Feb. 12, 1957 H. C. BOLT 2,780,844

COLLAPSIBLE HABITABLE STRUCTURE

Filed Sept. 8, 1953

4 Sheets-Sheet 1

Fig. 1.

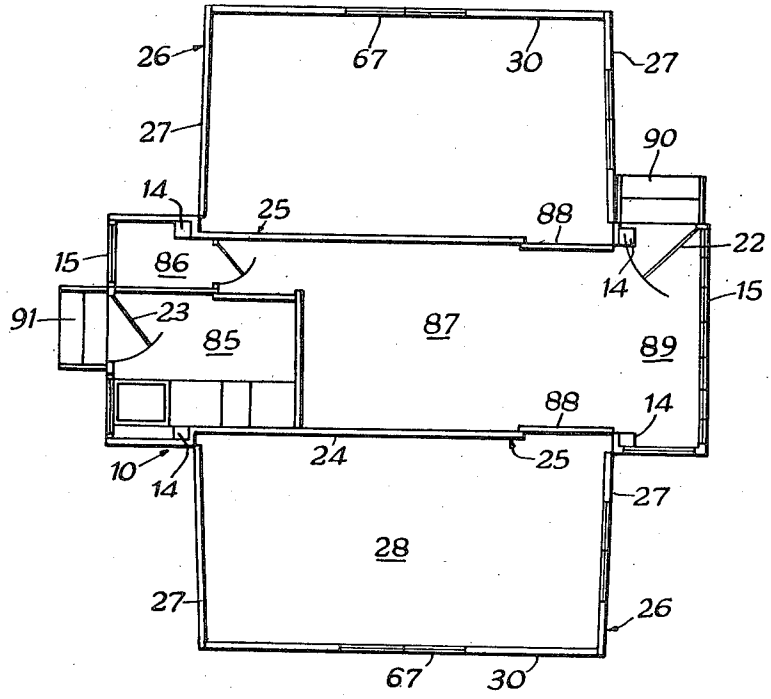
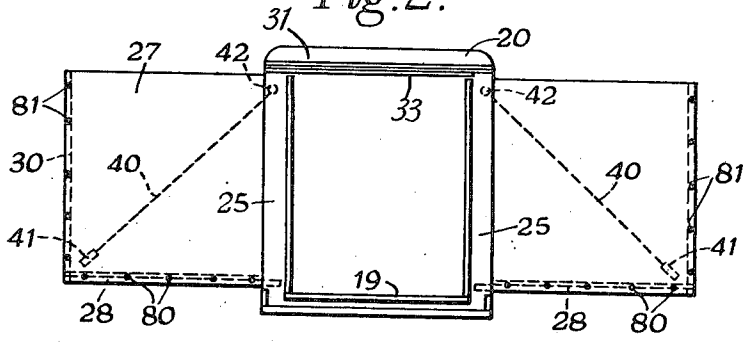


Fig. 2.



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COLLAPSIBLE HABITABLE STRUCTURE

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Fig. 3.

