June 16, 1953 H. B. TOBIAS 2,642,162

COLLAPSIBLE METAL SHELTER

Filed May 24, 1948 2 Sheets-Sheet 1

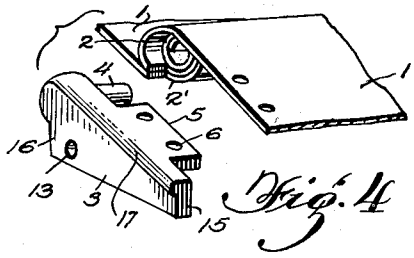


Fig. 4

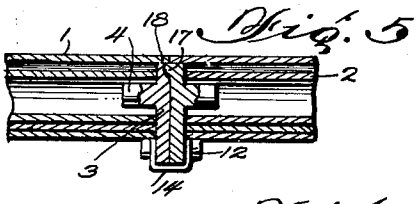


Fig. 5

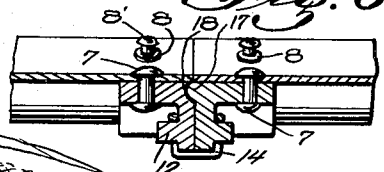


Fig. 6

Fig. 2

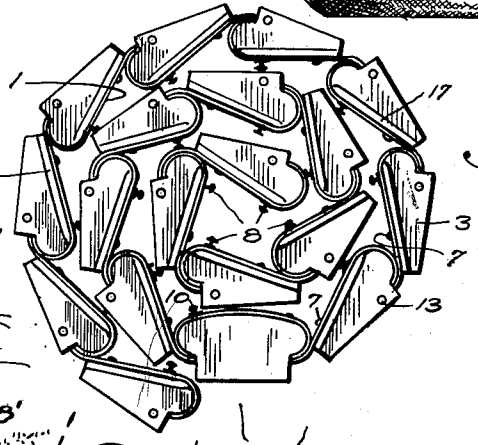


Fig. 3

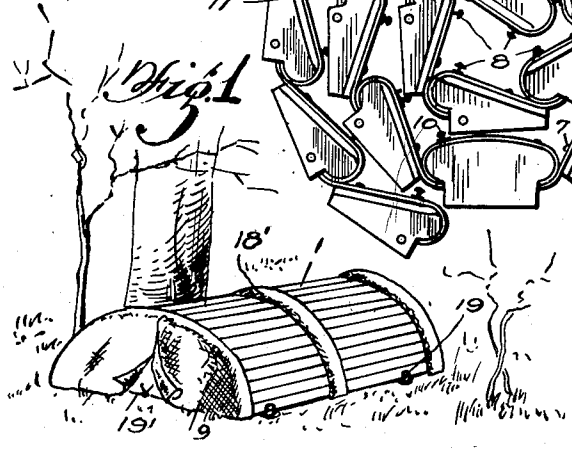


Fig. 1

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COLLAPSIBLE METAL SHELTER

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Fig. 10

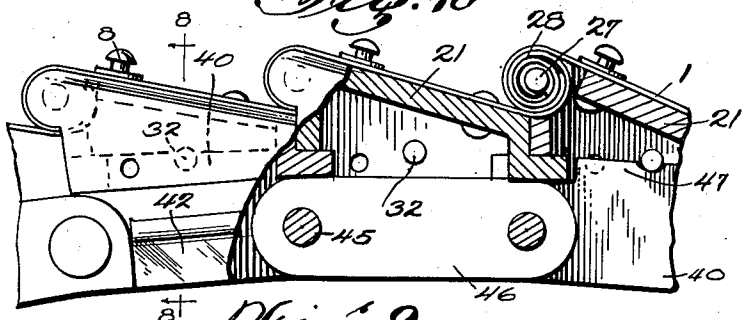


Fig. 8

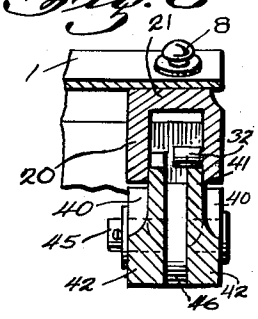


