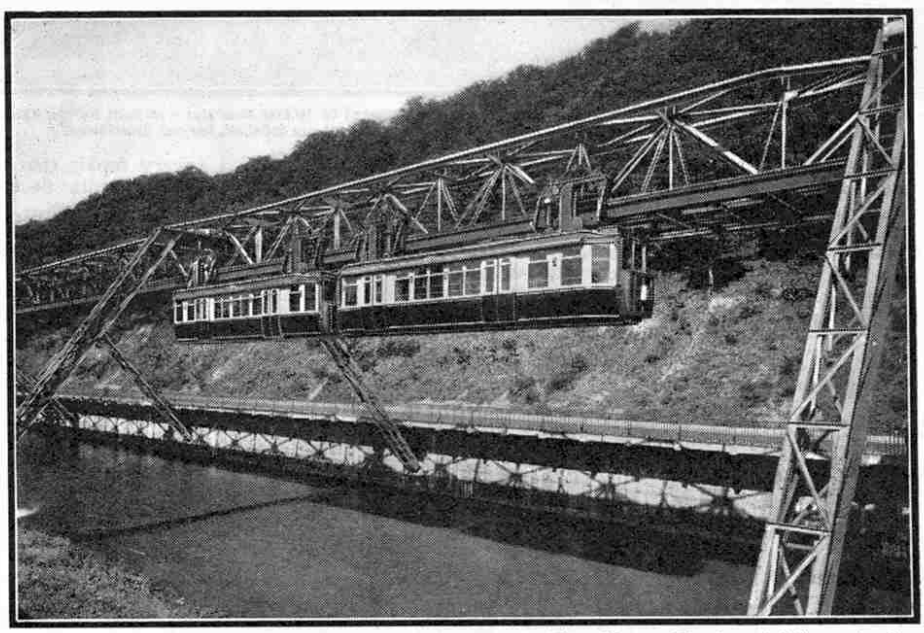
The Barmen-Elberfeld Overhead Railway

Advantages of a Suspended System

By Hans F. Kutschbach

THE development of towns that are situated fairly close to one another soon creates a demand for rapid and convenient transport facilities between them. The German towns of Vohwinkel, Elberfeld and Barmen are situated in the valley of the River Wupper to the east of the Rhine. The shape of this valley caused the development of these towns to take place along the course of the river, with the result that to-day the three form practically one town. In addition to this waterway they are connected by rail, by a street tramway system and, most interesting of all, by the well-known overhead Barmen-Elberfeld Railway.

During the last years of the 19th century the rapid growth of the three towns towards one another resulted in a great deal of street traffic congestion. With a view to relieving this an elevated electric railway providing rapid transit was proposed, and ultimately it was decided to adopt the system, then recently designed by an engineer named Eugen Langen, of a mono-rail suspended railway. This particular type was especially suited to the conditions to be met, for the only route available was above the river flowing through the three towns, and the numerous sharp curves at frequent intervals would have made the building of an ordinary surface railway a matter of great difficulty. Work was started in 1898 and the section of the line between Elberfeld and Vohwinkel was opened three years later. The completed system was finally opened in 1903 and is 8.3 miles long. Along the part of the line that follows the course of the river, the rails from which the cars are suspended form part of a triangulated framework, supported at intervals by "legs" that straddle the river banks. Elsewhere the framework is supported by "U"-shaped plate girder erections that remind one of giant croquet hoops.



A two-car train on the Barmen-Elberfeld Railway system over the River Wupper. The characteristic construction of the framework and the suspension arrangements are shown in this illustration.

The car bodies are suspended below the running rails. On their roofs are mounted two strong frames of special construction in which are arranged the running wheels and the electric motors for propelling the train. The power supply is direct current at a pressure of 600 volts, and the maximum speed is restricted to 25 m.p.h. Each car has its own motors, and trains are made up of two or three cars each. Special arrangements ensure that in the event of a derailment of the wheels the cars are prevented from falling from the track. No case of a car falling has ever occurred, and in the 30 years or so of the existence of the line only one fatal accident has been recorded. Even this instance was not due to any defects in construction or in maintenance, and in fact, ever since the opening, the working has been perfectly satisfactory and the frequency of the service afforded remarkable. The 20 stations are spaced at an average of 765 yards apart, and during rush hours the trains follow each other at intervals of less than two minutes.

