Jan. 19, 1937. V. F. HAMMEL 2,068,022

TUBULAR STRUCTURE

Filed June 18, 1932 3 Sheets-Sheet 1

Fig. 1,

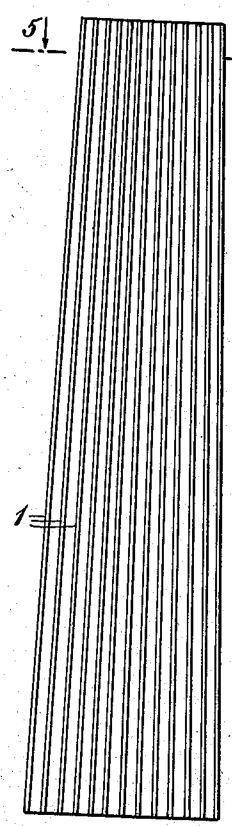


Fig. 2,

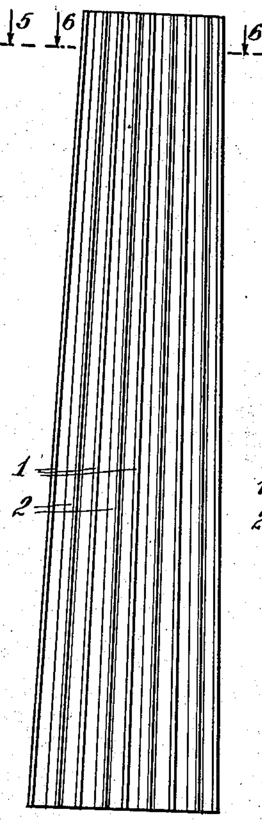


Fig. 3,

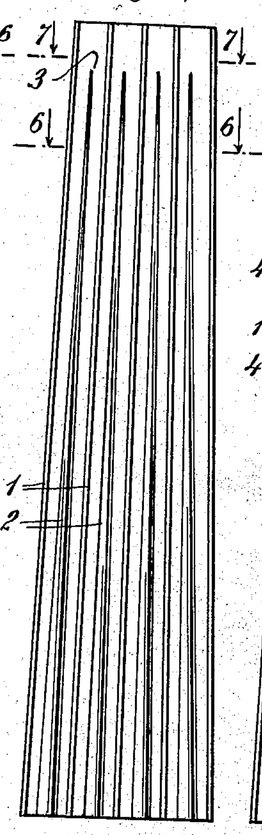


Fig. 4,

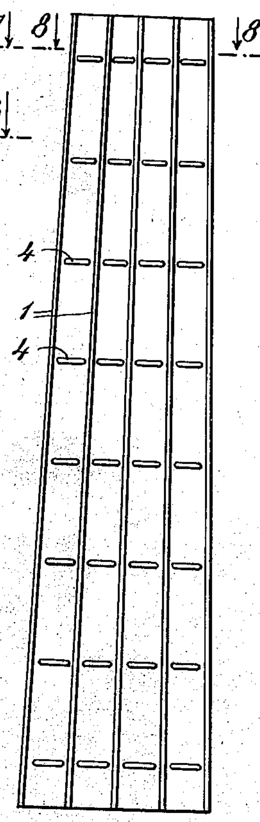


Fig. 5,

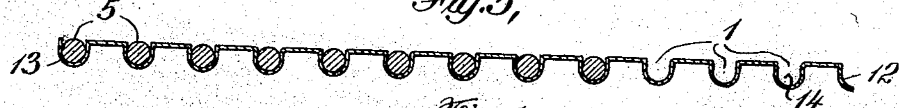


Fig. 6,

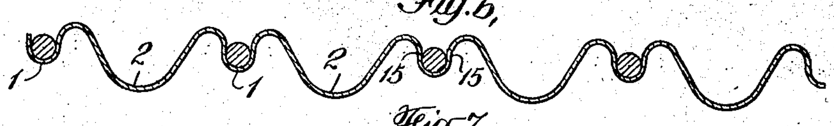


Fig. 7,

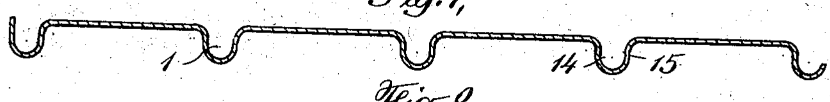


Fig. 8

INVENTOR
Victor F. Hammel
BY
Pennie, Davis, Marvin & Edmonds.
ATTORNEYS

Jan. 19, 1937. V. F. HAMMEL 2,068,022