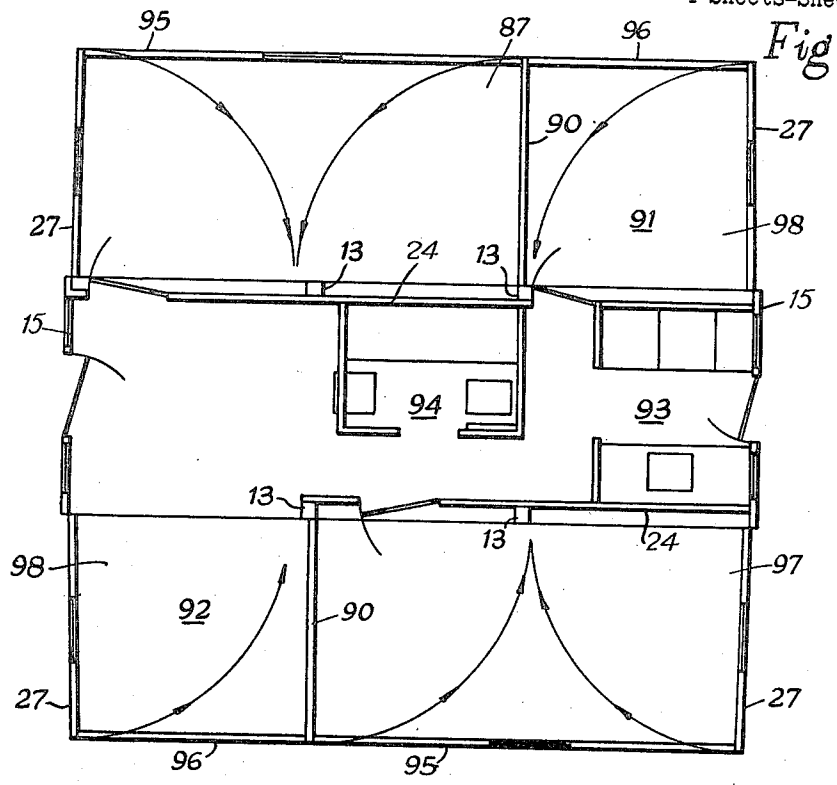
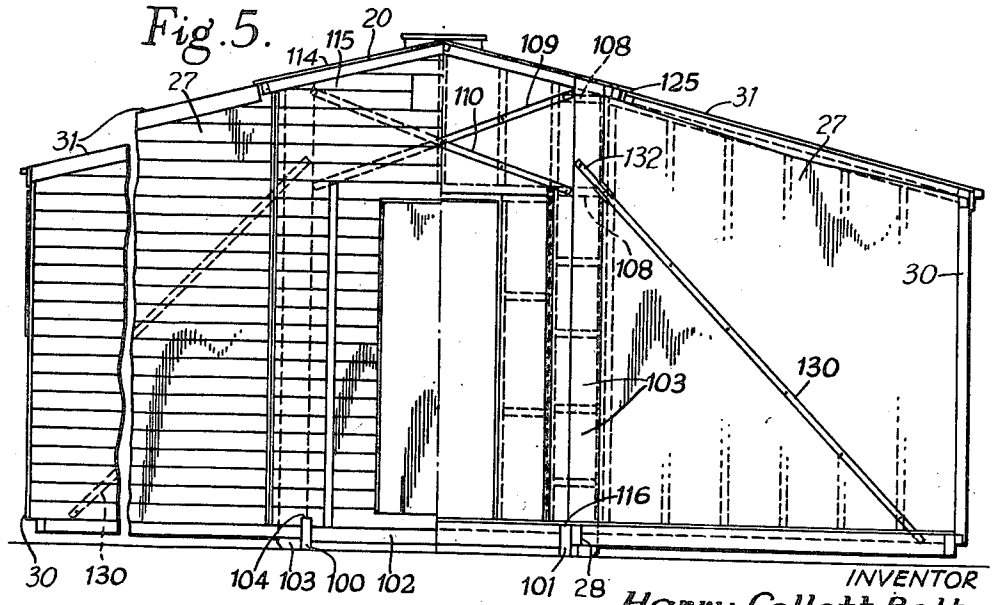


Fig. 5.