Fig. 9

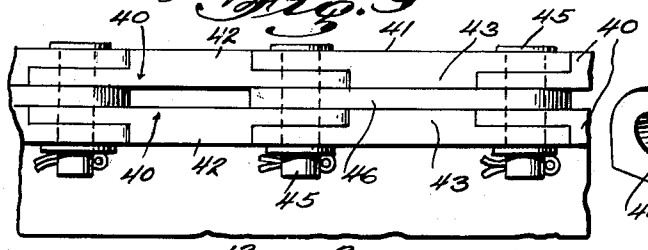


Fig. 11

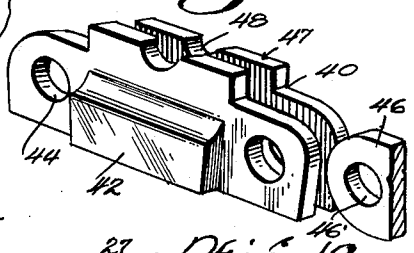


Fig. 7

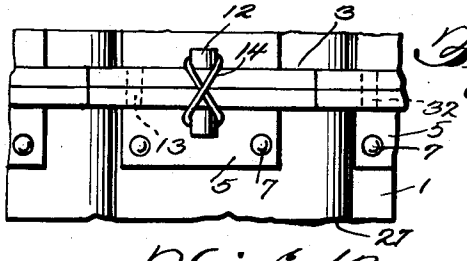


Fig. 12

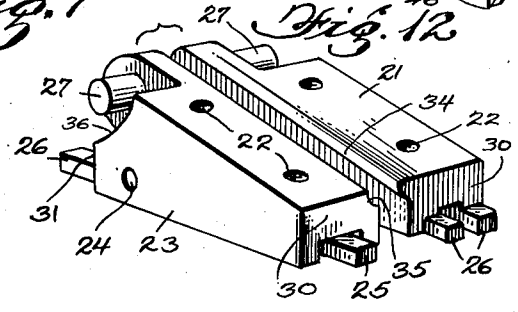


Fig. 13

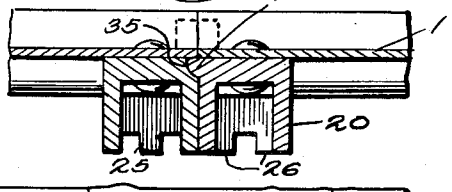
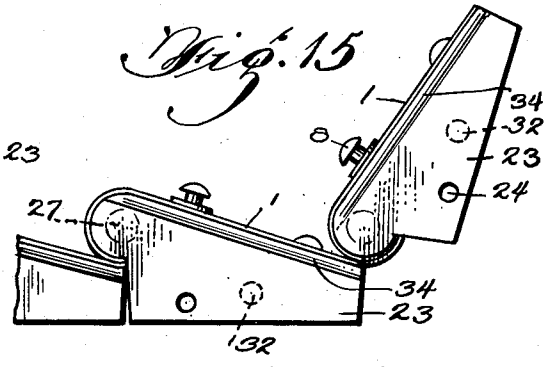


Fig. 15



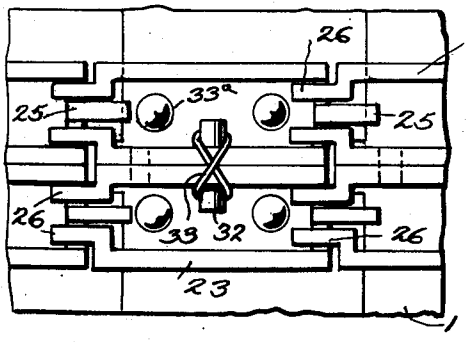


Fig. 14

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UNITED STATES PATENT OFFICE

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COLLAPSIBLE METAL SHELTER

Herrmann B. Tobias, Washington, D. C.