TUBULAR STRUCTURE

Filed June 18, 1932 3 Sheets-Sheet 2

Fig. 9,

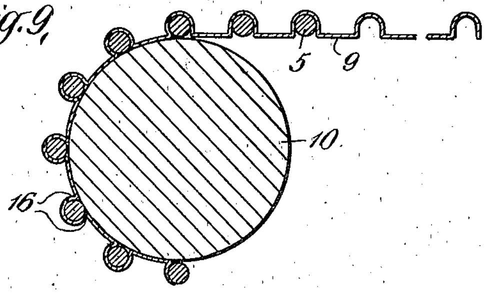


Fig. 10,

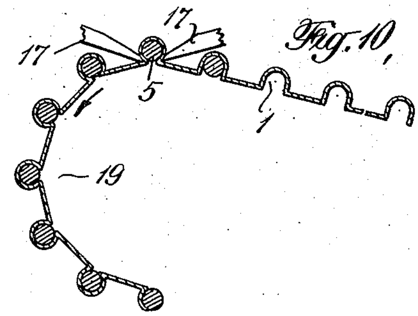


Fig. 11

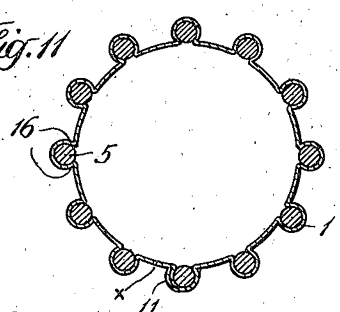


Fig. 12,

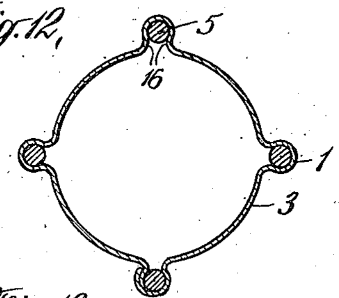


Fig. 15,

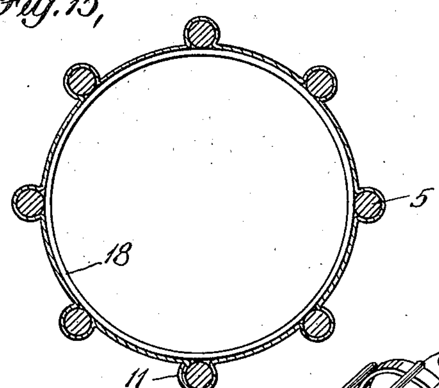


Fig. 13,

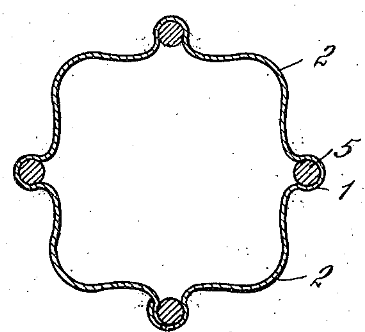


Fig. 14,

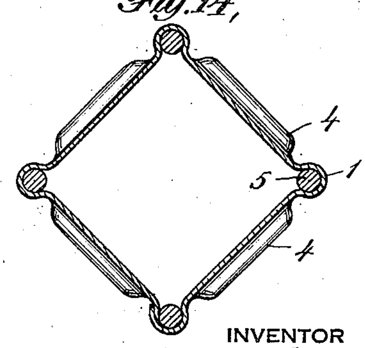
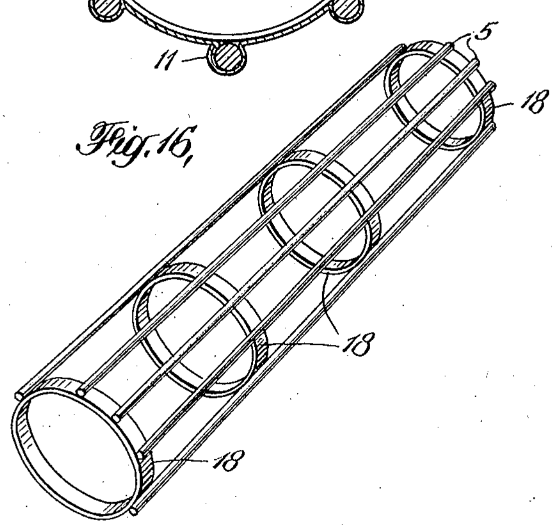


Fig. 16,



INVENTOR

Victor F. Hammel

BY

Pennie, Davis, Marvin & Edmonds

ATTORNEYS.

