or ceiling by means of cast iron or malleable iron hangers, the tralleys used being of very simple construction, usually with one or two wheels running on the top surface of the rail, and capable of being readily taken off the track, which is of special advantage where meat hooks and similar attachments are a part of the trolley. This is the most primitive type of overhead tramway system, referred to previously.

Another, but rare type, employs two channel beams arranged either back to back or face to face, with an adequate space between them in which operates that part of the trolley to which the hoist or load is attached. The wheels of the trolley (usually four in number) run on the top flanges (beams back to back), or on the bottom flanges of the beams (face to face), respectively, due provision being made to have the hangers for this type of track also act as separators. It is probably the most expensive kind of tramrail, without having any particular meritorious qualities.

The plain I-beam track is used perhaps more than any other form, the trolley wheels running on the lower flange of the beams, while the supports are attached to the upper flanges. To obtain the most satisfactory results, the beams must be carefully straightened before being erected and the ends should be sawed rather than sheared. Special attention must be paid to splices and switches so as to have a minimum gap at the joints, and curves must be very smooth, particularly so where trolleys are operated at high speed (i.e., from 600 to 800 feet per minute). Any jar due to an uneven track is communicated to the entire trolley mechanism and load, and in motor driven outfits, parts of the machinery are thus often loosened or broken, merely because of a rough and poorly constructed track.

THE CORROSION OF CONDENSER TUBES BY CONTACT WITH ELECTRO-NEGATIVE SUBSTANCES.*

Arnold Philip, B.Sc., Assoc. R. S. M.

At the annual meeting of the Institute of Metals Mr. Philip (Admiralty Chemist) contributed a paper dealing with the corrosion of condenser tubes by contact with electro-negative substances, this constituting the first part of a series of contributions to the history of corrosion that he has promised to present to the Institute of Metals.

The paper is devoted to an examination of the relatively small number of cases experienced by the British Navy in which localized corrosion occurs in condenser tubes made of Admiralty composition, namely copper 70, tin 1, and zinc 29 parts per cent. The author makes the interesting statement—interesting because the causes of corrosion have generally been regarded as so mysterious—but the causes of fully 90 per cent. of the cases of corrosion observed in the establishments of the Royal Navy have long been known.

In the author's opinion the main problems which remain to be solved concerning localized corrosion are, firstly, the explanation of the causes of rather less than 10 per cent. of the cases, which are now observed; and, secondly, the devising of a general means of preventing these and all other cases of corrosion superior to the method of protector bars, etc., of zinc., aluminum, steel, or iron as at present employed.

Mr. Philip includes in his paper a schedule of queries as issued by the Admiralty to those of its officials who are likely to be able to throw any light on the subject of the corrosion of condenser tubes. This list of questions is very similar to the Corrosion Enquiry Form recently issued by the Institute of Metals, and if all who are experiencing trouble with their condenser tubes would fill up the latter Form (which is modeled to some extent on that of Mr. Philip's, and can be obtained from the Institute of Metals, Caxton House, Westminster S.W.) there is little doubt that Mr. Philip's "10 per cent." of mysterious cases of corrosion would be mysterious no longer.

The paper concludes with a consideration in detail of five very definite cases of corrosion of tubes used in the condensers of battleships, torpedo-boats and electric generating plants of the British Navy.

THE EFFECT OF TIN AND LEAD ON THE MICRO-STRUCTURES OF BRASS.*

F. Johnson, M.Sc.

In this paper the author records the results of experiments made with the object of ascertaining the structural relations which exist between lead and tin when present in brass where the ratio of copper to zinc is 2:1.

He found that by itself, tin was thrown out of the solution in the alpha phase (70 copper, 30 zinc) in the form of a hard pale-blue compound (probably $SnCu_4$) some time after solidification of a slowly cooled alloy. Annealing either preceded by rolling or not enabled this compound to again pass into solution in the alpha phase.

In a brass consisting of the alpha and beta phases, where the latter was present in sufficient amount (e.g., Naval Brass and Muntz Metal) the copper-tin compound was much more soluble, being apparently retained by the residual beta.

In an alloy where the beta phase exists in an unstable form (such as the alloy containing 2 parts copper to 1 part zinc) it is insufficient in amount to retain the tin compound which is deposited mainly as a thin envelope or film separating the beta from the alpha phase, thus giving a reticulated appearance to a polished and etched section.

With regard to lead, the author found that this acted independently of the tin, exhibiting behavior similar to that of lead in ordinary brass or in copper. That is to say it retained its individuality and existed in small particles unalloyed with more than mere traces of any other metal, these particles tending to segregate toward the areas last to solidify. In presence of the excess of the beta phase lead is probably held in solution therein.

As a result of the observation the author strongly advocates a thorough annealing of all cast material of the 70:29:1 and 62:37:1 compositions (admiralty and naval brass respectively) before subjecting it to rolling or drawing, in order that the brittle tin compound may be enabled to pass into solution.

FURTHER EXPERIMENTS ON THE CRITICAL POINT AT 470 DEGREES IN COPPER-ZINC ALLOYS.*

Prof. H. C. H. Carpenter, M.A., Ph.D.

In this paper it is shown that the so-called beta constituent in copper-zinc alloys is to be regarded below 470 degrees C. as an extremely minute and uniform complex of alpha and gamma particles. Its structural stability is so remarkable that even after six weeks' annealing at 445 degrees C. no appreciable coalescence of these particles has

* Papers read before the Institute of Metals at the annual meeting.