

EARTHING OF ELECTRICAL CONDUCTORS

This invention is concerned with improvements in or relating to the provision of earth electrodes especially in buildings having concrete foundation slabs.

In buildings having concrete foundation slabs, where it is wished to provide an earth electrode for example for lightning protection, internally within the building, it is necessary to penetrate the main foundation slab of the building in order to achieve an effective earth. However, any penetration of the foundation slab of the building by the earth electrode must be achieved in a water-tight manner to prevent ingress of water past the earth electrode into the building; this is especially important where the earth electrode penetrates below the water table of the building site.

Means of providing satisfactory earthing by earth rod electrodes passing through concrete foundation slabs have previously been proposed. UK patent specification number 774220 describes earthing using earth rod electrodes and this system has been found to work satisfactorily in many cases. However, the construction proposed in the aforementioned patent is not altogether

satisfactory for modern buildings in which a water-proof membrane, for example of heavy weight polyethylene sheet, is incorporated in the concrete foundation slab to prevent penetration of water upwardly through the slab into the building. Furthermore, the previously proposed methods for ensuring that a seal is achieved where the earth rod electrode penetrates a concrete foundation slab have required considerable precision in use and manufacture of a sealing assembly specifically for use in a particular building because it has not been possible to readily match the dimensions of the sealing assembly and of the concrete foundation slab on site.

One of the various objects of the present invention is to provide an improved apparatus suitable for use in providing a water seal preventing penetration of water through a waterproof membrane in a concrete foundation slab of a building along an earthing rod passing through the slab into the sub-soil and to provide an improved method of effecting a water seal.

In one aspect the invention may be considered to provide apparatus for use in providing a water seal preventing penetration of water through a waterproof membrane in a concrete foundation slab of a building about an earthing rod passing through the slab into the sub-soil comprising a support member adapted to be sealed to the waterproof membrane in the foundation slab, the support member providing a socket into which an end portion of a tube is slidingly inserted, first sealing means in the socket adapted to provide a water-tight seal between the

3

socket and an end portion of a tube inserted therein, an opening through the support member through which an earth rod may extend and a pocket in the support member in which second sealing means is mounted to effect a water-tight seal between the support member and earthing rod extending through the opening therein.

Preferably the support member of apparatus in accordance with the invention comprises means eg. an external shoulder by which a member having a surface area, in plan, substantially greater than that of the support member, suitably a generally flat plate, may be supported beneath the waterproof membrane and by which a first flexible water impermeable sealing sheet, for example of rubber, may be supported arranged to overlie and to be of greater area than the flat plate. Suitably the apparatus further comprises a lock nut adapted to be threadedly received on the support member to sealingly clamp the sealing sheet against the flat plate and the flat plate against the shoulder.

Preferred apparatus in accordance with the invention also comprises a hollow, bucket-like, member secured to the support member and projecting therefrom in a direction opposite the socket, the hollow member being adapted to provide an inspection pit in the use of the apparatus.

Preferably the first sealing means of apparatus in accordance with the invention comprises at least one O-ring seal housed in a groove in the socket and the second sealing means comprises an annular seal member adapted to be compressed between two compression rings accommodated in the pocket whereby to urge the annular seal member into sealing engagement with an earth rod received in the opening in the support member and with a wall of the support member defining the pocket. Conveniently pressure is applied to the annular seal member by a cap screw threaded onto an end portion of the support member.

Where a concrete foundation slab is to be laid extending below the water table at the site, it is sometimes desirable to include two waterproof membranes at spaced intervals in the concrete foundation slab. Apparatus in accordance with the invention especially suitable for use in such a system preferably comprises a

tube having an upper end portion received in the socket of the support member and a further sealing element slidably received on the tube. The further sealing element is adapted to be located in the region of the second, lower waterproof membrane in the use of the apparatus and comprises an outwardly projecting flange sealingly secured and adapted to be urged against the second waterproof membrane, a second flexible water impermeable sheet of greater area than and arranged to be supported by and overlies said projecting flange, and third sealing means adapted to provide a water-tight seal between the further sealing element and the tube.