Jan. 19, 1937. V. F. HAMMEL 2,068,022

TUBULAR STRUCTURE

Filed June 18, 1932 3 Sheets-Sheet 3

Fig. 17,

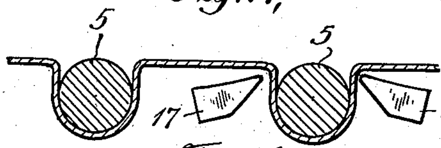


Fig. 18,

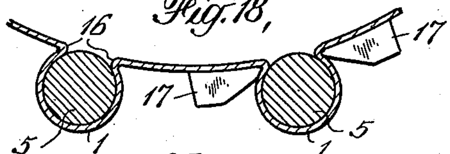


Fig. 19,

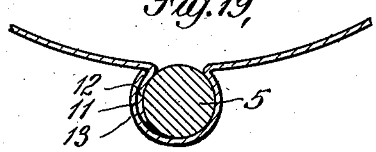


Fig. 20

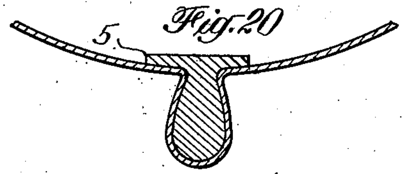


Fig. 21

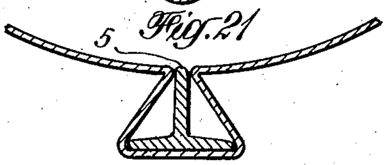


Fig. 22

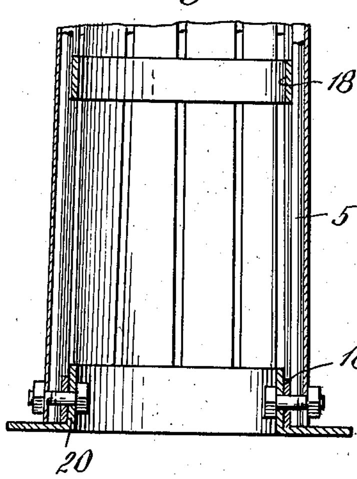


Fig. 23,

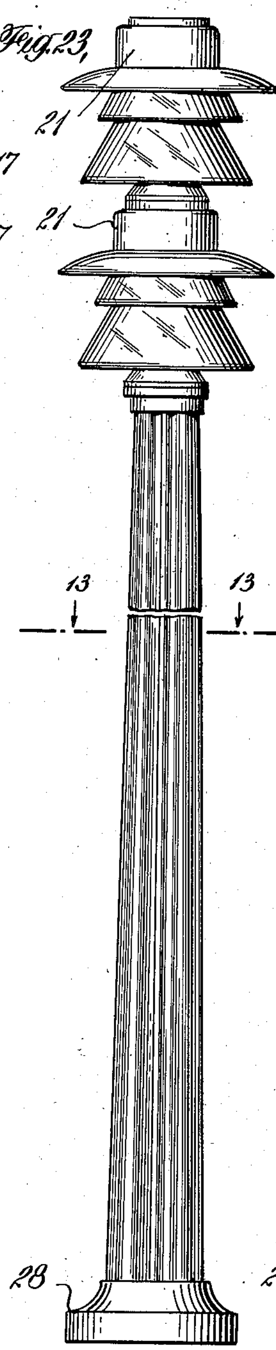
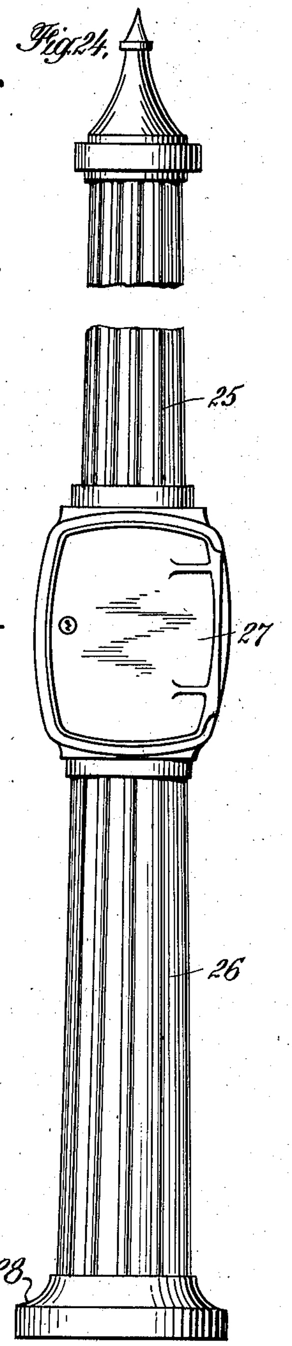


Fig. 24,



INVENTOR
Victor F. Hammel
BY
Pennie, Davis, Marvin & Edmonds
ATTORNEYS

Patented Jan. 19, 1937 2,068,022

UNITED STATES PATENT OFFICE

2,068,022

TUBULAR STRUCTURE

Victor F. Hammel, New York, N. Y.

Application June 18, 1932, Serial No. 617,991

4 Claims. (Cl. 189—23)

This invention pertains to tubular structures, more particularly of thin-walled stiffened construction.

Objects of the invention are to provide a thin-walled tube of unit structure which is stiff, strong, light in weight, economical of construction, and of non-corrosive material; being thereby adapted for use as a columnar support for aerial electrical conductors, for supporting insulators carrying outdoor switchyard high tension busses, etc., as a support for signs, as a lighting standard, a conduit for fluids, wires, cables, etc., a flue for gases, and many analogous uses.

The principle of my invention is in fact generally applicable wherever it is desired to impart strength into structures of stiff thin-walled material.

I attain these ends by providing spaced grooves in the thin-walled material and housing strength members, such as bars, within the grooves, which are thereafter caused to follow the contour of the strength members to the extent of wedging or locking the bars in position, forming thereby a unit structure. By the manner of thus positively interlocking the strength bars I eliminate costly riveting, bolting or other attachments and means of trussing the strength bars. For added strength the strength members may, however, be fused, welded or otherwise additionally affixed to the enveloping shell.

Applied to tubular construction the thin-walled material constitutes an outer shell enveloping the strength bars which are housed within spaced longitudinal grooves thereof in the manner stated.

The outer shell is composed of a normally stiff, self-sustaining material capable of being molded, pressed, rolled, stamped, drawn or otherwise fashioned about the strength members to wedge them in place.