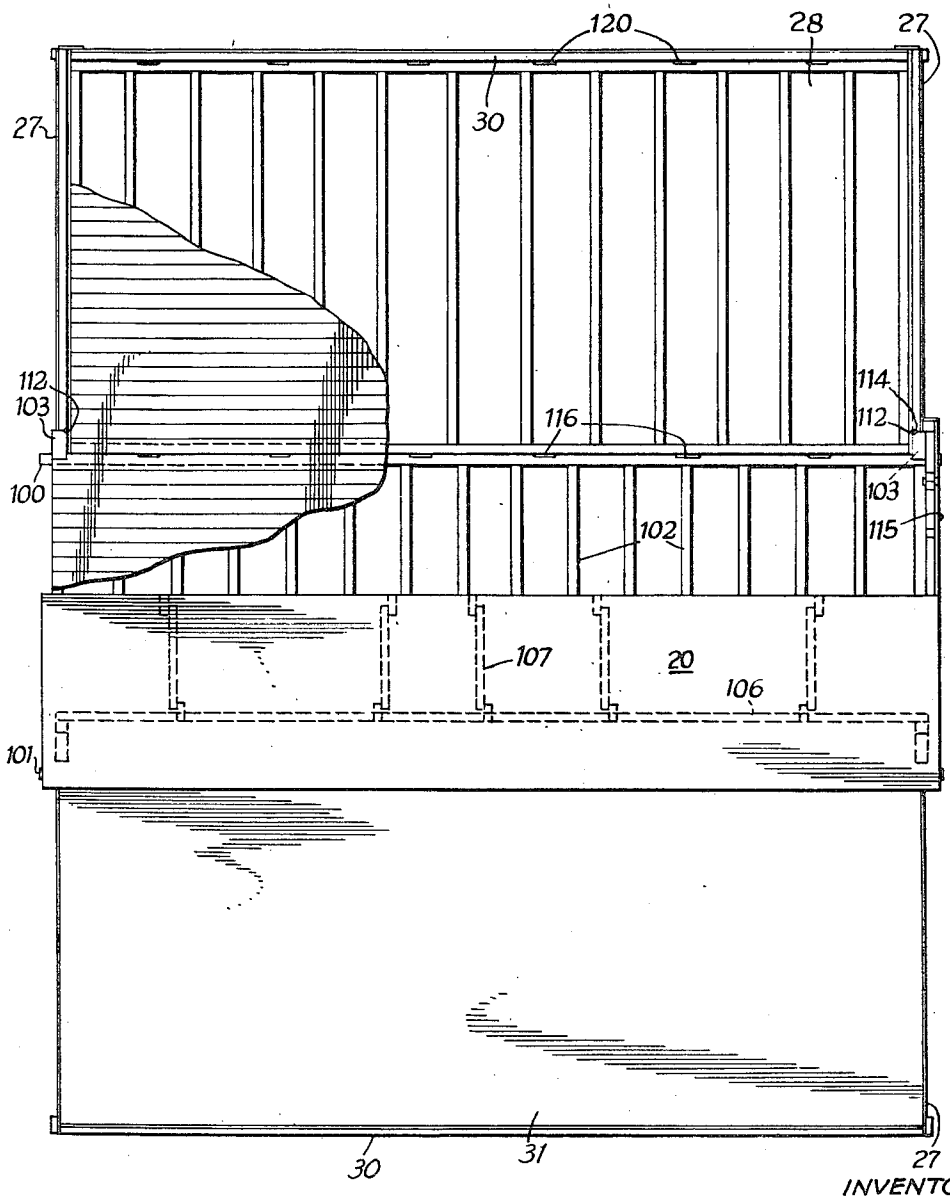
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Fig. 4.



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Fig.6.

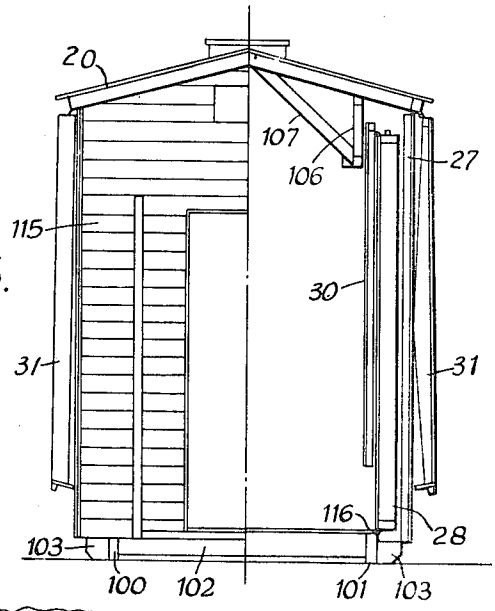


Fig.8.

