses provide space wherethrough lifting hooks or grapples may engage from above with the block bottom webs for manipulation, lifting and placing of the so-engaged block without interference with adjacent or previously placed blocks. When a series of blocks A are disposed in end-engagement, as shown in Figures 6 and 7, adjacent recesses **29** of each pair of engaged blocks cooperate to form a laterally-elongated opening through the conduit bottom, which opening may be filled with grout, or the like, after the conduit installation has been suitably aligned and brought to grade. If desired, the blocks A may be formed with paired, laterally-aligned holes **30** adjacent each of the block ends somewhat above the bottom web **26**, which holes provide means for the insertion of bars transversely through the block for use in lifting and moving the unit.

The cover elements of the improvement are in the form of integral caps B, preferably formed of the same material and in the same manner as the blocks A, adapted for super-position on and in interlocking relation with an aligned series of blocks A. Each of the caps B is formed as a shallow, channeled unit having a top web **31** of a length and width equal to the corresponding dimensions of the bottom web **26**, and spaced, parallel, marginal side flanges **32** perpendicularly related to the top web **31** and of a length and thickness corresponding with the like dimensions of the base block side walls **25**. The side flanges **32** may project beyond the top web **31** a distance equal only to the depth of the notches formed in

the block side wall upper margins, as shown in Figure 17, but said flanges preferably have a somewhat greater projection to at all points provide a marginal rib along each side of said top web. The side flanges 32 of each cap B are intersected by notches similar to those in the side walls of the blocks A, said flange notches being of the same depth as the block wall notches, presenting straight, plane bearing surfaces 33 offset from and in a plane parallel with the plane common to the side flange margins and adapted to seat on and bear against upper margins of the block wall end portions that project above the block wall notches, and having such length as to embrace and closely engage about the complementary, paired, upwardly-projecting side wall end portions of end-engaging aligned blocks A. The notches of the cap side flanges are limited in length by shoulders 34 perpendicular to the plane of their bearing surfaces 33, and the faces of said shoulders are disposed at such an angle of inclination relative to the flange side faces as will cause said faces of the shoulders 34 to register with and bear in aligned parallelism against the corresponding faces of the block shoulders 28 when the caps B and blocks A are related as shown and hereinafter described to form a closed conduit. Thus, whatever be the degree and direction of inclination of the faces of the shoulders 28, the faces of the shoulders 34 will have the same degree and the opposite direction of inclination. The lengths of the caps B being uniform in a given installation and equal to the uniform lengths of the blocks A, and the notches of the cap side flanges being positioned centrally of said flanges and of such lengths as to telescope closely over a pair of the upwardly-projecting block side wall end portions when adjacent blocks are aligned in end engagement, it follows that each cap B will bridge across the joint between a pair of end-engaged blocks and extend at its ends to the transverse center line of the blocks so bridged, the downwardly-extending side flange end portions of unnotched depth each engaging within and filling one-half of one of the block side wall notches, the said caps being thus arranged for successive alignment in end-abutting relation as a cover closing over and interlocking with an aligned series of blocks A.

The top webs 31 of the caps B are formed to such thickness, or are so reinforced, as to permit of transverse concaving of the web top surface without weakening of said cap web beyond its capacity to sustain the estimated probable load which may be imposed thereon, and the concaving of said web upper surface is of such degree as to provide a wide, shallow channel longitudinally and symmetrically of each cap upper surface, which channels of successively-aligned cap members cooperate to form a shallow gutter into which surface water may drain laterally and from either side of the cap. Each end of the cap webs 31 is formed with a laterally-extended recess 35 perpendicularly intersecting and opening endwise from said web, which recesses of end-abutted caps cooperate to form a symmetrically-disposed, laterally-extended opening communicating through the otherwise continuous gutter formed by the cap top surfaces and with the trough formed by the aligned blocks A, through which openings, uniformly spaced along the length of the conduit assembly, water accumulated in the channels of the cap webs may drain into said trough. As was set forth in connection with the description of the base block 29, the recesses 35 provide means for the engagement of lifting hooks, grapples, and the like, with the caps B in such manner as to facilitate lifting, manipulating, and placing of said caps in the desired end engagement with each other and in the desired covering and interlocking relation with the associated blocks A. The opposite ends of the caps B being identical, it follows that said caps require no reversal of longitudinal disposition to fit them in cooperating relation with their base block assembly, and, due to the angular construction and directional relationship of the faces of the cooperating shoulders 28 and 34, each cap member is so engaged with its associated block members as to be firmly held against both lateral and longitudinal displacement relative to the latter.

In a given installation, all of the caps B will be of like construction and dimensions, the length and width of the cap units corresponding with like dimensions of the blocks A with which they are associated, so that a series of said caps may be placed, without cutting, working, or special fitting thereof, in end-engaging alignment and in covering relation with an aligned series of blocks A to complete a closed conduit whereof the top surface presents a shallow, longitudinal channel communicating at regularly-spaced intervals with the interior of the conduit, transverse joints between the blocks A and between the caps B being staggered longitudinally of the conduit and the said blocks and caps interlocking to inhibit lateral and longitudinal relative displacement of the separate elements constituting the assembly. Since each cap B covers one-half of each of two end-abutted blocks A, a suitable number of preformed half blocks and half caps is provided for use at the ends of the conduit assembly, thus facilitating coplanar registration of the cap and block end faces terminating the conduit assembly.