To this end I may employ a structural quality steel, a strong non-corrosive alloy such as stainless steel, "Everdur", the metals aluminum, copper, zinc or alloys thereof.

High strength, non-corrosive, alloy sheet metal manufactured for the automotive and aeronautical industries which is rejected for minor but not structural defects, is ideally adapted to the manufacture of the tubular structure I propose; especially where such structure is to be used as an ornamental street lighting standard, a traffic signal post, sign post or the like, calling for strength combined with pleasing and artistic appearance. The natural finish of the metal is such that no protective coating of paint, etc., is required from the standpoints of utility and aesthetic appeal.

I may make the outer shell of glass reinforced by strength members in the manner described. Such a structure employed as a lighting standard or sign post would lend striking decorativeness, for example, to automobile gas and oil filling stations.

The outer shell may be manufactured as a seamless tube as would be the case with glass, or it may be fabricated from sheet material, cut, corrugated and joined along its longitudinal edges in the manner hereinafter described.

It has heretofore been proposed to fabricate tubular supporting structures exclusively of a recurrent metal sheet longitudinally corrugated for stiffness. The ultimate strength of such a structure for a sustained load is definitely limited by the thickness of material employed. Such a structure, moreover, has the disadvantage that it is apt to collapse quickly under impact forces, or to become thereby dented, marred and unsightly.

To add to the strength of tubular poles formed with a thin-walled outer shell, various forms of internal bracing have in the past been utilized, such as transverse diaphragms or vanes, web members, or central posts of solid or latticed construction. All of such modifications as have come to my attention are variously objectionable as not providing equal strength in all transverse directions, as being expensive and complicated of structure, as being incapable of withstanding impact forces without injury, and as not producing a unit structure of maximum strength, being in reality, a supporting column housed for appearance within a separate outer shell of little strength. The internal bracing, moreover, by obstructing the internal passage, renders the structure ill adapted or impossible of use as a flue or conduit.

My invention overcomes the mentioned disadvantages of existing structures. The strength bars being situated substantially in the plane of the outer shell in nowise impede the internal passage of the tube. By locking or wedging the strength bars in the spaced grooves, I produce a resultant unit structure wherein the bars are maintained in proper spaced relation and caused to act in unison, providing thereby a structure of a large section module. The great strength of the alloy steel or other material employed for the outer shell, renders the tube strongly resistive of torsional stresses.

When a force is applied to the top of a structure of this kind, tending to deflect it, the bars on one side are stressed in tension and the bars on the other side are subjected to compression, the enveloping sheet supplying the relatively small resistance to keep the compression resisting bars from lateral deflection.

In the tubular structure of my invention the strength bars, which completely fill the projecting grooves or ribs, take up the shock of impact forces, and thus prevent collapse of the structure or marring of its appearance through denting the outer shell. Also the natural resiliency of the construction affords protection against the effects of pulsating wind loads.

Figs. 1–4 are illustrative of the manner of grooving, corrugating, fluting or warping rectangular or trapezium shaped blanks of deformable material preparatory to formation of the outer shell of tubular structures such as I propose.

Figs. 5–8 are sectional views along **5—5**, **6—6**, **7—7** and **8—8** of Figs. 1–4. The manner of inserting the strength bars is indicated in Figs. 5–6.

Figs. 9 and 10 illustrate two methods of making the tubes.

Figs. 11–15 are sectional views of finished tubes formed from the grooved and corrugated blanks Figs. 1–4.

Fig. 16 shows a framework of spaced strength bars which, in one modification, is enveloped in a grooved sheet.

Figs. 17–21 are sectional details which show the manner of placing and wedging in position, strength bars of different shapes; and also one arrangement for joining the longitudinal edges of the enveloping sheet.

Fig. 22 is a fragmentary sectional view of a finished structure in accordance with Fig. 16.