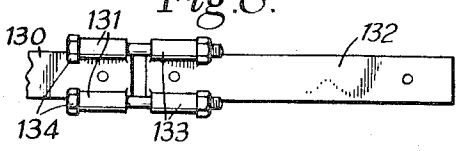
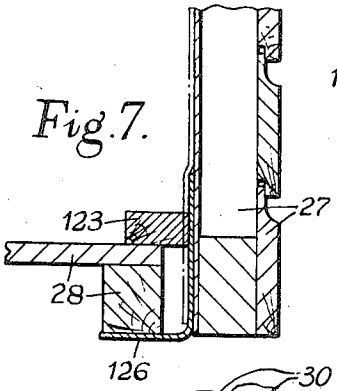


Fig.7.



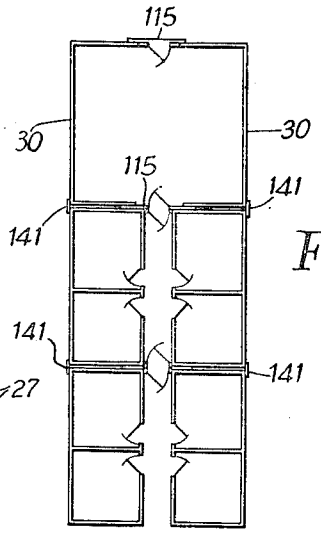
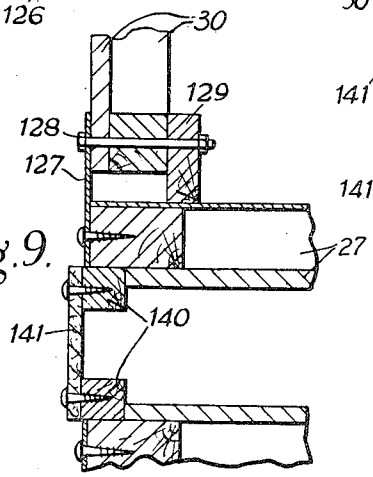


Fig.10.

Fig.9.



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COLLAPSIBLE HABITABLE STRUCTURE

Harry C. Bolt, Hampstead, London, England

Application September 8, 1953, Serial No. 379,033
6 Claims. (Cl. 20—2)

This invention relates to transportable habitable constructions. The present application is a continuation in part of my application No. 81,719 dated March 16, 1949 now abandoned.

Various types of such habitable constructions are known as prefabricated or other temporary houses, but these are not easily moved to another site and require a good deal of fixing. Caravans provide living accommodation and are of course readily moved from one site to another, but they offer very little space and no ready change of atmosphere such as is obtained in house by moving from one room to another; and they require articles of furniture or parts thereof to be used for two or more purposes which involves inconvenience such as requiring one person to get up in the morning to enable the bed or part of it to be used as a seat at breakfast for himself and the other occupants.

The main object of the present invention is to provide a structure which can be transported to a required site in a folded condition and can be very quickly opened out and will provide full living accommodation.

A further object is to provide a central body with living rooms carried by the body without requiring ground supports.

A still further object is to enable the folded parts to be easily brought into exact registering position.

Another object is to facilitate use of side living rooms which have a length more than twice their width.

An additional object is to enable structures to be joined together to form a larger construction of any desired size.

A fundamental feature of the invention is that a foldable floor flap has a one piece outer wall flap secured thereto along its long outer edge whereby great stiffness is imparted to the floor and a novel sequence of folding and unfolding the various parts is provided so as to avoid forming a rectangular structure of certain foldable parts and trying to fit another part into this rectangle, this being a serious fault in known structures which leads to difficulty in erecting, scraping and spoiling of inner surfaces, and faulty weatherproofing.

