V 15

A New System of Suspension Bridges.

Neues System für Hängebrücken.

Un nouveau système de ponts suspendus.

Prof. G. Krivochéine,
Ingenieur, General-Major, Prag.

The object of the system of suspension bridge construction now to be described is to reduce the horizontal tension in the cables and consequently the weight of the bridge. The system consists of a cable of which the horizontal tension is taken up not by stiffening girders, but by a polygonal arch (Figs. 1, 2 and 3), the stiffening girders serving merely to resist bending moments. The proposed system can be carried out in a statically determinate form (Fig. 4a), in which case there are two hinges in the side opening and one hinge capable of longitudinal displacement in the central opening; after the bridge is erected all three hinges, or the central hinge alone, can be eliminated, in which case the central hinge should be constructed in such a way as to be able to carry only bending moments without transmitting longitudinal forces (Fig. 4d). The system would then be statically indeterminate in one or three degrees.

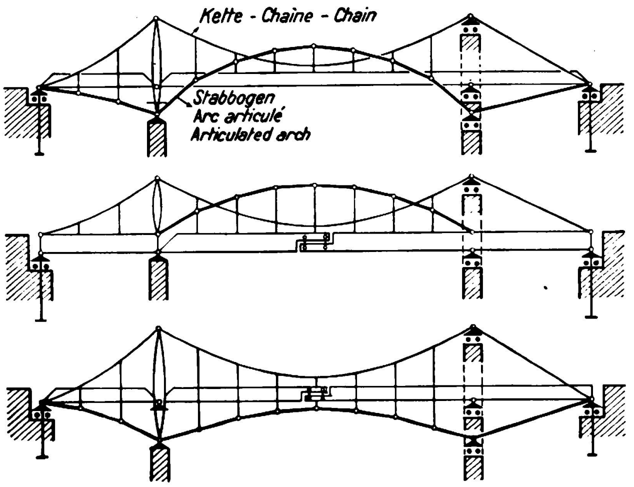

Fig 1—3.

For the statically determinate system (Fig. 4a) the horizontal tension of the cable can be calculated from the conditions of equilibrium of the left hand portion as indicated in Fig. 4b, and of the left half of the main girder (Fig. 4c):

$$1.\quad H_1 = H_2 = H,$$

$$2.\quad +C\,(l_o - c) + Hz_1 = 0,$$

$$3.\quad +C\left(l_o + \frac{1}{2}l\right) + A \cdot \frac{1}{2}l - Hz_2 = 0,$$

$$4.\quad C + A = \frac{1}{2}P.$$

If the hinge G lies on the line CA, we have

$$H = P \frac{l}{4(f_1 + f_2)}.$$

The simple suspension bridge with the horizontal tension eliminated gives

$$H_1 = P \frac{l}{4 f_1}$$

$H = \frac{1}{2} H_1$ and if $f_1 = f_2$.

In other words, the horizontal tension in the cable of the proposed type of suspension bridge combined with an arch is only half as great as the correspon-

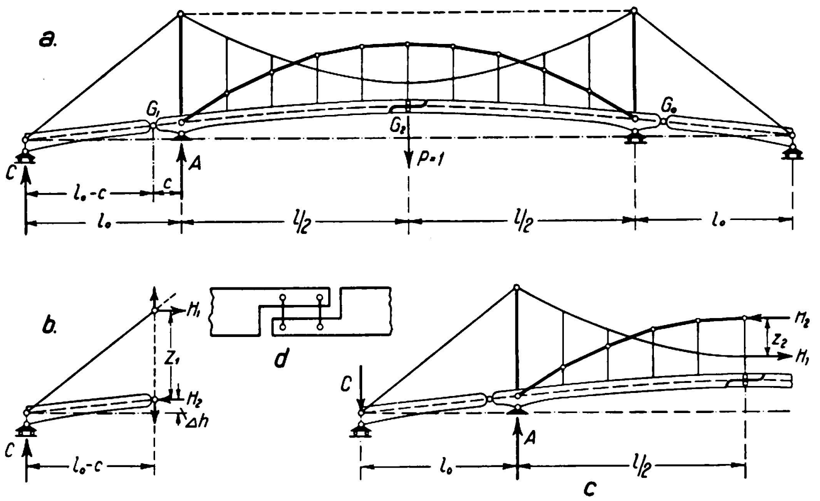

Fig. 4.

ding tension in a suspension bridge with a stiffening girder alone. In this fact lies the principal characteristic of the proposed system, which results in great economy.