Figs. 23 and 24 are side elevations of finished tubes employed as columns.

A roll of sheet metal or other deformable material may be cut without wastage, rectilinearly or on a bias, into blanks preparatory to forming tapered or non-tapered tubes as desired.

The blanks have stamped, pressed, rolled, drawn, formed, molded or otherwise fashioned therein, spaced longitudinal grooves **1** of constant cross-section throughout, Figs. 1 and 5; or, in the case of a tapered tube, by spaced grooves **1** of constant section alternating with flutings **2** varying in lateral dimension with longitudinal extent, Figs. 2 and 6. These flutings may commence at an intermediate distance **3** of the structure, Fig. 3, increasing in lateral dimension toward one end of the structure, Figs. 3, 6 and 7, thereby increasing the stiffness corresponding to the increasing magnitude of bending moment from top to bottom of the tube employed as a columnar support. Increased stiffness to torsional and deflecting stresses may be attained by the addition of transverse deformations **4**, Figs. 4 and 8.

It is to be understood that if the tubes are to be made of constant section throughout, i. e. non-tapered, they will be formed from rectangular shaped blanks, whereby the spaced grooves **1**, Fig. 1, and the longitudinal flutings **2**, Fig. 2, will be equally spaced and of constant lateral dimensions throughout the length of the structure.

Strengthening bars **5** are placed in the grooves, Figs. 5 and 6, and 17–21, the tube being then formed, according to one method, by progressive wrapping of the strength-bar-containing sheet **9**, Fig. 9, about a mandrel **10**. Upon completion of the wrapping the grooved or crimped longitudinal edges of the enveloping sheet are formed into a joint **11**, Fig. 19, by insertion of one grooved or crimped edge **12**, between the opposite longitudinal grooved edge **13** and contained strength bar **5** thereof.

To ensure against the entrance of moisture, I may weld the thus formed interlocking joint **11** of the enveloping sheet in a continuous fusion weld, or I may spot weld the crimped or grooved longitudinal edges **12** and **13** of the sheet to the contained strength bar **5**. Again, I may complete the closure of the tube by a seam or lap weld by simply joining the longitudinal edges at a point intermediate the strength-bar-containing-grooves as indicated at X, Fig. 11.

The finished tubes, Figs. 23 and 24, thus comprise a thin, flexible moisture proof outer shell of non-corrosive material, enveloping spaced strength bars housed in projecting longitudinal grooves of the shell, providing thereby protective ribs of great strength against compressive, bending, twisting, or impact forces.

The configuration may be that of a tapered or rectilinear, ribbed, cylindrical tube, of substantially circular section throughout, Figs. 11 and 15. Or the sectional contour, in the case of the tapered construction, may vary from substantially circular or polygonal at one end, Figs. 12 and 14, to pseudo-polygonal at the other end, Fig. 13, due to the presence of the aforementioned interposed flutings **2** varying in lateral dimension.

Thus employment of an enveloping sheet deformation in accordance with Figs. 1 and 5 would provide a tube having the sectional contour throughout of Fig. 11. An enveloping sheet deformation corresponding to Figs. 3, 6 and 7, would provide a tube having a sectional contour varying from circular, Fig. 12, or polygonal, Fig. 14, at the top, to pseudo-polygonal, Fig. 13, at the bottom.

The spaced grooves **1** intended for reception of the strength bars, are initially formed of apertures corresponding to the maximum width of the housed portion of the bars, Figs. 5–6 and 17, and are given a contour in the trough **14**, Figs. 5, 7 and 8, corresponding to the sectional shape of the bar up to its maximum width, above which the side walls of the grooves are substantially parallel for an extent **15**.