In order that the invention may be clearly understood and readily carried into effect, the same will hereinafter be more fully described with reference to the accompanying drawings which illustrate one embodiment thereof by way of example and wherein:

Figure 1 is a plan view with the roof removed of a construction made in accordance with the invention;

Figure 2 is an end view thereof with the end wall and adjacent parts removed;

Figure 3 is a plan view with roof removed of a modified construction;

Figure 4 is a plan view of a construction similar to Figure 1 but having half the roof removed and showing greater details;

Figure 5 is an end view thereof with half the end wall boarding removed;

Figure 6 is a view similar to Figure 5 but showing the parts in folded condition;

Figure 7 is a section on a vertical plane through the bottom edge of an end wall and adjacent floor of the structure of Figure 4;

Figure 8 is an enlarged view of a detail shown in Figure 5;

Figure 9 is a section on a horizontal plane through one corner of a structure as shown in Figure 4 and through one corner of an adjacent similar structure, and through a weatherproofing strip between said structures; and

Figure 10 is a plan diagram illustrating three structures connected together.

Referring first to Figures 1 and 2, there is shown a main body structure **10** which is of dimensions approximately corresponding to those of a large caravan. This structure, which is mounted on a suitable chassis, is formed of frames comprising upright sections **14**, **14** which at their lower ends are firmly secured to the chassis and at their upper ends are secured together by bars. These two frames may be made from wood such as ash, or from angle-section steel or aluminium alloy joists, and are heavily constructed and braced so as to support the load of the extended side or wing sections which constitute the aforesaid additional living spaces. The chassis supports a floor **19** which extends from one end to the other of the structure **10** and the frames support a roof **20**. The opposite ends are closed by walls **15** which may be provided with windows. A door **22** is provided in one side wall of the structure **10** at the forward end and another door **23** is provided in one of the end walls.

Over the greater part of its length, i. e. between the spaced frame members **14**, **14**, each side wall **24** of the main body structure is recessed at **25** to accommodate the flaps which, when extended, form closed wings **26** providing the additional living space at each side of the body **10**. These flaps comprise at each side two end walls **27**, **27** which are hinged at their outer vertical edges to the vertical sections **14** of the frames, a floor **28** which is hinged to the chassis, and a side wall **30** which in turn is hinged to the outer edge of the floor **28**. These flaps in their folded position are adapted to be accommodated within the recesses **25** in such manner that the outermost flap **27** at each side is flush with the end portions of the side walls **24** of the body **10**. Sliding roof flaps **31** are provided which, in the closed position, are accommodated one above the other beneath the roof **20** of the body **10**. Due to this superposed arrangement of the roof flaps **31**, the end wall flaps **27** and side wall flap **30** at one side of the structure are of slightly greater height than the corresponding flaps at the other side.

The end wall flaps **27** of the wings **26** are adapted to be suspended in the extended position in such manner as to relieve the hinges of undesirable strains. For this purpose each flap may be fitted with a wire cable **40** which passes therethrough in a generally diagonal direction from adjacent the lower outer corner to adjacent the upper inner corner. At its lower end the cable is connected to a strainer **41** which is rotatably mounted in the flap and is adapted to be turned by a key or the like inserted in an opening in the lower edge of the flap. The upper end of each cable extends through an aperture in the inner vertical edge of the flap and is provided with an eye adapted to be removably engaged over a pin **42** or the like projecting from the body frames.

The walls and roof of the body **10** as well as the hinged and sliding wing flaps are of hollow construction to provide efficient temperature insulation. These parts may be made, for example, of wooden or aluminium alloy frames which are covered externally by aluminium sheeting and internally by so called "hardboard" or other suitable panels, suitable heat insulation or lagging material such as glass wool being packed between said coverings. All external parts are suitably weatherproofed and packing or jointing of, for example, strip rubber may be provided along the contacting edge por-

tions of the wing flaps to render the additional living spaces or rooms thus formed properly habitable.

When the structure is to be conveyed from one site to another the wing flaps **27**, **28** and **30** are folded inwardly, and accommodated within the recesses **25** in the side walls of the body **10**, while the roof flaps **31** are slid inwardly above the bearers **33** to the position shown. The overall dimensions may be such as to conform with road traffic regulations and it will be seen that there are no projecting parts at either side.