Application May 24, 1948, Serial No. 28,957

12 Claims. (Cl. 189—2)

(Granted under Title 35, U. S. Code (1952), sec. 266)

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The invention described herein may be manufactured and used by or for the Government for governmental purposes without the payment to me of any royalty thereon.

This invention relates to metal shelters of an emergency and portable type comparable in many respects to canvas tents such as used by the United States Army.

One of the objects of the invention resides in the provision of a shelter of lightweight metal that may accommodate several persons, and yet which may be readily bundled for portage.

Another object of the invention consists in the provision of a lightweight metal shelter that may be easily erected and knocked-down with great speed and without the use of tools.

A still further object of the invention resides in the provision of a knockdown lightweight metal shelter such that when erected it will have sufficient rigidity to support earth, brush, thatch, snow or other similar materials which it may be desired to use as a camouflage or for protection against heat, cold, dampness and/or radiation.

A further object of the invention resides in the provision of a knockdown lightweight metal shelter unit that may be assembled with similar units to form a shelter of any desired capacity, or if relatively small units are used they may be joined together to provide a passageway to a concealed shelter formed of the larger units.

Other objects and advantages of the invention will be apparent from the following description when taken in connection with the accompanying drawings, in which,

Figure 1 is a perspective view of two of the novel shelters combined into a unit;

Figure 2 is a fragmentary perspective view, on an enlarged scale, of the shelter set-up for use;

Figure 3 is an end view of the shelter in knocked-down condition ready for portage or shipment;

Figure 4 is a perspective view of one of the voussoir members separated from the hinge member, which is shown fragmentally in perspective view;

Figure 5 is a longitudinal fragmentary sectional view through the hinge connections on a pair of the collapsible shelters which have been united end to end;

Figure 6 is a sectional view similar to Figure 5, taken through the lacing pins;

Figure 7 is a fragmentary bottom plan view of the voussoirs shown in Figures 1–6, and showing the manner of tying together in end-to-end relationship two of the collapsible shelters;

Figure 8 is a transverse sectional view taken on

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the line 8—8 of Figure 10, looking in the direction of the arrows;

Figure 9 is a fragmentary bottom plan view of the construction shown in Figure 10;

Figure 10 is a fragmentary end view, partly in section, of a shelter of substantially larger capacity than that shown in Figures 1–7 inclusive and provided with an optional reinforcing arch;

Figure 11 is a perspective view of a portion of the links employed in the reinforcing arch, separated to better illustrate their relative positions;

Figure 12 is a perspective view of a pair of the complementary voussoir members of Figure 10 as they would appear on the adjoining ends of two of the large collapsible shelters about to be connected end-to-end;

Figure 13 is a fragmentary sectional view through the joint formed by two of the complementary voussoirs of Figure 10 when two of the collapsible shelters are joined end-to-end;

Figure 14 is a fragmentary bottom plan view of a plurality of the voussoirs of Figure 12 shown in their operative relationship; and,

Figure 15 is a fragmentary end view of a plurality of the voussoirs indicating the manner in which they may be folded for the purpose of portability.

Referring to the drawings in greater detail and particularly to Figures 1–7 inclusive the numeral 1 indicates slats of sheet metal, preferably of lightweight metal such as aluminum or the like. The number of slats 1 employed in forming a collapsible shelter will of course vary to some extent with the size of the shelter and the width of the slats employed in the particular construction.

The slats 1, in the present embodiment of the invention, are hingedly connected by forming reverse curves or spirals in the adjoining edges and interlocking the same as clearly shown in Figure 4 and indicated by the numeral 2. This type of hinge construction not only provides a suitable pivotal or hinged connection between the slats 1 but also precludes the admission of rain water or the like to the interior of the shelter by way of the hinges. The spirals 2 are cut back at their ends, as indicated by the numeral 2', so as to provide for the attachment of voussoir members hereinafter described.

