

fir, whitewood, redwood, pitch pine, slash pine, western hemlock and kauri pine, and the following hardwoods: English, American, Tasmanian and Japanese oak, maple, birch, beech, teak, gurjun, jarrah, seraya and pyinkado. A brief description of these is given in Tables I and II.

Sub-floors of concrete which are finished with wood boards are referred to on p. 65, Vol. I. The boards are shown nailed to splayed fillets or bearers partially embedded in the concrete.

A more recent method of securing the bearers is to anchor them to the concrete by means of *floor clips*. Two patent floor clips are the "Spearpoint" and the "Bull Dog," shown in Fig. 10 at A and D respectively.

The Spearpoint clip is made of 20-gauge mild steel, which is either galvanized or sherardized to prevent corrosion. It is in one piece, having two spear-shaped flanges or legs which are inserted into the concrete, a cross-piece and two upper nailing flanges or ears between which the wood bearers are fixed. Each leg has three projecting holed *bosses* which assist in increasing the bond between the concrete and metal. It is obtainable with the ears bent down and in four sizes, *i.e.*, for 1½, 2, 3 and 4-in. wide bearers; the usual size employed for the average floor is that designed to receive 2-in. square bearers. The clips are spaced in rows at 14 to 16-in. centres, according to the thickness of the floor boards and the weight to be supported, and at 16-in. centres along the rows.

The clips are fixed in the following manner: The legs of the clips are pressed into the concrete within about half an hour after it has been laid and levelled, and before its plasticity has disappeared. Either a plank or a templet (consisting of two long boards with upper cross-pieces nailed at intervals) is used to ensure accurate spacing of the clips in true alignment and the prevention of damage to the surface of the green concrete by the workmen. The ears, being horizontal when the clips are inserted, lie flat on the surface of the concrete and thus present no obstruction to wheeling, etc. operations which are usually carried out when the concrete has hardened. The plank or templet is marked along its edges at 16-in. intervals or other required intervals, and the fixers standing upon it press the clips into the concrete at the divisions. The broken lines at G, Fig. 9, represent a portion of a templet, the width of which equals the distance between the edges of the extended ears in adjacent rows. The clips are sometimes staggered. When the concrete has hardened, the ears are prised by the claw of a hammer until they are vertical (see B, C and D, Fig. 9, and A and B, Fig. 10). The bearers are placed in position between the ears and first nailed through the slots; they are then levelled and, if necessary, packed with small wedges between the underside of the bearers and the surface of the concrete screeding, which may be somewhat irregular. The bearers are finally nailed through the top holes and the floor boards laid in the usual way.

Complete circulation of air round the bearers is assured, as the central portion of each clip is slightly above the concrete (see B, Fig. 9), although if the screeding is imperfect the space between it and the bearers is filled with cement grout. Thus, this method of fixing is an improvement upon that described in Vol. I, where partially embedded fillets are employed. Incidentally, the use of clips results in a saving in the thickness of screed. It is emphasized that the concrete must be dry before the bearers are fixed; the latter should be sound and well seasoned, and, as an extra precaution against the onset of dry rot, they should be thoroughly creosoted before being fixed.

The Bull Dog clip is of 20-gauge sherardized sheet metal and is of H-section (see D, Fig. 10). The standard clip has 1½-in. long legs, but if the screeding is less than 1¾-in. thick, clips having 1¼-in. long legs are obtainable.

They are fixed at the same distance apart and in a somewhat similar manner to that described in the preceding column. Before insertion, the two ears are folded over (see C, Fig. 10) and they are not raised until the floor is ready to receive the bearers; unimpeded use of the floor for walking, wheeling, etc. is thus permitted. Two nails are driven through the upper holes of each ear into the bearers. End joints between the bearers should coincide with the clips, and the lower hole in each ear is to allow an additional nail being driven through at the bearer end. An additional application is shown at E, Fig. 20, Vol. II.

A further development is the "acoustic" type of floor clip. This has a pad of rubber or other insulating material fixed on the cross-piece. The bearers thus rest upon the pads, and a reduction in the transmission of sound through the floor results.

2. *Wood Blocks*.—The following notes are supplementary to those on p. 65, Vol. I. The tongued, grooved and dovetailed wood block shown here at E, Fig. 10, is a type which is much favoured, as the dovetail provides a good key for the hot mastic, and the interlock provided by the tongue and groove prevents the loosening of blocks and the development of an uneven surface. The ends are sometimes tongued and grooved. The sketch at F shows the blocks laid to the basket-weave pattern on a concrete sub-floor, the surface of which must be truly level; another common design is the herringbone. The blocks forming the borders are arranged in a variety of designs; blocks which are stained a different colour to that of the general flooring may be used for borders, or a contrast may be afforded by the use of one or more rows of blocks of different timbers. The border blocks are usually mitred at the corners as shown.

The blocks should be quartered (rift-sawn or edge-grained) to ensure the maximum resistance to wearing action and the minimum expansion and contraction. They should be carefully kiln-dried to the required moisture content (see p. 10), and it is very essential that the building in which they are to be fixed is as dry as possible if good results are to be obtained. Hence the fixing of the blocks in a new building should be deferred until any abnormal moisture in the structure and atmosphere has been removed. Further, the mastic will not adhere to concrete which has not dried out. Adherence of the mastic to the sub-floor is assisted if the surface of the concrete is well brushed to remove the dust and then given a good coat of creosote.

A good test for determining the dryness of a concrete sub-floor is as follows: Approximately 1-sq. ft. of the floor is covered with crystals of calcium chloride. A sheet of glass is placed over them and its edges are sealed with putty. If the crystals are unaffected after three days, the laying of the floor can be proceeded with; otherwise this should be delayed as the dissolving of the crystals indicates the presence of moisture in the concrete.

Wood block flooring is sometimes laid on a cheap wood sub-floor. The surface of the latter is generously covered with the adhesive, a portion at a time;