The object of this latter construction is to assure a locking or wedging **16**, Figs. 9, 12 and 18, of the bars in their respective grooves due to the progressive bending of the enveloping sheet upon formation into a tube. This feature may be accentuated by additionally subjecting the strength-bar-containing grooves to external clamping pressure between jaws **17**, Figs. 17 and 18, drawing the sheet metal closely into contact with the bars. Simultaneously the sheet metal may be spot welded to the bars thus bonding the bars and protective shell into a unit tube varying in thickness about its sectional periphery, wherein the metal is concentrated at strategic points to assure maximum strength and stiffness.

Instead of forming the tube by wrapping upon a mandrel **10** which is subsequently removed, Fig. 9, I may make a skeleton of strength bars **5** assembled in spaced relation and welded to spaced rings **18**, Fig. 16. Around this skeleton I wrap the previously formed sheet, Figs. 1–8, with each strength bar of the skeleton fitting into its respective longitudinal groove, being wedged therein in a tight socket fit with the progressive bending in wrapping, Fig. 15. I then weld the final interlocking longitudinal joint 11, as required, in order to ensure closure of the enveloping sheet in a moisture-proof joint, and to provide resultant stiffness of the structure, and coordination of the several parts in unitary action.

Alternatively I may wrap the assembled sheet and bars, Fig. 5, around spaced rings, welding the rings to the strength bars as they come into contact in wrapping, and finally complete the closure by welding along the longitudinal edges as aforesaid. The construction would then accord with that of Fig. 15.

Finally I may form the tube exclusively through the agency of clamping action by external jaws 17, Fig. 10. According to this process, with the insertion of each strength bar 5, the groove 1 is subjected to clamping pressure between jaws 17, drawing the metal into close contact with the bars; simultaneously the sheet metal is spot welded to the bar. As the action proceeds there results a gradual shaping and closure 19 of the tube, as indicated, with each successive operation at each groove. With this method it may be necessary, in order to avoid excessive curling, to form the tube about a mandrel which is subsequently removed.

When employed as a supporting column or post the ends of the tube as well as the longitudinal joint of the enveloping sheet must be sealed against the entrance of moisture which might otherwise cause corrosion of the strength bars, Figs. 23 and 24.

Where the tube employed as a column is subject to severe transverse forces it is advisable to clamp or weld the tube at the base to an internal bracing ring 20, Fig. 20, provided with flanges for affixment to a pier or footing.

The tubular structure employed as a column finds various application. Fig. 23 illustrates a tube capped by high tension insulators 21 adapting it to the support of outdoor switchyard high tension busses such as are employed in unhoused transformer stations.

Fig. 24 shows a tubular support according to my invention constructed in sections 25 and 26 interrupted longitudinally by the insertion of a switch-box 27 or the like.

It is not necessary that the tube be provided with a base 28 as in Figs. 23 and 24, but may be set directly in earth whereby the earth packing in and about the corrugations will provide great resistance against earth movements.

There is no restriction as to the configuration of the strength bars 5 which may be of circular section, Figs. 17–19, of the usual structural shapes, such as T bars, angle bars, etc., Fig. 21, or of special shapes, Fig. 20.

I claim:

1. A stiffened tube comprising metal strength bars resistant to bending wedged in spaced internally facing grooves of an enveloping metal tubular shell welded to said bars, said bars completely occupying said grooves and said grooves conforming to the contour of said bars.

2. A stiffened tube comprising a framework of spaced longitudinal bars integrated by transverse bracing, and a thin-walled outer shell enveloping said framework and containing grooves conforming in spacing and contour of said bars to the extent of locking the bars in said grooves.

3. A tapered tube comprising a metal sheet having formed therein spaced longitudinally extending grooves of uniform section throughout alternating with non-uniform flutings initiating near one end of said tube and increasing in lateral dimension toward the other end, said metal sheet enveloping stiffening bars affixedly housed in said grooves.

4. A stiffened tube comprising metal strength bars resistant to bending wedged in spaced internally facing grooves of an enveloping metal tubular shell, said bars completely occupying said grooves and said grooves conforming to the contour of said bars.

VICTOR F. HAMMEL.