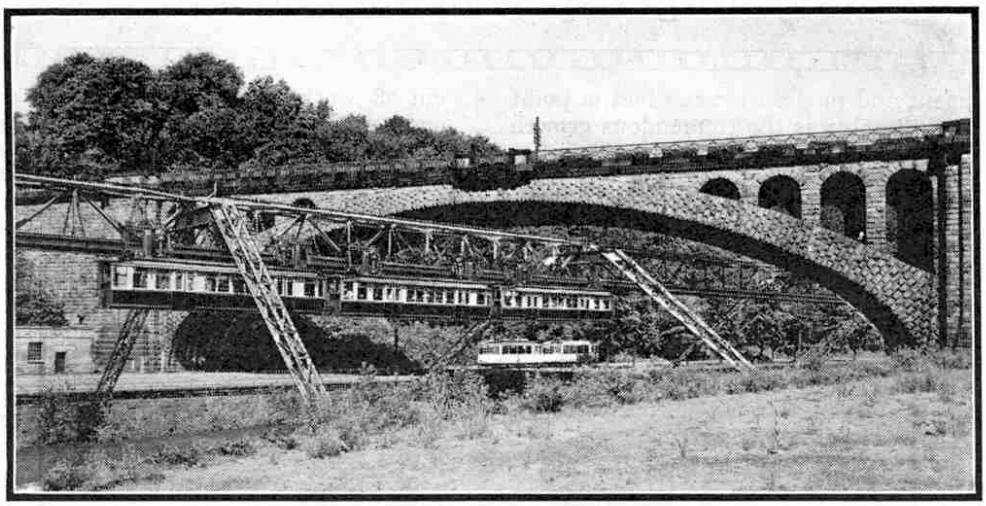
The safety of operation, when the frequency of the service is borne in mind, is a striking feature of the system, and this, together with the punctual running and general trustworthiness of service, is no doubt largely accounted for by the soundness of the signalling system. In view of signalling developments during recent years on ordinary surface and underground railways it is interesting that train movements on the Barmen-Elberfeld line have always been controlled by automatic colour-light signals arranged on the "approach lighting" system. This means that the signal lights are illuminated only on the approach of a train within a certain distance of the signal, and that the lights go out when it has passed. Although various alterations have been made as a result of experience in operation, the main principles of the system are as embodied in the original apparatus.

The signalling sections extend from station to station. Entrance to a section is governed by a two-aspect starting signal with the usual red and green indications. There is in addition a special yellow light that can be illuminated, together with the red light, when permission has been obtained, by telephone from the station in advance, for a waiting train to proceed with caution into an obstructed section.