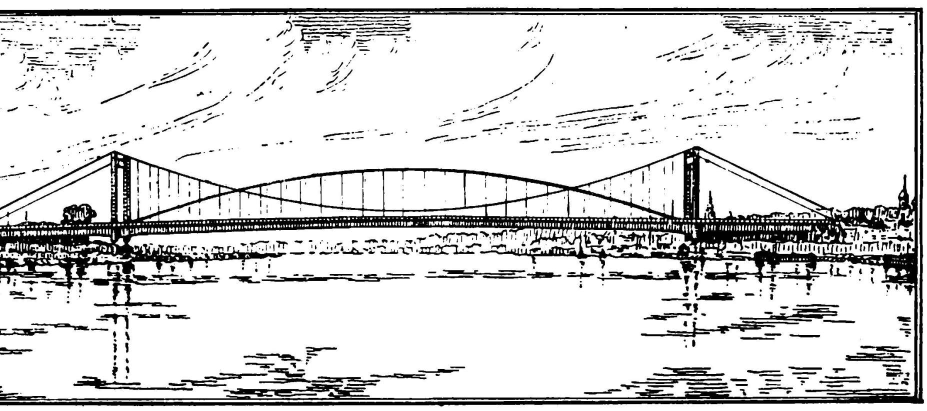

Fig. 5.

Design for a suspension bridge with unstiffened arch, at Cologne-Mülheim, on the system of Professor G. G. Krivochéine.

For instance, for the Rhine bridge at Cologne-Mülheim, having a central span of 315 m as shown in Fig. 5, this system would realise an ecenomy of one million RM, that is 20 %.

The system has been suggested by the author:

1) In the competition for the design for the road bridge over the Elbe at Bodenbach-Tetschen in Czechoslovakia (l = 118 m).
2) For the road bridge over the Elbe in Aussig, Czechoslovakia (l = 124 m).
3) In the competition for the design of the railway and road bridge in Porto-Novo, Dahomey, Africa (1 = 169 m) for the French cable works of Leinekugel-le-Cocq. (Etablissements Metallurgiques, Corrèze.)

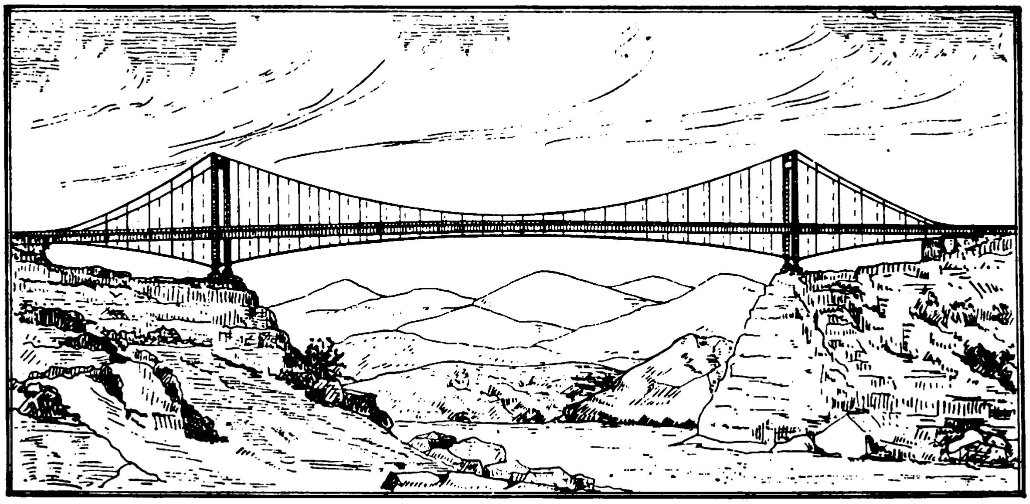

Fig. 6.

Suspension bridge with unstiffened arch.
System of Professor G. G. Krivochéine.

The opinion was expressed by a large German firm that the preliminary design was not satisfactory from an aesthetic point of view because the arch introduces a foreign element into the otherwise clear and pleasing appearance of the suspension bridge but Figs. 3 and 6 show sketches of suspension bridges in which the arch is placed completely below the frame, so that this critisism loses its force.