

track. If the forest-floor cover is only slightly or with difficulty inflammable, it is sufficient to keep bare a strip between the right of way and the woods, so that a fire starting cannot pass it; even this is sometimes not necessary as the light far-flying sparks are not dangerous.

Protection of Pine Forests.

The conditions are quite different if the railway crosses a wood with highly inflammable ground-cover. There is especial danger for extended stands of pine on poor dry soil. In such stands, the danger lasts nearly all the year, and the flames, running swiftly over the ground, easily reach the crowns; they are safe only as long as the snow is on the ground, or as long as it is raining. In these stands, as well as all others, in which there is a large amount of easily inflammable, dry material, special precautions must be taken. Ordinarily these consist of treeless spaces, which are either used as farming land or planted with hardwood managed on short rotation. But on dry forest soils, where the danger is greatest, hardwood will not grow, and farming does not pay, in which case broad, entirely unused strips are left on both sides of the right of way, which must be plowed each year, entailing expense and bringing no return, and sometimes also entailing danger to the railway through drifting sand.

Protection Strips.

If these strips are needed to stop sparks, they must be very wide. A width of ninety feet on either side does not protect, for Burkhard has observed that sparks have set fire 240 feet from the track. But a strip 33 feet wide and a quarter of a mile long contains one acre, therefore a strip 33 feet wide on each side of the track would mean eight acres per mile, not only lying useless, but in some cases increasing the danger of fire, as it has been proved that where a railway runs through a forest which lies close to the track, there the danger is, on the average, less than when the woods are farther away. If the trees are close the wind is compelled to follow along the narrow lane of the track, while if the trees are farther away, the wind can blow from the side and drive the sparks among the trees.

To overcome these disadvantages, and to protect the forest from the danger of fire from locomotive sparks, it is necessary to manage the wood near the track, and to prepare a strip on which all fire will die out before it can set fire to the crowns, or kill the trees, and at the same time catch all sparks. The glowing sparks are rather large and fall immediately to the ground as soon as they strike the still air stratum inside the protection stand, just as snow-flakes fall behind a hedge or sand-clouds behind fences and grass tufts. The protection strips, which the author of this pamphlet has recom-

mended for pine forests of North European plains, answer a double purpose. They permit the use of woodland right up to the track, even in districts most subject to fires, protect the track from drifting sand, and are relatively cheap to keep up. They consist of strips of trees, 36 to 45 feet wide, which have a bare ditch or path 4.5 feet wide toward the forest, and a strip, 3 feet wide, of bare ground next to the track. The two bare strips are joined by foot-paths, kept bare, every sixty or ninety feet.

As mentioned above, every fire starts from a small beginning, which cannot harm the trees, and is dangerous only when it has succeeded in spreading. Very often the dry grass or moss on the railway embankment catches, and has quite a large front by the time it reaches the edge of the woods, and that it may not spread over into the wood, the edge of the wood is kept bare for three feet. Then the fire goes out. The glowing sparks which fall directly on the strips of wood beyond the first bare place can start only small fires, and if these spread, they must die out on reaching the second bare strip of 4.5 feet, or one of the cross lanes.

Wooded Strips to be Narrow.

Care must be taken that the fire on the protection strips never reaches the size of a crown fire, and thus spreads over the bare strips. This end is achieved by the narrowness of the wooded strips. If there is not much fuel on the ground, a fire 36 to 45 feet from its origin is not high; height comes only when a fire has reached deeper into a forest, over a larger surface, which much increases the heat. The amount of inflammable material on the protection stand, both on the ground and above it, must be kept down as much as possible; all dry branches, weeds, juniper and other inflammable objects must be removed; suppressed and dry branches of the trees up to breast-height must also be pruned off. Only the green branches on the edges of the stand must be kept as near the ground as possible. The closer the green branches are on the side toward the track, the better the protection strip fills its second important purpose, i.e., to stop the lighter far-flying sparks.

To attain this end, the stand on the protection strips must be closed and without large gaps; a stand which is too thick is not favorable, for between the close standing trunks, the flames easily rise higher than where the trees are not so close, and crowded trees do not develop good crowns.

Since very old stands become too thin and the high trees are likely to be thrown on the tracks by storms, or at least may damage the telegraph lines, it is necessary to choose a short rotation for protection strips. In determining this rotation, the first consideration is the purpose of the protection stands; the second is the yield. The rotation