The first stage in extending the wing sections from the body **10** involves outward pivoting of the flaps **27** about their vertical hinged edges to a position generally normal to the longitudinal axis of the structure. The floors **28** are then lowered by hand until they are aligned with the lower edges of the end wall flaps **27**, and are thereafter connected to said latter flaps by means of bolts **80** which are passed through apertures adjacent the lower edges of said flaps and are threaded into sockets in the edges of the floors. To facilitate this operation the ends of each floor flap **28** may converge outwardly so that the end flaps **27** are not exactly perpendicular in their extended condition to the side walls **24**. The wall flaps **30** which are hinged to the outer edges of the floors, are then swung upwardly into alignment with the outer edges of the end wall flaps **27** and are secured to said latter flaps by bolts **81** which are passed through apertures adjacent the edges of the said end wall flaps **27** and are threaded into sockets in the edges of the said side wall flaps **30**. The roof flaps **31** are now slid outwardly, suitable bearers having first been placed across the tops of the wings, and are bolted down against the upper edges of the end and side wall flaps. The end wall flaps are preferably so inclined along their upper edges that the roof flaps **31** have an outward drop of perhaps two or three inches. All that now remains to be done is to connect the upper ends of the cables **40** to the pins **42** and tension said cables. The side room roof bearers each have a depending part at the outer end to enable the bearers to be lowered (with the roof resting thereon) to the upper edges of the end and side wall flaps, said depending parts engaging within slots in the side wall flaps.

The main body or section of the structure extending between the end walls **15** and the side walls **24** may be fitted with a self-contained kitchenette **85** and separate lavatory **86**. The remainder of the main section may constitute the main living room **87** and the wings may serve as bedrooms, access being had thereto from the main section through door openings **88** provided in the recessed parts of the side walls **24**.

The embodiment shown in Figure 3 provides further additional living space at each side of the main structure as compared with that described with reference to Figures 1 and 2. This is achieved partly by utilizing the entire length of the structure at each side for the additional living space, and partly by the re-arrangement of the flaps and the use of partition flaps.

As here shown the end wall flaps **27** are pivoted to the end walls **15** of the main structure and an additional or partition flap **90** is pivoted to each of the main frame members **13**, one at each side of the structure and in transversely staggered relationship. This arrangement provides an additional room at each side of the structure, one of which rooms **91** may comprise, for example, a further bedroom, while the other room **92**, by omitting part of the associated side wall **24**, may combine with a part of the main space of the structure to form a living room. The remainder of the main space may be fitted out as a kitchen **93** and bathroom **94**. The single side wall and floor flaps of the earlier embodiment are preferably each replaced by two side wall flaps **95**, **96** and two floor flaps **97**, **98** in order to limit the weight of each component and thus facilitate extension and folding of the flaps.

Many other modifications may be made within the scope of the invention. For example, the roof flaps, instead of being slidable, may be pivoted on the frames so as, in the closed position, to lie outside the end flaps **27**. The end wall flaps may have integral bracing straps which extend diagonally from the lower outer corners, said flaps being bolted in their extended positions to the sides of the transverse frame **13**. Demountable steps such as are shown diagrammatically at **90** and **91** in Figure 1 may be arranged adjacent the front and rear doors **22**, **23** respectively.

Referring now to the more detailed drawings of Figures 4 to 9, the body has a floor or chassis consisting of two spaced longitudinal bars **100**, **101** connected by transverse bars **102**. At the corners of this floor there are provided uprights **103** which are recessed at their lower ends so as to seat on the bars **100**, **101** as at **104**. The upper ends of these uprights are connected together by a roof **20** which includes box girders **106** and tie bars **107**. The uprights carry short horizontal connecting bars **108** near their upper ends to which crossed bars **109**, **110** are bolted so as to form strong means for tying the uprights together so that they can support the full load of the side rooms whereby the latter do not require separate ground supports.

Pivoted to the uprights **103** at **112** on vertical axes are the end wall flaps **27**. The meeting surfaces at **114** of the end wall flaps **27** and uprights **103** are covered by end frames **115** which are wooden frames carrying weather boarding. The frames **115** thus extend widthwise sufficiently to cover the joint or crack **114** and extend longitudinally beyond the end walls **27**. The frames **115** are connected by cleats, bolts or the like to the uprights **103**.

