(*d*) *Swings*: As the swing of wires between supports often affects the width of right-of-way, the following vertical swing angles will be of service in allowing for this characteristic:—

Copper conductors, 45°; steel aluminium, 50°; aluminium, 55°.

(*e*) *Insulators*: Insulators are of two main types—the pin and the suspended. The former are used almost universally up to voltages of 60 or 70 kv., while for higher voltages the suspended insulators are preferred,—the number of units being dependent on the amount of the voltages.

Pin insulators for high-tension service are always of the petticoat type and are manufactured in a great variety of designs. The modern practice is to use wrought iron or steel pins and care should be taken that the insulators are strong against electrostatic puncture to the pin. The ratio of the resistances to puncture and to flash over should be about 1.6.

If possible, pin insulators should be used on account of their many superior characteristics, chief among which should be mentioned their rigidity. The advantage of a rigid support for the conductor is manifest should there be any tendency of the wire to "whip" under the following conditions: Suppose, for example, there is a heavy coating of sleet on a conductor with a warm sun and wind. The sleet will in general be melted off in large blocks rather than gradually. These long blocks of heavy ice suddenly released impart to the wire a whipping effect in a vertical plane which is transmitted along the wire by a wave-like motion. If the point of support is rigid the whipping is arrested, but if not it may jump high enough to touch part of the tower or even meet another conductor. For this reason conductors on suspended insulators are seldom if ever in modern design placed vertically over one another. Often each conductor is suspended by two strings of insulators each set at a good angle to the other in order to secure greater rigidity.

Suspended insulators are of two or three main types, each unit being a duplicate of every other one. The bell or petticoat units are familiar to all. A design presented by E. M. Hewlett has several new points,* but has not proved very successful.

With whatever type of insulator a high-tension line be equipped, it is to be borne in mind that the first two or three years will be in the nature of test years, for electric storms will in that time be pretty sure to have discovered the weak insulators, and irrespective of any lightning protection a marked improvement in the annual insulator cost should be apparent by the end of the third year. The whole question of high-tension insulators is, however, a very large one and the reader is referred for a further discussion of the subject to an able article by O. A. Austin.†

(*f*) *Ties*: The design of the tie is always dependent on its required function. Certain ties are designed to be rigid, and to hold the wire not only from vertical displacement but from longitudinal movement as well. Such ties would be placed on any dead-end or anchor tower. Sometimes it is desired that in the event of a cable breaking, the entire longitudinal pull shall not be given to only one tower but rather distributed over two or more. In this latter event the tie is designed to allow a certain amount of slip. In certain instances it or the pin is designed to break absolutely should the load become more than nominal (*e.g.*, ties to a so-called "flexible" tower). Whatever type of tie to pin insulators be adopted there are two points that should not be overlooked:—

1st.—Protection must be given the conductor against arcing from it to the grounded pin.

2nd.—Protection must be given the cable against confined arc occasioned by a puncture of the insulator. The first is usually afforded by a large amount of serving in the cable by the tie wire end and the second is accomplished by extra parcelling around the cable with either soft copper or aluminium plate.

For detail of ties, etc., the reader is referred, among many other sources of information, to Messrs. Ralph D. Mershon, J. H. Finney and W. G. Chace.

Before leaving the question of ties it may be well to note that in certain designs, iron or steel clamps are often used when extra security against longitudinal displacement is desired. These clamps are, of course, well insulated. For illustration see article by R. D. Mershon already quoted.

It may be remarked in passing that the ground wire cable is usually attached directly to the tower by a clamp of some standard type.

(Concluded in the next issue.)

*See "New Type of Insulator for High Tension Transmission Lines," by E. M. Hewlett, and "H. T. Lines," by H. W. Buck, together with subsequent discussion. Trans. Am. Inst. E.E., vol. XXVI., pt. 2, p. 1259.

†See Trans. Can. Soc. C.E., January-June, 1911.

SHIPBUILDING ON PROFITABLE BASIS

"During the present year real and substantial progress has been made in the direction of establishing the shipbuilding industry on a permanent and profitable basis," said Hon. J. D. Hazen, minister of marine and fisheries, after the launching of dredge No. 16, the largest dredge ever built in Canada for the department of marine and fisheries, at the shipbuilding works of Canadian Vickers, Limited, Maisonneuve. The dredge was built by Canadian Vickers, Limited, for the use of the department in making the north channel, Beaujou, about 35 miles below Quebec, passable for big ships, and is 292 feet in length, 48 feet in breadth, with a depth of 20 feet 6 inches, capable of dredging at a depth of 57 feet and having a capacity of 1,500 tons per hour.

Plants at Montreal, Toronto, Collingwood, Port Arthur and Vancouver were splendidly equipped for the construction of steel ships, and, in addition, Hon. Mr. Hazen reported the successful building of wooden vessels in Nova Scotia. A large number of the highest class of auxiliary schooners for use in the timber trade between British Columbia and Australia and the Orient are under construction in Vancouver.

Canadian yards have secured a number of contracts for ships for Norway. Following the outbreak of the war the Dominion parliament decided to prohibit the export of ships from Canada without first obtaining approval from the government, and permission has been granted for the export of ships to be constructed as follows:—

Messrs. J. Coughlan and Son, Vancouver, B.C., three large steel freighters, with a carrying capacity of over eight thousand tons each, for a price of approximately $1,200,000 each; the Wallace Shipyards, Vancouver, four large steel freighters; the Western Drydock Company, Port Arthur, three full canal-size steel freighters; Thor Iron Works, Toronto, two full canal-size freighters; Polson Iron Works, Toronto, two steel freighters of approximately 3,000 tons capacity, and two of 4.250 tons capacity; Canadian Vickers, Limited, Montreal, two steel freighters of about 7,000 tons capacity; the Nova Scotia Steel Company, New Glasgow, N.S., three steel freighters.