carrier. For this purpose a mechanical device was considered preferable, consisting of a main driving pulley with a "C" shaped rim, around which the hauling rope makes 2½ turns. This pulley is driven by worm reduction gear actuated by two bevel wheels on an extension of the motor shaft. These bevel wheels run loose on the shaft, to which, however, either one or the other can be connected by cone clutches, and so reverse the motion of the drive to the worm gear. Either one or other of these clutches as required is thrown into gear by means of a weighted lever, the action of the lever being controlled by a trigger in the cam wheel. This cam wheel is driven by chain from the main driving wheel, and is so arranged that as soon as the driving-wheel has made any required number of revolutions, the lever is thrown over, the one bevel wheel in gear is declutched, and the other bevel wheel clutches on to the motor driving shaft, thus reversing the motion of the hauling rope.

In another arrangement or the single-line ropeway, loaded conveyers are taken out directly on the rope, in a kind of combined cage and tippler, so arranged that on arrival at the point of tipping the tippler part of the cage is caused to revolve, capsizing the conveyer, as in the ordinary colliery tippler, and so automatically discharging its contents on to the tipping ground.

Another modification of this single-line double-rope system is well illustrated in the case of a ropeway employed at a steam power plant for conveying stock coal from railway cars on to the stocking ground, and back again from the stocking ground to the boiler bunkers when required for use. The dual capacity required rather different arrangements. In the first case the ropeway was required to be at its maximum height to provide ample space for automatic tipping, and in the second case the carrying rope had to be low down, so that the carrier could run below ground level for convenience in loading when taking up the stock coal. In the first arrangement, the coal to be stocked is emptied from the hopper-bottomed coal wagons, in which it arrives, into a conveniently-placed hopper, from which the coal runs by gravity along a chute into the carrier box in the ordinary manner. This carrier is large enough to hold one ton of coal, and, as space was limited, and it was desirable not to break the coal more than absolutely necessary, the box, instead of being made to tip right over in the usual manner, was made with bottom doors so arranged that they only opened sufficiently to let the coal out gently. As soon as the box is loaded the starting switch is moved over and the driving gear, which is similar to that described above, takes the load along past the first standard until it arrives at the tipping point on the stocking ground, where the coal is tipped automatically. As soon as the coal is tipped to a sufficient height (12 ft.), portable tramways are laid down and the coal is tipped directly into tipping tramway wagons and taken all over the tipping ground, which has an area of rectangular shape about 400 ft. long and 200 ft. wide.

When it is required to take the coal back again, the main rope of the ropeway is lowered by means of the special gear provided, until the carrier box is low enough to run in a trench dug along the line of route, so that the top of the carrier box is at about ground level. The coal is then brought along in the tramway wagons already described and tipped directly into the ropeway box, the capacity of both the ropeway box and the tram wagons being the same. The coal is then taken back by the ropeway to the original loading point. At this place the carrier is automatically released from the hauling rope, and is run by hand (at present) along a short length of run-rail to the boiler bunkers, into which the coal is tipped in the ordinary manner. At the same time, an empty carrier which is standing ready on a shunt rail, is run out on the ropeway ready for the next load, so that no loss of time is involved.

It it sometimes necessary to utilize to the utmost advantage such space as may be available for dumping, and naturally the best way is to carry the dump as high in the air as possible.

There are several methods of arranging this. In the case of the single-rope system, one way of getting over the difficulty is to employ a movable return terminal fitted on wheels, whilst the main rope of the ropeway is carried for some distance, sometimes several hundred yards beyond the point where tipping commenced, the return tension sheave, of course, being fitted at the far end of the rope, and approximately on the ground level. The tipping frame is situated at the commencement of the tipping ground, and the two ropes, that is, the outer and return ropes, are diverted upwards at this frame by means of sheaves, so as to be out of the way of the carriers, which at this point run off the rope in the manner already described on to the return rail, and are run round by hand from the outwards to the rope, the contents being tipped at the same time on to the ground just ahead of the tipping frame. Here the material is carefully packed at a higher elevation, and after sufficient tipping has taken place and is suitably trimmed, the frame itself is bodily moved forwards on to the higher ground, when tipping again takes place as before. At each successive move of the tipping frame the ground is carried higher, and with it, of course, the frame gradually rises, thus providing more and more tipping room as it travels along and upwards. This arrangement is quite good, but it requires the constant employment of at least two men to tip the carriers and run them round the return rail, and the actual continual movement of the frame itself is a matter of some difficulty.

In case of the double-rope system an ingenious but rather expensive arrangement has been introduced with a certain amount of success by one eminent firm of ropeway builders. In this case a rigid steel structure is provided with fixed run rails, along which the loaded carriers are conveyed. This framing is built of steel to the angle at which the tipping heap is to be made, sometimes as steep as 1 in 2, and as tipping proceeds, the steel frame itself is extended bodily out, section by section, until the required height has been attained. This arrangement works very well, but is somewhat expensive, both in the first expense and in the cost of maintenance. Probably one of the most effective methods after all is by the simple expedient of merely raising the height of the tipping standards themselves. In one case, a ropeway was originally installed some 1,010 ft. long to carry pit dirt from a colliery over a river, and there tip it automatically on the tipping ground beyond. The length of the ground is about 560 ft., and the standards and return terminal were made 50 ft. high, giving a tipping space for 60,000 tons of pit dirt, which was estimated would last the colliery some considerable time. After the work was completed, the colliery company were fortunate enough to strike a new seam, increasing their output of coal and dirt enormously, with the result that the capacity of the ropeway, which was originally designed for carrying 6 tons of dirt per hour, had to be increased by adding on further and larger carriers up to about 20 tons per hour.