Pivoted on horizontal axes at **116** to the longitudinal bars **100**, **101** are the side room floor flaps **28**. Pivoted to the outer edges of the flaps **28** on horizontal axes at **120** are the side room outer wall flaps **30**. These are one-piece walls built up of framework covered with weatherboards or the like. The pivoting of these one piece walls **30** to the floor flaps **28** is of the greatest importance as they serve as exceedingly strong struts to add great stiffness to the outer edges of the floor flaps thereby preventing sagging which makes weatherproofing almost impossible. The flaps **30** are pivoted on axes which are substantially in the plane of the floor flaps so that the flaps **30** fold flat on the floor flaps. The flaps **30** are innermost of the flaps when folded and the end flaps **27** are outside of the floor flaps **28**. Roof flaps **31** are pivoted to the body roof **20** at **125**.

The end flaps **27** carry at their lower edges inwardly turned angle plates **126** on which the floor flaps **28** seat as shown in Figure 7. A beading strip **123** is eventually fitted at the joint. The flaps **27** also carry at their edges vertically extending plates **127** (Figure 9) which plates extend inwards to form abutting and locating surfaces for the walls **30** which are (after erection) bolted to the plates **127** by bolts **128** together with a beading **129**.

When erecting a side room, the roof flap **31** is lifted, the end walls **27** are opened, the floor flap **118** is lowered on to the angle plate **126** and the outer flap **121** is finally brought up to the plates **127**. When lowering the floor flap **28** and raising the outer flap **30**, the flaps **27** and **31** are still free to pivot and thus do not form a rigid rectangle to be fitted by the flaps **28**, **30**. Thus a definite and most important sequence of flap opening movements is ensured in such a way that a rigid rectangle of walls is not first formed into which a flap is required to fit exactly. Such exact fitting is impracticable as it leads to scraping of inner surfaces and difficulty of fitting and weatherproofing.

The end flaps **27** completely close the ends of the side room, make effective closed contact with the end edges of the floor flap **118** and wall **121** and are folded flat against the outer surface of the floor flap **28** when the latter is vertical.

In order that the weight of the side rooms and their

contents may be carried by the uprights **103** without undue loading of the hinges, a metal strengthening or bracing strap **130** extends across each of the end flaps **27** from adjacent its lower outer corner to adjacent its upper inner corner. At its upper end the strap **130** has welded to it a pair of tubes **131** (Figure 8). The uprights **103** carry short bars **132** on which also short tubes **133** are welded. Bolts **134** are passed through the tubes **131, 133** and drawn tight thereby taking the load off the hinges of the end walls **27**.

It is very desirable that constructions of this type should not only be capable of use singly but should also be capable of being joined together to form larger units of varying sizes to form offices, workshops, dormitories and so forth. For this purpose we form the end frames **115** with aligned door openings. Two or more structures are then placed together end to end as shown in Figure 10 with adjacent end frames **115** abutting. There now remains the problem of weatherproofing the whole of the gap up the side walls and roof between the two structures. This is effected by providing permanent wood fillets **140** (Figures 4 and 9) attached to the end flaps **27** at their outer side margins adjacent the metal plates **127**. A strip of felt **141** is placed over the whole gap and tacked to these fillets. When the structures are to be transported to another side, only the felt **141** is destroyed and at the new site a new piece of felt is applied and tacked again to the fillets **140**.

I claim:

