This invention relates to trench bracing means and particularly to means for temporarily bracing the soil and to support adjacent structures and an overhead deck such as a street during excavating operations in the construction of trenches, subways, tunnels and the like.

In building subways and tunnels particularly under streets, it has been customary before excavating to deck over the streets and underpin adjacent buildings independently of the trench bracing, using heavy bracings and sheeting material for these purposes. This method has been objectionable because it entails considerable materials and labor and duplication of bracing.

The object of this invention is to overcome these objectionable features in bracings for subway and tunnel excavations and to provide an efficient bracing means which will save materials and labor and simultaneously brace the excavations, underpin the adjacent buildings, and support the overhead deck forming the street surface without complicating the bracings.

Further objects and advantages of the invention will be apparent from the following specification and drawing, in which

Fig. 1 is a sectional view of a trench bracing constructed in accordance with this invention, for a subway excavation below the surface of a street.

Fig. 2 is a view taken on line 2—2 of Fig. 1.

Fig. 3 is a sectional view of a modified trench bracing constructed in accordance with this invention.

Fig. 4 is a view taken on line 3—3 of Fig. 3, and

Fig. 5 is an enlarged detailed view showing the connection between the metal sheathing and the sheet piling.

In the embodiment of the invention shown in Figs. 1 and 2, the vertical pits 10 and 11 are sunk and excavated on opposite sides of the street. These pits are protected by a lining or sheathing such as the box sheathing 12 through the dry soil to the water line 13. The pit 11, as shown in Fig. 1, is extended below the water line 13 by means of a sheet piling 14 which extends through the wet soil. Within these pits 10 and 11 within the area bounded by the box sheeting and sheet piling are placed the vertical supports 15 and 16 illustrated as I-beams or girders, but if conditions warrant may be concrete or wooden beams. Filling material such as concrete indicated at 17 and 18 is poured around the vertical supports 15 and 16 to secure the supports within the box sheeting and sheet piling forming solid vertical supports. The concrete filler extends to a point of the pit selected as the position for the longitudinal cross braces.

The vertical supporting girder 16, as shown in Fig. 4, provides a support or underpinning for the building 19.

After the vertical supports 15 and 16 are in place the soil is excavated therebetween down to the level of the concrete within the box sheetings and the longitudinal cross braces 20 which may be I-beams, girders or wooden beams are then connected directly to the vertical supports 15 and 16 by angles 21 which may be bolted to the support and bracings. The street surface is thereafter decked over by a decking of planks 22 which is supported by the longitudinal braces 20 through the intermediate supporting structure 23 built up from the cross braces. The excavating under the cross braces 20 can thereafter proceed without interference to remove the soil indicated at 24.

As the excavating of the soil 24 proceeds sheathing material 25 is placed in position between the adjacent pits for preventing caving in of the soil between adjacent pits, which may be provided if necessary with diagonal cross braces 26 connected to the cross braces 20. In the portion of the excavation where the soil is wet and sheet piling such as 14 has been used, metal sheet piling 27 preferably in the form of a bow is connected to and between the pilings 14, as shown in Figs. 2 and 5.

The vertical supports 15 and 16 being embedded in concrete are of sufficient strength after excavation to transmit the soil pressure loads in opposite directions to the cross braces 20, supporting the street deck 22 and underpinning the building 19.

In Figs. 3 and 4 a construction is shown
2 wherein the pits can be spaced at a greater distance lengthwise of the excavation than is possible in the construction shown in Figs. 1 and 2. In this structure the vertical supports 28 and 29 are also embedded in concrete with box sheeting for the protection of the pits and for forming a mould for the concrete. The excavating after the vertical supports are in place, extends to the level of the concrete embedding the supports and thereafter the longitudinal supports 30 and 31 are bolted or otherwise secured to the vertical supports 28 and 29 in the direction of the excavation. Longitudinal cross braces 32 are thereafter placed in position and connected crosswise at the vertical supports 28 and 29 to the longitudinal supports 30 and 31 by means of angles 33. The street deck 34 is then built up from the cross braces 32 with the intermediate supporting structure 35.

As the excavating proceeds sheeting material 36 is placed longitudinally of the excavation between the adjacent vertical supports, being reinforced at intervals by the supports 37 placed between the sheeting material 36 and the longitudinal supports 30.

The trench bracings of this invention are especially adapted for construction in trenches, subways and tunnels, but are not so restricted and can be used in any building construction requiring vertical and longitudinal bracing.

I claim:
1. The method of excavating trenches, subways, tunnels and the like which consists of sinking pits on opposite sides of the soil to be excavated, protecting said pits with sheeting material, inserting vertical girders within said pits, filling in material within said sheeting material to encase said girders, securing cross girders to said vertical girders, excavating the soil between said pits and beneath said girders in the line of excavation, and placing sheeting material between pits along the line of excavation as the excavation progresses to form soil retaining walls which are supported by and transmit the soil pressures to said vertical girders.

2. The method of excavating trenches, subways, tunnels and the like which consists in placing spaced vertical supports along the line of excavation on opposite sides thereof, securing cross braces to opposite vertical supports, removing the soil between said supports and beneath said cross braces, and inserting soil retaining wall forming members between said supports along the line of excavation as the excavation progresses to form soil retaining walls which are supported by and transmit the soil pressures to the vertical supports.

3. The method of excavating trenches, subways, tunnels and the like which consists in sinking pits along the line of excavation on opposite sides thereof, erecting vertical reinforced metallic supports therein, securing longitudinal horizontal supporting members to adjacent vertical metallic supports along the line of excavation, securing cross braces to opposite vertical metallic supports, excavating the soil between said vertical supports along the line of excavation, and erecting soil retaining walls between adjacent vertical supports as the excavation progresses.

4. The method of excavating trenches, subways, tunnels and the like which consists in placing vertical metallic supports therein, filling said pits with reinforcing material to encase said vertical supports to a distance below the ground level sufficient to accommodate a traffic bearing deck structure, excavating between said pits along the line of excavation to the top of said reinforcing material, securing cross braces to said vertical supports, erecting a traffic bearing deck structure on said cross braces, and continuing the excavation below the said deck until the excavation is completed.

5. The method of excavating trenches, subways, tunnels and the like which consists in placing said metallic supports therein, filling said pits with reinforcing material to encase said vertical supports to a distance below the ground level sufficient to accommodate a traffic bearing deck structure, excavating between said pits along the line of excavation to the top of the reinforcing material, securing cross braces to said vertical supports, erecting a traffic bearing deck structure on said cross braces, continuing the excavation below the said deck until the excavation is completed, and forming soil retaining walls between adjacent pits as the excavation progresses.

JAMES C. MEEM.