As is illustrated in Figures 19, 19*a*, 19*b* and 19*c*, the blocks A may be preformed as units of varying depth and of uniform widths, lengths, wall thickness and side wall upper margin conformation, so that the block units will all, regardless of their depths, cooperate with identical caps B when aligned with their side wall margins in a common plane. This arrangement not only enhances the convenience of developing drains of different capacities in association with a given surfaced area, while maintaining uniformity of drain and trench widths, but provides particularly convenient means for varying the capacity of a given conduit through the association of blocks of greater depth in end communication with blocks of lesser depth while maintaining upper margins of said blocks coplanar. Further, through the placing of two contiguous blocks of greater depth in operative alignment with a series of blocks of lesser depth, a downwardly-offset basin may be provided where desired along a given drain, which basin functions as a trap to collect and hold sand, soil, and non-floatable debris where it may be conveniently reached for removal through the opening left when the cap B covering the meeting joint between the blocks of greater depth is lifted away, and is clearly shown in Figure 4. When blocks of greater depth are abutted against blocks of lesser depth, either for increase of drain capacity or for the development of a sand trap, it is desirable that a suitable wall or baffle 36, preferably of masonry, be disposed beneath the block of lesser depth and in closing relation across the end opening of the block of greater depth which is below and

in non-communicating relation with the conduit channel. As will be apparent, the use of blocks A of varying depths facilitates the development of a system of intercommunicating drains wherein conduits of lesser capacities connect with and for discharge into conduits of greater capacities.

When and where it may be desired to dispose a lateral or cross drain in sub-surface, connecting relation with one or more of the surface-interrupting drains, a preformed block and cap arrangement of the type shown in Figure 18 may be employed to advantage to provide a capacity equal to or greater than that of the drain or drains with which it connects. The construction and operative relationship of the elements shown in Figure 18 is identical with that of the blocks A and caps B hereinabove described, the only differences being in size and proportion. The block A' of the cross drain is made wider and shallower than the like elements of the drain with which it connects so as to present a cross-sectional flow area equal to or greater than that of the associated drain, thus permitting disposition of the connected drains with their base webs at the same level and the top surface of the cross drain lower than that of the associated drain for sub-surface traverse beneath the surfaced area or adjacent ground level. The cap B' of the cross drain is formed to a width equaling that of its associated base and may present a flat, rather than a longitudinally channeled top surface, since the channel serves no purpose when the drain is buried, though economy in number and use of moulding forms may be had in some instances by including the channel feature in the cap B', as shown in the drawing.

As is shown in Figure 1, the improved surface drain conduit may be combined with and developed on and in superposed relation with sub-soil drains of conventional type, it being feasible and convenient to provide a drain trench initially deeper than is required for the surface-type drain and partially fill said trench, to the base level of the sectional drain, with gravel, crushed rock, or the like, to form a "French" drain **37** wherein may or may not be embedded a line of drain tile **38**, as is common practice. In certain installations, no occasion for sub-soil drainage will be found, in which case the bases of the blocks A will rest directly on the bottom of the trench.

Obviously, the number of sectional flow conduits and the flow capacities of such conduits will be proportioned to the surface drainage requirements of the area or areas to be served thereby, and said conduits may be developed in surface-flush relation with and along the margins of highways, airport runways, and other strips, between the surfaced areas and adjacent shoulders, or may be disposed in longitudinally-intersecting relation with the surfaced areas to provide one or a plurality of drains, as may be required, the surface of the properly installed drain presenting no obstructional hazard and being adapted to receive and support rolling loads for free passage thereover.

Since many changes, variations and modifications in the construction, arrangement and specific combination of the elements shown and described may be had without departing from the spirit of my invention, I wish to be understood as being limited solely by the scope of the appended claims, rather than by any details of the illustrative showing and foregoing description.

I claim as my invention:

1. In a sectional surface drain conduit, a series of like, uninterruptedly open-sided base blocks adapted for alignment in end-abutted relation to form an open-top trough, each of said blocks comprising an integral, preformed unit including a plane bottom web, side walls upstanding in spaced, parallel relation from the opposite long margins of said web for disposition of their free upper margins in a common plane parallel with said web, a notch opening upwardly through the central portion of each side wall upper margin, shoulders perpendicular to the plane of said web defining the ends of each said notch, and faces on said shoulders inclined to the planes of the side wall surfaces so that the said shoulder faces of each notch converge laterally of the block and in a direction opposite to the convergence of the corresponding faces of the opposed notch; and cap element arranged to interlock against relative lateral and longitudinal displacement with aligned notched block side walls in bridging relation with the joint between adjacent blocks and in convering relation with the trough formed by said blocks.

2. In a sectional surface drain conduit, a series of like, uninterruptedly open-sided base blocks adapted for alignment in end-abutted relation to form an open-top trough, each of said blocks comprising an integral, preformed unit including a plane bottom web formed with longitudinally-opening recesses centrally intersecting its opposite ends for the accommodation of block placing and manipulating means, side walls upstanding in spaced, parallel relation from the opposite long margins of said web for disposition of their free upper margins in a common plane parallel with said web, notches intersecting central portions of the side wall upper margins and each opening upwardly between limiting shoulders perpendicular to the plane of said web, oppositely-inclined faces on the shoulders of each notch arranged in opposition to the corresponding faces of the opposite notch; and cap elements arranged to interlock against relative lateral and longitudinal displacement with said notched block side walls in covering relation with said trough.

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