

crab type. The standard weights range from 3 to 25 tons and for low vein mines the total height of the smaller sizes does not exceed 27 inches. The economy obtained in the use of the straight haulage type for delivering trips to the shaft, slope, entry tippie or breaker in mines having reasonably long haulage is generally acknowledged, and units of this type are used in practically all mines where electric service is available.

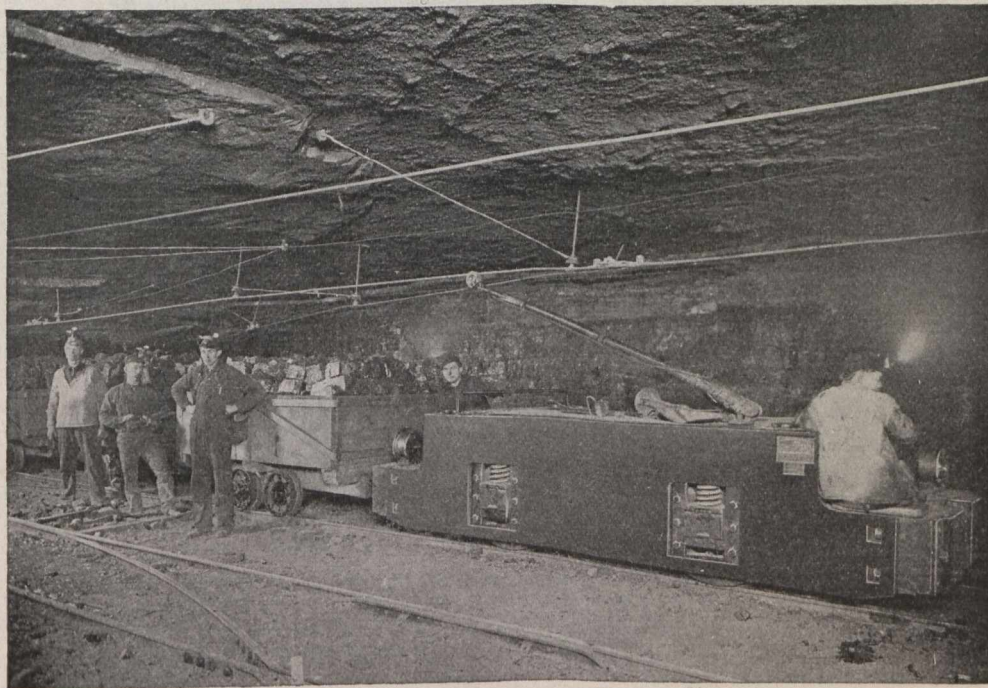
For the main haulage in mines the mule or horse has been almost universally discarded where electric service could be obtained, inasmuch as a single locomotive can effectively displace a considerable number of animals, can travel faster, requires less head room, and can operate 24 hours a day if required. For gathering, however, animals are still used to some extent, as the question of their replacement in this service by gathering locomotives is governed by such a diversity of operating conditions that each installation must in effect be considered as a separate problem.

In some of the larger mines the question of comparative operating costs for each group of workings has been ignored, and cable reel locomotives used throughout for gathering, simply on account of their greater capacity, reliability and general convenience, and the resulting increased output has in every case fully justified the ex-

capacity to permit of its being installed for any length of time without overheating.

After the cable is attached to the trolley wire and locomotive moves forward, the unwinding of the cable causes the motor to act as a series generator, and the counter-torque thus developed produces sufficient tension on the cable to cause it to pay out evenly and drop along the roadbed without producing kinks. This counter-torque produces enough braking effect to instantly stop the reel when the forward movement of the locomotive ceases, and as soon as the locomotive starts back the motor action comes into play and the reel is rewound at a tension sufficient to obviate any possibility of the locomotive overrunning the cable. As the operation of the reel is entirely automatic, the motorman is free to devote his entire attention to the handling of the locomotive.

For haulage in gangways in which the grading for the roadbed is such as to prohibit the use of cable reel locomotives, the combination or crab type, equipped with a hoisting drum and steel cable in addition to the cable reel, is generally used, as it can be blocked in the entries of successive gangways and by means of the hoist can draw the loaded cars up the slopes and then deliver the trips to the main haulage tracks. On short slopes it does the work as rapidly and effectively as a permanent



penditure involved in the complete abolition of animal haulage.

The type of gathering locomotive developed by the General Electric Co. consists of a reel of large diameter driven through double reduction gearing by a small vertical series wound motor, the reel being supported by the motor frame and rotating on ball bearings. Friction is further reduced by also providing the armature shaft with ball bearings. This motor is connected directly across the line and is equipped with a permanent series resistance which protects it from a heavy rush of current when the locomotive is standing still.

A combined switch and fuse is also inserted in the circuit for protection against short circuits and for convenience in opening the circuit if desired, but is not involved in any way with the ordinary operation of the reel. The motor is so designed that it is of sufficient

rope haul or hoist, with the added advantage of portability, and, as it can also perform the duties of both the straight haulage and cable reel types, it is often considered indispensable in mines where a limited number of locomotives can handle the entire output. Its "general utility" features have caused its adoption for all underground work in some of the largest mines in the anthracite fields where the irregular grades in numerous gangways render it especially valuable.

In collieries and mines where the breaker or tippie is located at a considerable distance from the entries or shafts, separate locomotives can be advantageously used for surface haulage, and as they are practically unrestricted in the matter of size, excepting in regard to the capacity of the breaker or tippie for handling the coal received, heavy locomotives—ranging from 10 to 25 tons, capable of delivering a large number of cars per