which the alignment of the shovel is gradually changed to conform to the desired alignment. Railway and other shovels moving upon steel rails are deflected from a previous alignment by the use of curved track. Shovels equipped with traction wheels change direction by the use of a steering appliance which swings the forward wheels in the direction desired for any given movement.

Revolving shovels mounted upon traction wheels are equipped with the steering appliance mentioned above, but shovel operators quite frequently prefer to alter the alignment of the shovel by a series of sliding movements, commonly known as "skidding the shovel," in which the entire machine is swung about by a slight longitudinal movement. Possibility of breakdowns or unlooked for accidents is not appreciably increased provided the movement is executed with reasonably good judgment and care.

### Skidding and Its Advantages

Fig. 6 shows a shovel placed in proper position for "skidding" in a counter-clockwise direction. It will be noted that the nearest rear wheel is trigged to prevent a forward movement and that other wheels are free to move both forward and sidewise. The dipper is thrust vertically downward and takes a firm, even bearing upon the pit bottom, the dipper arm being subjected to a slight pressure, which has the effect of tending to raise the boom.

Immediately upon the completion of the above preparation, the shovel is subjected to a combined swinging and traction effort. In the case here described, the shovel body is swung slightly in a clockwise direction. This movement, combined with the forward tractive effort, subjects the vehicle portion of the shovel to a thrusting force which produces a lateral slipping of the nearest front wheel and a combined lateral and forward movement of the wheels on the opposite side of the shovel. The nearest rear wheel executes a slight pivotal movement but, being trigged, remains otherwise stationary.

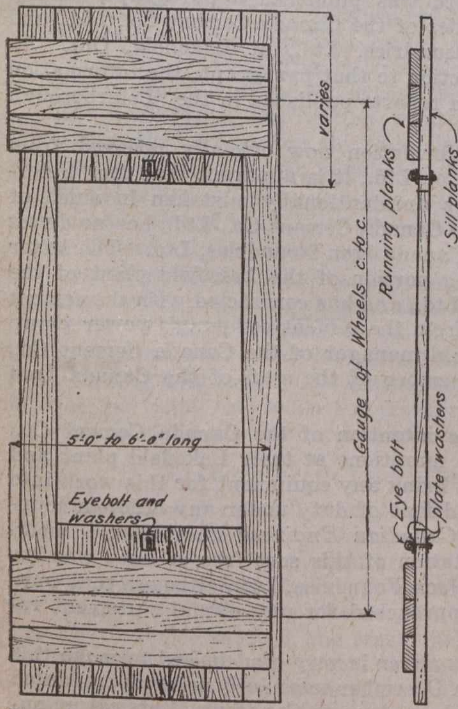


FIG. 5—BUILT-UP WOODEN TRACK—ALL PLANKS BOLTED OR SPIKED IN PLACE

Turning the shovel by this method possesses three advantages especially worthy of mention:—

1.—The area required for the execution of the movement is small in comparison with that required for a movement involving the use of the steering appliance.

2.—The time and labor elements are reduced to a minimum.

3.—The excavation of material is continued throughout the execution of the movement at a rate only slightly reduced below normal.

### Dipper and Boom Operation

The composition, physical properties, etc., of the material to be excavated constitute important factors entering into effective dipper and boom operation. A brief consideration of natural soils, including rock formations, is therefore essential to a discussion of the functions affecting the efficient operation of these members.

Broadly considered, natural soil materials are divided into five general classes: Rock, gravels, sands, clays, and ordinary soft soils and earths.

Rock varies in its physical properties from the granites, syenites and other hard crystalline rocks, to the sandstones, conglomerates, shales and other comparatively soft rocks of sedimentary origin. Rock formations must generally be broken into comparatively small fragments by blasting before they can be excavated with a steam shovel. However, very soft sandstones, conglomerates, shales and other rocklike material commonly known as "rotten rock," can frequently be excavated without blasting.

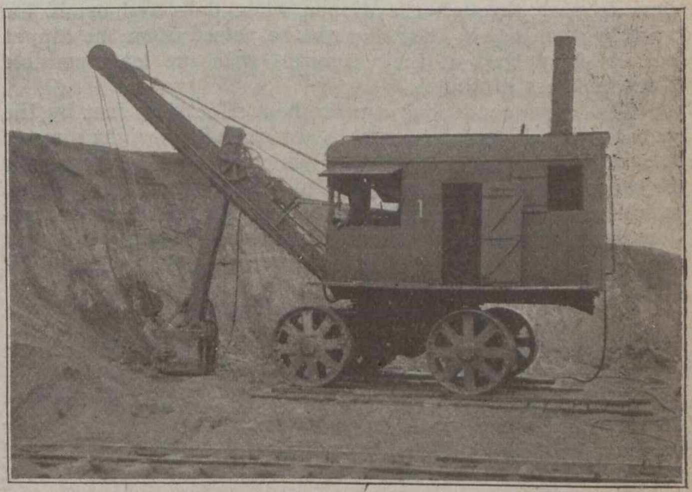

FIG. 6—SHOVEL IN POSITION FOR SKIDDING

Gravels vary widely in composition and texture. A coarse gravel firmly cemented with a natural earthy cement containing iron, lime or other cementing material, may require to be blasted before being excavated; while on the contrary, a loose, disintegrated gravel may be freely excavated without previous preparation.

Sand-like gravel varies widely in composition and texture. It may exist as hard, practically cemented material or, when saturated with water, as a soft, unyielding, semi-fluid material.

Clay varies in its physical composition from that containing a considerable amount of fine, sandy material to that which is commonly known as "gumbo," in which there is no sand. It may exist as a firm, solid material of great cohesion and density, closely resembling shale rock, or as a pasty, semi-fluid material which will squeeze and ooze under pressure.

Soft soils and earths commonly contain vegetable matter. Swamp deposits of peatlike soils are almost entirely of vegetable origin.

From the above consideration of the diversified character of natural earths, it is clearly apparent that the operation of the dipper and boom is especially exacting, demanding the closest attention and skill on the part of the operator. The operation of the dipper involves two primary movements:—

(1)—A thrusting, commonly termed "crowding," movement by which the dipper is forced into the material; and

(2)—A vertical or lifting movement by which it is drawn through the material.

To these may be added a horizontal swinging movement, which is secondary in its nature, since it is produced by a swinging movement of the boom rather than by the dipper-operating machinery. The thrusting and lifting movements are almost invariably applied simultaneously.

A fully loaded dipper accomplished by the least possible effort and in the least possible length of time is the primary object sought by the operator. To this end he directs all dipper movements. However, the magnitude and the speed of the thrusting and lifting movements are influenced to a marked degree by the physical character of the material. A dense, hard and uniformly firm material (for example, a shalelike