Where apparatus in accordance with the invention is to be used on a site having readily penetrable sub-soil a preferred apparatus in accordance with the invention further comprises an outwardly projecting collar carried at a lower end portion of the tube whereby to militate against the tube penetrating undesirably far into the sub-soil.

In another aspect the invention may be considered to provide a method of effecting a water seal preventing penetration of water through a waterproof membrane in a concrete foundation slab of a building about an earthing

rod passing through the slab into the sub-soil which comprises embedding a tube in the foundation slab so that a lower end portion of the tube is open to the sub-soil with an upper end portion of the tube disposed at a pre-selected datum level and with the upper end portion of the tube slidingly received in first sealing means in a socket of a support member, the method comprising positioning of the tube with its upper end portions at the datum level, pouring a first layer of the foundation slab, positioning the support member on the tube with a flat plate carried by the support member of the upper surface of the first layer laying a waterproof membrane on the upper surface of the first layer over the flat plate with an upper portion of the support member projecting through the membrane, positioning a first flexible, water impermeable sealing sheet of greater area than the flat plate on the support member so that it overlies the plate with its periphery against the membrane, pouring a second layer of the foundation slab onto the first and, when the concrete has set, driving an earthing rod through an opening in the support member and through the tube into the sub-soil to effect earthing, and providing second sealing means in the support member to effect a water-tight seal between the support member and the earthing rod.

There now follows a detailed description to be read with reference to the accompanying drawings of apparatus suitable for use in providing a water seal about an earthing rod passing through a foundation slab, and methods of using the apparatus to effect a seal. It will be realised that the apparatus and methods have been selected for description to illustrate the invention by way of example.

In the accompanying drawings:-

Figure 1 is a view in section showing a first apparatus embodying the invention;

Figure 2 is a view in section showing a modified apparatus embodying the invention; and

Figure 3 is a side view of an alternative support member for apparatus embodying the invention.

The apparatus shown in Figure 1 is intended for use in effecting a water-tight seal to an earthing rod passing through a concrete foundation slab which may be cast in at least two layers 10, 12. The first illustrative apparatus comprises a support member 14 of any suitable material for example gun metal or stainless steel, which is incorporated into the foundation slab 10, 12 during the casting operation along with the remainder of the apparatus.

The support member 14 is adapted to be sealed to a waterproof membrane 16 for example of heavy-gauge polyethylene sheet which is arranged to be incorporated in the foundation slab at the junction between the two layers 10, 12 and extending generally parallel with the final ground level, in known manner.

The support member 14 provides a downwardly projecting socket 18 adapted to slidably receive an upper end portion 20 of a tube 22 of the apparatus. The tube is of any suitable material and may be, for example, of rigid extruded PVC pipe. First sealing means provided by two O-ring seals 24 are accommodated in grooves in the socket and are adapted to provide a water-tight seal between the socket and the upper end portion 20 of the tube. The seals 24 may be of any suitable material, for example neoprene rubber.

An opening 26 passes through the support member and an earthing rod 28 is arranged to extend through the opening 26 in the use of the first illustrative apparatus.

A pocket 32 is provided in an upper end portion of the support member 14 and is adapted to receive second sealing means comprising a first compression ring 30 arranged to slide loosely along the rod 28 until it abuts a shoulder at a lower end portion of the pocket 32, an annular sealing member 34 of resilient compressible sealing material, for example neoprene rubber, and a second compression ring 36. The compression rings 30, 36 are preferably made of a suitable rigid plastics material

e.g. nylon. The second compression ring 36 is preferably provided in two generally semi-circular complementary parts which fit more closely between the wall of the support member 14 defining the pocket 32 and the earth rod 28 than the first ring 30. In use of the illustrative apparatus pressure is applied to the annular sealing member 34 by a cap 38 screw threaded to an upper end portion of the support member and adapted to bear on the second compression ring 36.

The support member further comprises an external shoulder 40 by which a flat plate 42 eg. of stainless steel may be supported below the waterproof membrane 16. Suitably the flat plate 42 is of square periphery viewed in plan and may be provided with a locating peg 44 which abuts the shoulder 40 to prevent relative rotation of the plate 42 and support member 14; to this end, the shoulder 40 may conveniently be hexagonal when viewed in plan.