The station master at each station has under his care

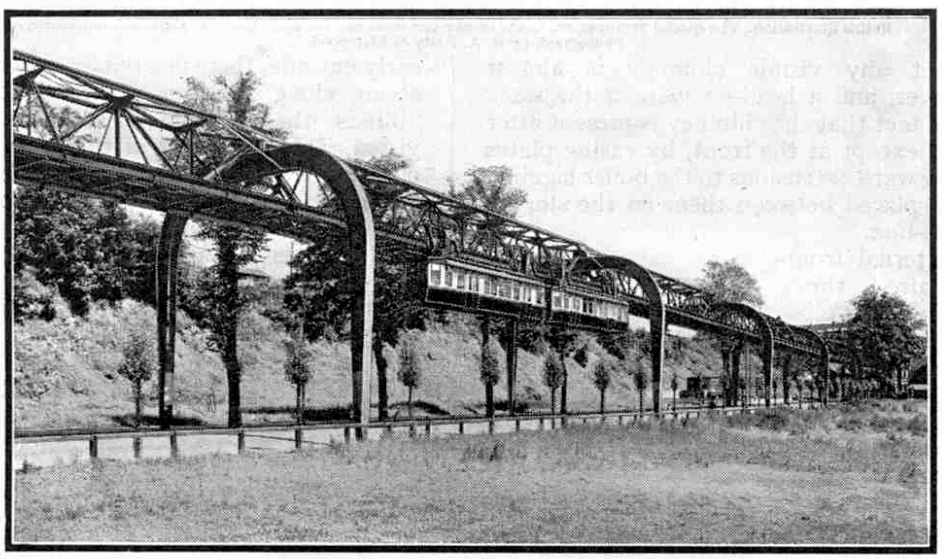
the signalling apparatus, such as the operating relays, pilot lights and emergency switch gear for that section; and he has to take any special steps necessary for dealing with any emergency that may arise. He can keep a signal at danger independently of the automatic arrangements, if this should be necessary for any reason.

The automatic operation of the signals makes use of the 600-volt power current, and short lengths of special rail form contacts for the collector shoes on the cars. When one shoe on a car makes contact with one of these special lengths, the other is still on the live rail; and as the shoes are connected in parallel, current is then supplied to the signal circuit. Only the shoes on the first car of a train affect the clearing of a section; but if a train stops after only part of it has passed the contact rail, and then proceeds, or if one is backed on to a contact rail, there is no irregular clearing of the signal in the rear.



An interesting photograph showing the suspended Railway, the River, and the roadway alongside. The bridge that crosses them all carries a railway line of normal type.

In view of the success of this overhead railway it is surprising perhaps that similar systems have not been adopted more widely as the means of transport. Possibly the day of schemes of this kind has yet to come, when existing surface or underground systems are found incapable of dealing with more traffic. A great advantage of the overhead form of construction is that its framework is said to cost only half as much as a tramway, and of course it does not in any way obstruct the street or other surface traffic, but is carried along completely above it. A disadvantage that it shares with other railways of such a special nature is that the arrangement of points and crossings is a difficult matter.



How the line is suspended along the road. Bearers of plate construction replace the lattice form used elsewhere.

Special switch rails are used on the Barmen-Elberfeld Railway that have the effect of lifting the double flanged wheels of the cars clear of the main rail, and of diverting them as required, the main rail itself remaining unbroken. The operation of such switches is naturally somewhat slow and more complicated than that of corresponding main line equipment. In the latter case it is only necessary to move the switch rails a few inches, but on the suspended line a portion of the whole track has to be moved some feet in order to allow sufficient clearance for the cars and their suspending frames. The reversing of the trains at the terminal points is effected by running them round a loop line. A loop is also situated intermediately.

It may be that the experimental installation of the Railplane system at Milngavie near Glasgow shows a possible future development. This involves a trestle-like structure carrying overhead rail tracks from which are suspended cars whose bodywork is designed on the lines of airships. In addition to the running rail above each car there is a rigid guide rail to prevent any swaying of the car while in motion. The important point about this system is that it involves a non-adhesion drive. The propulsion of the car is effected by means of airscrews at the front and the rear, driven by electric motors that obtain their current from a live rail. The design of the bogies from which the cars are suspended is such as to check the tendency for the cars to rise in the air when in motion, to a greater extent than is required to relieve the weight on the laminated springs of the bogies. Two bogies of short wheelbase are used for each car, this two-point suspension being flexible enough to allow the trestle structure to follow largely the contours of the land.

Interesting details of the design are the measures adopted to promote rapid and silent running. Ball and roller-bearings are freely used, and combined with the shape of the cars they tend to reduce resistance to a minimum. For silence a patented steel wheel construction is adopted. A ring of rubber is placed between the wheel centre and the tyre, and it also acts as a shock absorber.

A full description of the Railplane system, together with illustrations, appeared in the August 1930 issue of the *"M.M."*