In order that the series of hinged slats may be conveniently supported in the form of an arch the respective ends of the slats are provided with voussoir members 3 which, of course, include a keystone voussoir at the crown of the arch, the others being right and left handed as clearly illustrated in Figure 2.

The voussoirs 3 may be formed of cast metal of a selected strength and weight and are each provided with a laterally extending pin 4 adapted to extend into the open end of the hinge 2. The voussoirs are also formed with plates 5 provided with apertures 6 by means of which they may be riveted or bolted to the ends of the metal slats as indicated by numerals 7 and 8 (Figure 6). One of these rivets such as 8 is preferably provided with a supplemental head or extension 8' providing a fastening means through the medium of which a canvas drop or curtain may be suspended over the end of a shelter as indicated by the numeral 9 in Figure 2.

While the slats 1 are shown as permanently secured to the voussoir members it should be noted that the keystone voussoirs are connected to the central slat by means of threaded bolts and wing nuts 10 and 11 respectively, whereby the keystone slat and voussoirs may be disconnected when it is desired to divide a shelter into two sections.

The voussoirs 3 are also provided with laterally extending pins 12 and with apertures 13. The pins 12 serve as fastening means to permit two of the collapsible shelters to be laced together by flexible cords or the like 14 as indicated in Figure 5, and the apertures 13 serve as supplemental means for securing two of the collapsible shelters together in end-to-end relationship by passing cords through aligned openings 13 at the adjacent ends of aligned shelters so that may be securely tied together.

The ends of each voussoir are squared as indicated by numerals 15 and 16 and when mounted, as shown, these squared portions provide skew-bearing surfaces which limit the movement of the voussoirs about their hinges 2 so that they automatically form an arch when swung into set-up position. On the other hand, this arrangement permits the voussoirs to be swung in the opposite direction and to be collapsed into a compact bundle as indicated in Figure 3 when the movements of the slats about their hinges are reversed.

As shown in Figure 6, the voussoir members on one end of each slat are provided with tongues 17 and those on the other end of each slat are provided with grooves 18 so that a tongue and groove joint is formed when two of the shelters are united end-to-end. By reason of this tongue and groove joint a barrier is provided against the seepage of water to the interior of the shelter and for additional protection a canvas strip 18' (Fig. 1) may be placed over the joint between connected shelters and secured in position by means of the buttons 8' heretofore mentioned.

When the shelter is set-up, it is desirable that stakes 19 (Figure 1) be driven into the ground along the edges of the lower-most slats so as to prevent the shelter from spreading and collapsing. This object may also be attained, however, by tying the opposed lower-most slats together by ropes or the likes as indicated by reference numeral 19'. The collapsible shelters as set-up in Figures 1 and 2 may be covered with brush or other desired material for camouflage purposes or for heat or cold insulating purposes, as may be desired.

The form of the invention, as shown in Figures 8–14 inclusive, is quite similar to that shown and described in connection with Figures 1–7 inclusive but is intended for considerably larger and more substantial shelters and, therefore,

the voussoirs are larger and more substantial and are provided with greater skew-bearing surfaces to impart greater stability to the construction. These voussoirs are indicated by the numeral 20 and are of inverted box-like construction provided with a top wall 21 having riveting apertures 22 and with side walls 23 provided with tying apertures 24. One end of each voussoir member on one end of a shelter may be provided with a centrally located pin 25 and the opposite end with a pair of spaced pins 26 between which may be received the centrally located pin 25 of the adjacent voussoir in the series, thus providing a pin and groove connection between the members. The positions of the pins on the voussoirs of the opposite end of the shelter may be reversed as shown in Figures 12 and 14. These voussoirs are tapered just as are the voussoirs of the previously described form of the invention and the larger ends are provided with laterally extending pins 27 adapted to be seated in the ends of the hinges formed by spirally curving in reverse directions the adjoining edges of adjacent slats and interlocking them as indicated in the present modification by the numeral 28. These spirals are cut back at their ends to receive the voussoirs in the same manner as the spirals shown in Figures 1 to 7 inclusive. As will appear by viewing Figure 12, the ends of the voussoirs are squared as indicated by numerals 30 and 31 and due to their extended area provide substantially greater skew-bearing surfaces than do the ends of the voussoirs shown in the smaller construction of Figures 1–7 inclusive. These voussoirs like those heretofore described are provided with laterally directed pins 32 which provide abutments around which a lacing cord 33 may be wound in securing two of the collapsible shelters in end-to-end relationship. Also, as in the earlier described form of the invention, the voussoirs of one end of a structure are provided with elongated tongues 34 while those of the other end are provided with grooves 35 so that a tongue and groove joint may be provided when two of the shelters are tied together in end-to-end relationship as indicated in Figure 14.