1. A transportable habitable construction comprising a body, having a floor, a roof, and vertical walls, a set of flat rigid flaps on each of the two opposite sides of the body, each set forming a side room area comprising a floor flap, a side wall flap and two end wall flaps, and a rigid roof member, hinge means hinging the floor flap on a first horizontal axis to the lower side edge of the body to form the floor of the side room area, hinge means hinging the side wall flap at the outer edge of the floor flap on a second horizontal axis lying in the plane of the floor flap, said side wall flap constituting a complete integral one-piece rigid side wall of the side room area so that the said side wall flap can be placed flat against the floor flap and then said two flaps together can be folded flat in vertical disposition against the body with the side wall flap innermost, hinge means hinging the two end wall flaps respectively to the body on vertical axes further outwards from said body than said first horizontal axis whereby said end wall flaps are foldable flat against the outer surface of the floor flap when the latter is vertical, said end wall flaps, when opened, completely closing the ends of the side room and forming end walls thereof and making contact with and concealing the end edges of the floor and side wall flaps, support means carried by the lower edges of the end wall flaps supporting the end edges of the floor flap, and diagonal coacting means on the end wall flaps and the body supporting the end wall flaps and carrying the full weight of the side room area with its contents without requiring ground-engaging supports under the floor of the side room area, the rigid roof member covering said side room area; whereby when forming said side room area the end wall flaps are opened first, then the floor flap is lowered onto the support means, and thereafter the side wall flap is raised; the end wall flaps being outwardly shiftable about their vertical axes from their final position whereby upon opening said floor flap and side wall flap scraping of the interior surfaces of the end wall flaps is avoided.

2. A construction as set forth in claim 1, wherein said body includes a pair of spaced uprights at each end, a frame at each end providing a door opening, said openings at opposite ends being in alignment, said frame extending widthwise sufficiently to cover the meeting surfaces of the uprights and the end wall flaps which are pivotally mounted on said uprights.

3. A construction as claimed in claim 1, wherein the diagonal coacting means comprise a strengthening bar on each of the end walls extending from adjacent the lower outer corner to adjacent the upper inner corner, means connecting the upper ends of the strengthening bar to the body and comprising sockets on the body and bar respectively, and a connecting bolt connecting said sockets whereby the weight carried by the end walls is carried by said diagonal connecting means.

4. A construction as set forth in claim 1, wherein the end wall flaps carry vertical metal plates at their outer edges covering the meeting surfaces of said end wall flaps and side wall flap, and wooden fillets carried by said end wall flaps on their side surfaces adjacent the metal plates for supporting a strip of weatherproofing material.

5. A transportable habitable construction comprising a body having a floor, a roof and vertical walls, a set of flat rigid flaps on each of the two opposite sides of the body, each set forming a side room area comprising a first floor flap, a second floor flap, a first side wall flap, a second side wall flap, two outer end wall flaps, an intermediate end wall flap, and roofing means; hinge means hinging the first and second floor flaps independently on a first horizontal axis to the lower side edge of the body to form the floor of the side room area, hinge means hinging the first and second side wall flaps respectively to the outer edges of the first and second floor flaps respectively on a second horizontal axis lying in the plane of the floor flaps, said side wall flaps each constituting a complete integral one-piece rigid side wall of the length of the side room area corresponding to the length of the floor flap to which it is hinged, so that the side wall flaps can be placed flat against the floor flaps respectively to form two pairs of flaps and then said two pairs of flaps together can be folded flat in vertical disposition against the body with the side wall flaps innermost, hinge means hinging the three end wall flaps respectively to the body on vertical axes further outwards from said body than said first horizontal axis whereby said end wall flaps are foldable flat against the outer surfaces of the floor flaps when the latter are vertical, said end wall flaps, when opened, completely closing the ends of the side room and forming end walls thereof and making contact with and concealing the end edges of the floor and side wall flaps, support means carried by the lower edges of the end wall flaps supporting the end edges of the floor flaps, and diagonal coacting means on the end wall flaps and the body supporting the end wall flaps and carrying the full weight of the side room area with its contents without requiring ground-engaging supports under the floor of the side room area, the roofing means covering said side room area; whereby when forming said side room area the three end flaps are opened first, then the floor flaps are lowered onto the support means, and thereafter the side wall flap is raised; the outer end wall flaps being outwardly shiftable about their vertical axes from their final position whereby upon opening said floor flaps and side wall flaps scraping of the interior surfaces of the end wall flaps is avoided.

6. A construction as claimed in claim 5 wherein a part of at least one side vertical wall of the body is omitted so as to merge at least part of the side room with a portion of the body area.

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