the hopper, which is raised to discharge the materials into the drum. A convenient size of wood *batch box*[1] for the aggregate (if 2½-cub. ft. of sand and 5-cub. ft. of coarse aggregate are used) is shown at H, Fig. 23, the box being twice filled for the coarse aggregate. The coarse aggregate is first placed in the hopper, followed by the sand and the cement. The capacity of the drum varies considerably, one of 10/7-cub. ft. being useful for average work ; the first number indicating the capacity (in cubic feet) of unmixed materials and the latter number that of the wet concrete produced. The correct amount of mixing water is discharged into the drum from an automatic tank fixed above it. Projecting metal baffle blades fixed to the inside of the drum assist in the distribution of the materials as they impinge against them whilst the drum is revolving. The period of mixing, which may be controlled automatically, should not be less than one minute and not more than two minutes after all of the materials have been added. The strength of the concrete is not materially increased if the latter period is prolonged ; excessive mixing produces an undesirable stiffening up of the concrete. When mixing has been completed, the drum is stopped and rotated vertically to discharge the concrete.

(ii) The *closed drum mixer* has a hopper, a mixing drum which rotates on a horizontal axis, and a steel chute which is inserted into the drum after the mixing has been completed and down which the concrete is discharged.

(b) *Continuous Mixers.*—These are used on large engineering jobs. The aggregate, cement and water are mechanically measured and fed into the mixer from which the concrete is continuously discharged.

CENTRAL MIXING.—In connection with large contracts, a central batching and mixing plant is often installed on the site. This may consist of large elevated storage bins, below which are hoppers and mixing drums. The aggregate is conveyed to the storage bins and these feed the measuring hoppers below as required ; the hoppers also receive the cement. The materials from the hoppers pass into the mixing drums, water is automatically added, and, after being mixed, the concrete is deposited into trucks and transported on rails to the required part of the site, where it is deposited.

Central batching plants are now being used to batch the materials and discharge them into mixing trucks which perform the actual mixing in course of transit from the plant to the job.

PLACING CONCRETE.—Concrete should be placed in position as soon as possible and within half an hour of mixing. For short distances the concrete is usually shovelled from the mixing platform or discharged from the mixing drum into watertight steel wheelbarrows or handcarts, often pneumatically tyred to reduce vibration, and conveyed to the place of deposition. In order that the effect of the mixing will not be nullified, concrete must be carefully placed and not thrown from a height, otherwise its consistence becomes non-uniform by the separation of the heavier from the lighter particles. Concrete required for upper floors is hoisted by means of a *barrow-lift* (pulley block and tackle, attached to the scaffolding, for lifting the full barrows) or *concrete-hoist* (large hoppers containing the concrete are lifted to any desired height, the apparatus resembling the ordinary passenger-lift).

[1] *This box is sometimes provided with a base.*

The placing of concrete on a large scale may also be effected either by tipping-trucks, towers or by pumping. Tipping-trucks, as already explained, run upon rails laid round the site and convey the concrete where required. A tower may reach a great height ; a mechanical mixer is placed at the bottom, and this feeds concrete into large receptacles which are hoisted to the top of the tower where the concrete is passed down inclined shoots and deposited where required. Pumping concrete has been proved effective on large jobs where congested conditions prevent the placing of the mixer on the site ; a pump forces the mixed concrete through a steel pipe, 4 to 6-in. in diameter, to the place of deposition ; concrete has been delivered in this manner to a height exceeding 100-ft. and for a horizontal distance of approximately 1,000-ft.

COMPACTING CONCRETE.—Concrete after being placed in position should be well *rammed* or *punned* or *tamped* to consolidate it. This is done either by hand or mechanically. Two forms of rammers are shown at F and G, Fig. 23 ; these may be used for mass concrete. Metal pummels, similar to G, of various sizes are employed for consolidating the concrete round the steel bars in reinforced concrete structures. For mass concrete work the concrete is laid in layers not exceeding 12-in. thick, and each layer must be compacted before the next is spread. For reinforced work the concrete should be deposited in successive layers not exceeding 6-in. in thickness, and these must be rammed in turn. A ⅝-in. rod is used for ramming (or " rodding ") concrete and expelling the air (see also p. 31).

For concrete work on a large scale, hand-compacting methods are being replaced by mechanical means. The concrete is consolidated by vibration, the *vibrators* being operated by compressed air or electricity. One form, called a *surface vibrator*, consists of a flat plate which is placed on the surface of the concrete, a vibrating appliance is attached, and this transmits rapid shocks or vibrations to the concrete which is consolidated as the plate is moved slowly over the surface. Another form of vibrator consists of a single needle, 2½-ft. long (or a fork with four prongs), which penetrates the concrete as the appliance, held by both hands at the head, vibrates and consolidates. *External vibrators* are adopted for vibrating reinforced concrete work. The vibrators are clamped to the formwork (temporary wood framing used to support the concrete until it hardens). These transmit shocks (some 9,000 per minute) through the formwork to the concrete and consolidation results.

Vibrated concrete is denser than that which is hand-compacted, and it is therefore more impervious and weather-resistant.

CURING CONCRETE.—The water must not be allowed to evaporate from the concrete, and the longer the concrete is kept moist, the more effective will be the chemical combination of the cement with the water. The rapid drying out of the water considerably reduces the strength of the concrete. The concrete should therefore be covered over immediately it has been consolidated. A layer of sand or sacking, upon which water is sprinkled each day for a week, is effective. Surface bituminous coatings are sometimes applied to prevent evaporation, the liquid being sprayed on the concrete.

Frost can do considerable damage to concrete before it has hardened, and