It will also be noted that the larger ends of the voussoirs are provided with arcuate walls 36 more or less concentric with the pin 27 so as to provide for the pin when it is inserted in the hinge 28 formed by the interlocked spirals on the edges of adjacent slats.

When relatively large structures, such as envisaged in the construction shown in Figures 8–15 inclusive, are required to carry a large protective load, it may be desirable to reinforce the arches formed by the voussoirs and for this purpose secondary or reinforcing voussoir arches may be employed. Such secondary arches are shown in Figures 8–11 inclusive and comprise pivotally connected voussoir members each comprised of a pair of spaced plates. The plates of alternative voussoir members are indicated by the numeral 40 and are provided with outwardly directed extensions or abutment 42, and the interposed voussoir members comprising the plates 41 are provided with inwardly directed extensions or abutments 43. The plates 40 and 41 are perforated as indicated by the numeral 44 to receive pivot pins 45 and alternate spacing links 46 are interposed between the inwardly directed abutments 43 on the plates 41 and serve to space the plates of both types of

voussoirs. These links **46** are provided with perforations **46'** at their ends and are also pivoted on the pins **45**.

The outwardly directed abutments **42**, the inwardly directed abutments **43** and the ends of the plates **40** and **41** are formed to provide skew-bearing surfaces on their opposite ends to cooperate with each other in the manner clearly indicated in Figure 9 so as to limit the pivotal movement of the voussoir members when swung into an arched shape but leaving them free to swing about their pivots when swung in the opposite direction for collapsing. The voussoir plates **40**, which are provided with the outwardly directed abutments **42**, are also provided with upwardly directed extensions **47** having semi-circular notches **48** formed in their upper edges intermediate their ends. These extensions **47** have a length corresponding to the internal length of the voussoirs **20** and are adapted to extend into such voussoirs with the notches **48** of alternate voussoirs engaging about the inwardly directed pins **32** on the voussoirs **20**, thereby interlocking the reinforcing or secondary arch with the main arch of the shelter.

From the foregoing description and the attached drawings it will be apparent that I have devised a collapsible and portable shelter which may be both set-up in rigid form and collapsed without the use of tools; that it is sufficiently sturdy to permit the use of brush, earth, etc., for camouflage purposes or for heat or cold-insulating purposes, and that the structures are so designed as to permit a plurality of them to be readily joined together end-to-end to provide structures of greater capacity, when desired.

In accordance with the patent statutes, I have described what I now consider to be the preferred forms of the invention, but since various minor changes may be made in structural details without varying from the essence of the invention, it is intended that all such variations be included within the scope of the appended claims.

I claim:

1. A collapsible shelter comprising a plurality of slats, the adjacent edges of adjoining slats being reversely curved and interlocked, and voussoir members fixed to the ends of said slats, said members being of substantially uniform length and pivotally connected solely through the medium of the slats.

2. A collapsible shelter comprising a plurality of slats, the adjacent edges of adjoining slats being reversely curved and interlocked to provide hinges, voussoir members fixed to the ends of said slats, said voussoir members being formed with cooperating skew-bearing surfaces to limit their swinging movement in one direction, said voussoir members being of substantially uniform length and pivotally connected solely through the medium of the slats.