The illustrative apparatus further comprises a flexible water impermeable sealing sheet 46, for example of rubber, arranged to overlie and to be of greater area than the flat plate 42. A lock nut 48 is adapted to be

threadedly received on an upper end portion of the support member whereby to sealingly clamp the sheet 46 against the flat plate 42 and to clamp the flat plate 42 against the shoulder 40. Where the flat plate 42 is square its sides may be conveniently about 40 cm in length.

The illustrative apparatus further comprises a hollow member 50 having a bottom portion and side walls, with a central opening in the bottom portion through which the upper end portion of the support member 14 is adapted to be slidably received. In the illustrative apparatus the lock nut 48 is arranged to bear on the bottom of the hollow member 50 to apply clamping pressure to the sheet 46 and flat plate 42. Suitably the hollow member 50 is of generally square cross-section viewed in plan and is moulded of a suitable semi-rigid plastics material; however, the hollow member 50 may be of any desired shape viewed in plan. Frame means 52a, or 52b are secured about upper end portions of the hollow member 50 to provide a support frame for covers 54a, 54b which may be removed to permit access to the upper end portion of the apparatus which projects into the hollow member 50. The frame 52a and associated cover 54a shown in the left hand half of Figure 1 are intended to be used at a

ground level indicated GL1 in areas where only pedestrian or light wheel traffic is encountered. The frame member 52b and associated cover 54b are of more substantial construction and for use with a ground level GL2 and thickness of concrete encountered where vehicular access is to be expected.

The lower end portion of the tube 22 and of the earthing rod 28 are as shown in Figure 2 of the drawings.

In a method of use of the first illustrative apparatus the lower end portion of the tube 22 is driven for a small distance into the sub-soil. The length of the tube 22 is selected to be such that an upper edge of the upper end portion 20 of the tube is at a datum level at a predetermined distance below the ultimate ground level GL1 or GL2. The tube 22 may be readily cut to the correct length, especially where it is of rigid PVC plastics material, using readily available tools for example a hacksaw and no special preparation of the tube 22 is required; thus, for example, it is unnecessary to provide any threaded portion on the tube 22 as has been necessary in previously proposed designs. The support member 14 is then slidably placed on the upper end portion 20 of the tube with the tube received in the

socket 18 and the upper edge abutting against a shoulder at the upper end of the socket 18, thus to locate the support member 14 to the datum level. The flat plate 42 is positioned on the member 14 supported by the shoulder 40. The first layer 10 of the foundation slab of concrete is then poured to the level of the shoulder 40, the plate 42 becoming embedded in the concrete. Thereafter the waterproof membrane 16 is laid on the surface of the layer 10 and over the flat plate 42. The sheet 46 and hollow member 50 are then positioned and the lock nut 48 tightened to clamp the assembly together and to urge the sheet 46 into sealing engagement with the plate 42 adjacent to the shoulder 40. As can be seen, the sheet 46 overlies the plate 42 and projects beyond the plate 42 around the whole periphery.

Conduits 56 are passed through the wall of the hollow member 50 at any desired position and sealed to the wall, for example by suitable sealant, to provide conduits for electrical conductors to be connected to the earth rod 28.

The hollow member 50 used will have a suitable frame 52a, 52b, according to the ground level GL1 or GL2 with which the apparatus is to be used.

The second layer 12 of the concrete foundation slab is then poured onto the first layer until the appropriate ground level GL1 or GL2 is reached.

The pressure of the concrete of the second layer 12 urges the sheet 46 into sealing engagement with the membrane 16 around the plate 42 to effect a tight seal and the sheet 46 and plate 42 become firmly embedded in the foundation slab.

If desired the periphery of the sheet 46 may be secured by adhesive tape to the membrane 16 or a further layer of heavy-gauge waterproof membrane may, if desired, be interposed between the sheet 46 and the upper surface of the plate 42 and taped to the membrane 16 before the sheet 46 is placed in position.

The hollow member 50 is selected to be of such dimensions as to provide an access pit to the upper end portion of the illustrative apparatus once the concrete of the foundation slab has set.

