Economy and efficiency of shovel operation are mainly dependent upon a properly proportioned combination of the latent power of the machine with the brains and experience of the operator. Broadly speaking, shovel operation may be divided into two phases:—

1.—The movement of the entire machine longitudinally, transversely or otherwise, as the physical requirements of the work may demand.

2.—The manipulation of the dipper and boom incidental to the actual excavation of the material.

Assuming that transportation facilities by cars, wagons or other means are ample for the removal of excavated material to the full working capacity of the shovel, and that this service is as nearly continuous as possible, the output

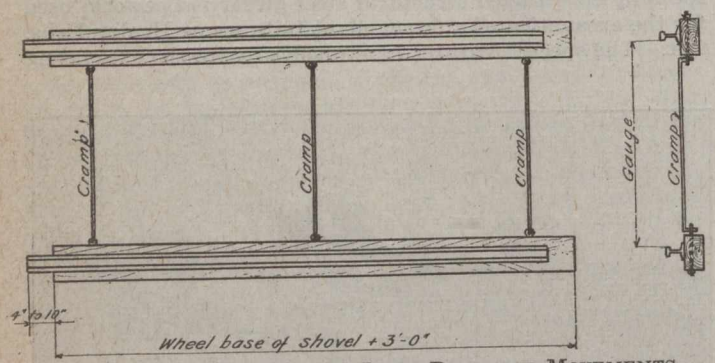

FIG. 3—TRACK SECTION FOR LONG DISTANCE MOVEMENTS

of the shovel is mainly dependent upon (*a*) the efficient operation of the dipper and boom and (*b*) the movements of the entire machine incidental to the enlargement of the excavated area.

Moving the Shovel.—Horizontal movements of the shovel are accomplished in several ways. The importance of making the "move up" in the least possible time is far too frequently underestimated. However, the thoroughly efficient shovel operator fully realizes its relation to the total excavated yardage handled in a given length of time.

Movements on Rails.—Whenever the shovel is to be transported comparatively long distances under its own power, the simplest form of track outfit consists of short sections of rails spiked or bolted upon wooden sills or stringers. The rails are maintained at proper gauge by means of eye-bolts and cramps. Details of this form of track section are shown in Fig. 3. Increased distribution of the wheel loads is generally provided, when necessary, by the use of transverse "mud sills" placed at intervals under the rail sills. The safe movement of a shovel down a grade requires that the track sections be secured against longitudinal movement by the use of rail splice plates or other appliances.

Economy effected by the use of track of this type, as compared with track of ordinary construction, is readily apparent.

To facilitate the "move up" of the shovel in the operating pit, somewhat shorter sections of track than those shown in Fig. 3 must be used. The length of rail is somewhat dependent upon the size of the shovel, but in general it should be equal to the length of the average "move up" distance.

Very Useful Track Section

The track section shown in Fig. 4 is well adapted to a wide range of service conditions. The joint ties perform a two-fold function,—the elimination of splice plates and bolts and the distribution of the wheel loads over a considerable area. The rails are held in place by the rail clips and coupling pins. The holes in the rail clips should be slightly slotted to facilitate the engaging of the holes in the rails.

Movement of joint ties is facilitated by the use of hooks or other specially devised carrying devices for which purpose eye-bolts are provided in the ends of the ties.

Movements on Wooden Skids.—Movements of the shovel on a wooden track are adapted to the use of shovels equipped with traction wheels. Usually the track consists of a double course of planks or lagging, the upper course of which is laid longitudinally or workwise with the direction of movement of the shovel. These are commonly called "running planks." The lower course of planks is laid transversely to the upper and serves to distribute the wheel loads on soft or uneven ground.

The upper and lower course planks may be used as detached pieces or they may be assembled into built-up track sections, as shown in Fig. 5, for use in conjunction with the shovel of the turntable class.

Whenever built-up sections are used, they are moved to and from their location in the track by being lifted upon the dipper arm, a sling chain being provided for this purpose. Doubtless the most important factor upon which the sucessful lifting, swinging and dropping of the track sections into correct position depends, is the expertness of the shovel operator. However, this is a detail in which a careful operator should be able to attain efficiency by a comparatively small amount of practice.

Tough, Hard Timber Required

The timber used must be tough and comparatively hard. The former property prevents splitting, while the latter facilitates "skidding" of the wheels when turning the shovel or changing the direction of the cut.

Movements without Track.—Shovels of light weight having traction wheels are occasionally operated without the use of track. In general the two conditions under which such operation may be undertaken are:—

1.—Upon a pit bottom consisting of a naturally cemented gravel or sand, shalelike clay or other exceptionally firm material.

2.—Upon a comparatively firm pit bottom and with a shallow cut rendering a "move up" necessary at short intervals.

Competent pit men contribute very greatly to the effective and satisfactory moving and operating of the shovel. One of their most important duties is the proper levelling and compacting of the pit bottom preparatory to the laying of track sections for the "move up." If this work be improperly

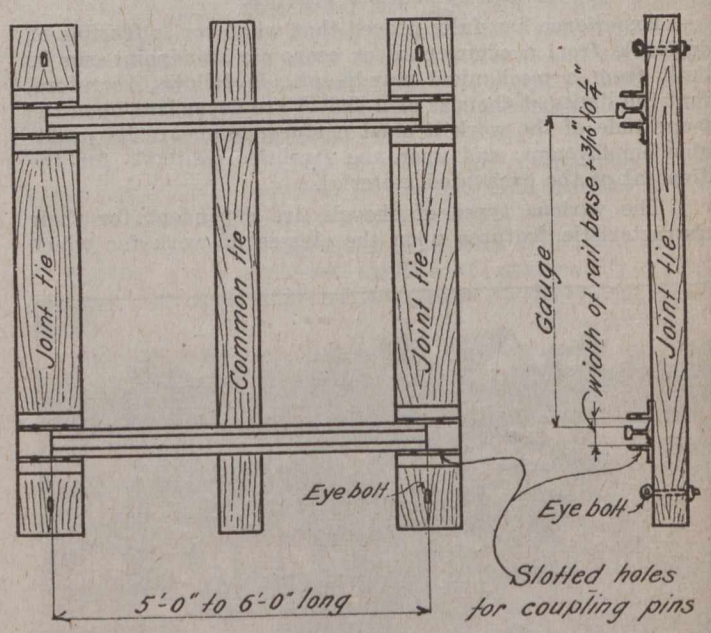

FIG. 4—TRACK SECTION FOR MOVE-UP IN PIT

done, the track will take an irregular bedding, which tends to increase the wear and tear upon the track sections and also, by reason of track deformations, produces irregularities in the working functions of the shovel. A hardpan or a broken stone pit bottom involves a quite different class of preparation from that composed of soft, yielding earth upon which an allowance must be made for settlement and possibly for localized soft spots.

Turning the Shovel.—Turning movements are commonly effected by a series of forward and backward movements by