3. A collapsible shelter comprising a plurality of slats, the adjacent edges of adjoining slats interlocked to provide hinges, a series of voussoir members corresponding to the number of slats, skew-bearing surfaces on the ends of the voussoir members, pins extending laterally from said members into the ends of said hinges, and means connecting the voussoir members to the ends of the slats, said voussoir members being of substantially the same length and pivotally connected solely through the medium of the slats.

4. A collapsible shelter comprising a plurality of slats, the adjacent edges of adjoining slats being curved and interlocked to provide hinges,

a series of voussoir members corresponding in number to the number of slats, a pair of pins extending laterally from each member, one of the pins of each pair extending into the end of a hinge and the other pin providing means for lacing two shelters together, and means connecting the voussoir members to the ends of the slats, said voussoir members being of substantially the same length and pivotally connected solely through the medium of the slats.

5. A collapsible shelter comprising a plurality of hingedly connected slats, a series of inverted box-like voussoir members connected to said slats, skew-bearing surfaces on the ends of said members, and a second series of pivotally connected voussoir members disposed beneath said first series when in set-up condition, and projections on said second series entering the inverted box-like voussoirs of the first series.

6. A substantially semi-cylindrical collapsible shelter comprising a plurality of hingedly-connected slats and voussoir members connected at their upper edges to the ends of the slats, said members provided with skew-bearing surfaces on their ends, said members being of substantially the same length and pivotally connected solely through the medium of the slats.

7. A substantially semi-cylindrical collapsible shelter comprising a plurality of hingedly-connected slats, voussoir members connected to the ends of the slats, said members provided with skew-bearing surfaces on their ends, and anchoring means on said voussoirs, whereby two or more of said shelters may be tied together end-to-end, said members being of substantially the same length and pivotally connected solely through the medium of the slats.

8. A substantially semi-cylindrical collapsible shelter comprising a plurality of hingedly-connected slats, hollow voussoir members connected to the ends of the slats, said members provided with skew-bearing surfaces on their ends, and pins on the interiors of said members, whereby two or more of the shelters may be secured end-to-end, said members being of substantially the same length and pivotally connected solely through the medium of the slats.

9. A substantially semi-cylindrical collapsible shelter comprising a plurality of hingedly-connected slats, voussoir members connected to the ends of the slats, said members provided with skew-bearing surfaces on their ends, one series of voussoirs provided with external ribs and the other series with external grooves, whereby two or more shelters may be sealed in end-to-end relationship, said members being of substantially the same length and pivotally connected solely through the medium of the slats.

10. A substantially semi-cylindrical collapsible shelter comprising a plurality of slats, the adjacent edges of adjoining slats being reversely curved and interlocked, voussoir members connected to the ends of the slats, and pins on the voussoir members having their ends positioned in the reversely curved portions of the slats, said members being of substantially the same length and pivotally connected solely through the medium of the slats.

11. A substantially semi-cylindrical collapsible shelter comprising a plurality of slats, the adjacent edges of adjoining slats being reversely curved and interlocked, voussoir members connected to the ends of the slats, said members provided with skew-bearing surfaces on their ends, and pins on the members having their ends posi-

tioned in the reversely curved portions of the slats, said members being of substantially the same length and pivotally connected solely through the medium of the slats.

12. A substantially semi-cylindrical shelter comprising a plurality of slats of sheet material having cut-away portions in the ends thereof, voussoir members of substantially uniform length connected at their upper edges to the uncut ends of the sheets, the adjacent longitudinal edges of the other portions of the sheets being reversely curved and interlocked to provide hinge connections between the slats, pins on the voussoir members having their ends positioned in the reversely curved portions of the sheets, said voussoir members being pivotally connected solely through the medium of the slats provided with cooperating skew-bearing surfaces adapted to limit the pivotal movement of the voussoirs in one direction but leaving them free for pivotal movement in the opposite direction.

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