When the concrete of the foundation slab has set, the earthing rod 28 is introduced through the hole 26 in the support member through the access pit provided by the

hollow member 50 and driven into the sub-soil to a sufficient extent, determined in the usual manner. The earth rod is provided in standard lengths which may if necessary be connected together by connectors 62 (see Figure 2). A pointed end portion 64 may be provided on the first length of earthing rod 28. When the earth rod has been driven into the sub-soil to a desired extent the second sealing means is introduced into the pocket 32 and compressed to effect a seal between the earthing rod 28 and the support member 14 by application of the cap 38.

In carrying out the method any rotary force applied to the rod 28 or cap 38 does not cause rotation of the member 14 as the member 14 cannot rotate relative to the plate 42 and the plate 42, being of square section and embedded in the concrete.

Conductors introduced through the conduits 56 can then be connected to the upper end portion of the earthing rod 28 in the usual way. The construction of the second sealing means permits the illustrative apparatus to be used with earthing rods of slightly different diameters without the need to provide separate sealing means for each diameter of earthing rod. Currently there are two types of earthing rod in common

use which differ slightly in diameter and which have required specially designed seals to effect an adequate seal in some known apparatus for effecting a water seal about an earthing rod.

The apparatus may be fabricated on site to fit various depths of foundation slab as the tube 22 may be readily cut length and will accommodate earthing rods 28 of 14.2 mm and 16 mm diameter, currently in use using the same sealing means.

Where a foundation slab is to be used in a location with a high water table two waterproof membranes may be incorporated in the foundation slab. In this case, it is desirable to provide sealing means associated with each waterproof membrane through which the earthing rod must pass. In a modified apparatus embodying the invention, to this end a further sealing element 66, see Figure 2, may be slidably received about a lower end portion of the tube 22. The sealing element 66 is provided with third sealing means in the form of O-ring seals 68 of any suitable material for example neoprene rubber to effect a water-tight seal between the outer surface of the tube 22 and the further sealing element 66. In the illustrative apparatuses the O-ring seals 24, 68 are identical. The

further sealing element 66 has sealingly secured thereto an outwardly projecting flange 70. A second flexible water impermeable sheet, for example of rubber, of greater area than the flange 70 is arranged to overlies and to be supported by the flange 70.

The modified illustrative apparatus, in use, first involves the driving of the lower end portion of the tube 22 into the sub-soil 74 until the upper end portion of the tube is at a predetermined distance below final ground level GL1 or GL2. The sealing element 66 is positioned on the tube 22 and a first layer 76 of concrete is cast to the level of the flange 70; the flange being embedded in the upper surface of the concrete layer 76. The second waterproof membrane 78 is then laid on the upper surface of the concrete layer 76 and the flange 70. The second impermeable sheet 72 is then positioned over the upper end portion of the sealing element 66. No clamp is necessary for the impermeable sheet 72 although one may be supplied if desired by screw threading a locking nut about the upper end portion of the sealing element 66. A support member 14 as shown in Figure 1 is then positioned on the upper end portion 20 of the tube 22 and the remainder of the second illustrative apparatus is

constructed as described above with reference to Figure 1, the main layer 10 of the concrete foundation slab being cast onto the first layer 76 and urging the second impermeable sheet into sealing engagement with the second waterproof membrane 78 around the periphery of the flange 70. A further seal is thus provided against the ingress of water through the foundation slab around the earthing rod.

Where the first or second illustrative apparatus is to be used on a site where the sub-soil is relatively unstable, an outwardly projecting collar 80 may be slidably inserted onto the lower end portion of the tube 22 to prevent the lower end portion of the tube 22 sinking too deeply into the sub-soil 74.

Figure 3 is a side view showing an alternative support member 14: like reference characters indicate like parts. The member 14 comprises a body portion 114 machined from suitable metal bar and of similar internal configuration to the first illustrative apparatus, having a socket 18, a pocket 32 for second sealing means and an opening 26. A flat plate 42a (square in plan) is butted against a small external shoulder 40a machined in the body portion 114 and welded thereto. Thus the body

portion 114 and plate 42a form an integral assembly. A sealing sheet 46 and hollow member 50 (both broken away in figure 3) can be clamped against the flat plate 42a by a lock nut (not shown, as previously described with reference to figure 1. The construction of the remainder and use of apparatus embodying the invention including the member 14 shown in figure 3 are as described with reference to figure 1.

The illustrative apparatuses are much more versatile and easily used with a variety of different foundation slab thicknesses than previously known apparatus and an access pit is readily provided by the hollow member 50. The apparatus will readily accept either the 14.2 mm diameter copper bond rod or the 16 mm earthing rod either of which may be used in current building constructions. As the tube 22 is made of plastics material e.g. high impact PVC, it can readily be cut to length on site and the apparatus adjusted as necessary.



CLAIMS

1. Apparatus for use in providing a water seal preventing penetration of water through a waterproof membrane in a concrete foundation slab of a building about an earthing rod passing through the slab into the sub-soil comprising a support member adapted to be sealed to the waterproof membrane in the foundation slab, the support member providing a socket into which an end portion of a tube, is slidably inserted, first sealing means in the socket adapted to provide a water-tight seal between the socket and an end portion of a tube inserted therein, an opening through the support member through which an earth rod may extend and a pocket in the support member in which second sealing means is mounted to effect a water-tight seal between the support member and an earthing rod extending through the opening therein.
2. Apparatus according to claim 1 wherein the support member comprises means by which a flat plate may be supported beneath the waterproof membrane.
3. Apparatus according to claim 2 comprising a first, flexible,



water impermeable sealing sheet arranged to overlie and of greater area than said flat plate.



4. Apparatus according to claim 3 comprising a lock nut adapted to be threadedly received on the support member whereby to sealingly clamp the sealing sheet against the flat plate.

5. Apparatus according to any one of the preceding claims comprising a hollow member secured to the support member and projecting therefrom in a direction opposite the socket, the hollow member being adapted to provide an inspection pit in the use of the apparatus.

6. Apparatus according to any one of the preceding claims wherein the first sealing means comprises at least one O-ring seal housed in a groove in the socket.

7. Apparatus according to any one of the preceding claims wherein the second sealing means comprises an annular seal member adapted to be compressed between two compression rings accommodated in the pocket whereby to urge it into sealing engagement with an earthing rod received in the opening and with a wall of the support member defining the pocket.



8. Apparatus according to any one of the preceding claims comprising a tube having an upper end portion received in the socket and comprising a further sealing element slidably received on the tube, the further sealing element being adapted to be located in the region of a second, lower waterproof membrane in use of the apparatus and comprising an outwardly projecting flange sealing secured thereto and adapted to be urged against said second waterproof membrane, a second flexible, water impermeable sealing sheet of greater area than and arranged to be supported by and overlies said flange, and third sealing means adapted to provide a water-tight seal between said sealing element and the tube.

9. Apparatus according to any one of the preceding claims comprising an outwardly projecting collar carried at a lower end portion of the tube.

10. Apparatus constructed, arranged and adapted to operate substantially as hereinbefore described with reference to Figure 1 of the accompanying drawings.

11. Apparatus constructed, arranged and adapted to operate substantially as hereinbefore described with reference to Figure 2 of the accompanying drawings.



12. A method of effecting a water seal preventing penetrating of water through a waterproof membrane in a concrete foundation slab of a building about an earthing rod passing through the slab into the sub-soil which comprises embedding a tube in the foundation slab so that a lower end portion of the tube is open to the sub-soil with an upper end portion of the tube disposed at a pre-selected datum level and with the upper end portion of the tube slidably received in first sealing means in a socket of a support member, the method comprises positioning the tube with its upper end portion at the datum level, pouring a first layer of the foundation slab, positioning the support member on the tube with a flat plate carried by the support member of the upper surface of the first layer, laying a waterproof membrane on the upper surface of the first layer over the flat plate with an upper portion of the support member projecting through the membrane, positioning a first flexible, water impermeable sealing sheet of greater area than the flat plate on the support member so that it overlies the plate with its periphery against the membrane, driving an earthing rod through an opening in the support member and through the tube into the sub-soil to effect earthing and providing second sealing means in the support member to effect a water-tight seal between the support member and the earthing rod.



13. A method of effecting a water seal preventing penetration through a waterproof membrane in a concrete foundation slab of a building about an earthing rod using apparatus according to any one of claims 1 to 11.
