PROBLEMS IN APPLIED STATICS.

T. R. Loudon, B.A.Sc.

This series of problems began in the issue for the week, October 22nd, 1909. It is assumed that the reader either has an elementary knowledge of the subject of Statics, or is in a position to read some text on such theory.

Fig. 81 represents an ordinary bell crank.

If a force P of 100 pounds be exerted at the joint of the upper arm as indicated, what force S must be exerted at the joint of the other arm in order to preserve equilibrium?

Consider the crank as the body acted upon. The forces acting on this body are P, S, and the reaction Q of the pin on the crank, and for this problem P and S will be considered as acting perpendicularly to the arms of the crank. Since these forces are in equilibrium, their

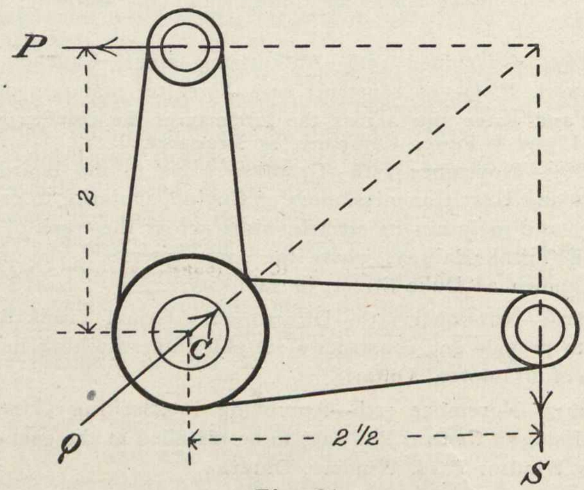

Fig. 81.

lines of action must intersect at a common point as indicated. (Three forces in equilibrium must act at a point.) These forces being in equilibrium, $\Sigma M = 0$.

Take moments about the point C, the centre of rotation of the crank.

$$\Sigma M = M_P + M_Q + M_S = 0.$$
$$-P.\ 2 + Q.\ 0 + S.\ 2\tfrac{1}{2} = 0.$$

Putting in the value of $P = 100$, we get:

$$-100 \times 2 + 0 + 2\tfrac{1}{2}.\ S = 0.$$
$$S = 80.$$

The positive result shows that the Ms about C is positive; i.e., S acts as indicted on the diagram.

Now, although S is the force which must act with P and Q to give equilibrium, it must be clearly understood that if a force P be exerted at one end of the crank as shown, that **the crank** will exert at the other end a force **equal but opposite to S** on any body to which it may be fastened. The body in resisting this will exert the force S as shown.

To Find the Reaction Q:—

Apply either the equation $\Sigma X = 0$ or $\Sigma Y = 0$ to the set of forces P, Q, and S. The value of the sine or cosine of the angle of inclination of Q may be found from the given distances of P and S from C, these distances forming the sides of a right angled triangle, one angle of which is the required inclination. If the hypotenuse of this triangle be calculated, the required sine or cosine may be obtained.

King Post Truss.

Fig. 82 represents a simple form of roof or bridge truss, known as a King Post Truss. It must be clearly understood, however, that the ordinary forms of roof bracing, consisting of the rafters and scantling tie-rods, which resemble the above truss in outline, do not really present the same problem as will be herein discussed. Usually, the rafters have the roof sheeting, shingles, etc., lying directly on them over their entire length. In

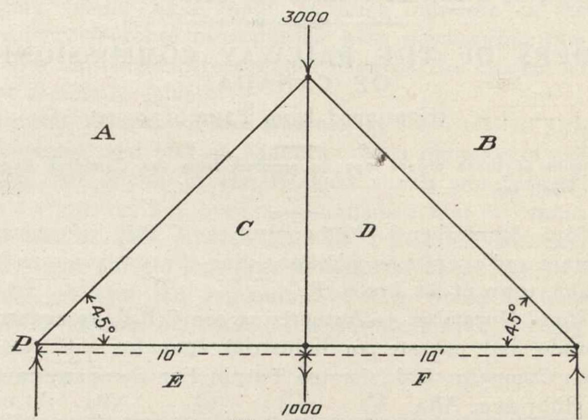

Fig. 82.

this case, these rafters are inclined beams supporting a distributed load, and the stress in them will not be simple Compression, but a combination of both Tension and Compression due to bending. If, however, stringers or purlins be laid from truss to truss on the roofing system so as to lie at the joints of the trusses, or nearly so, and if the rafters and roofing be built on these stringers, the load will then be transferred to the truss merely at the joints, and the case may then be worked out by the methods taken up so far. Fig. 82 A

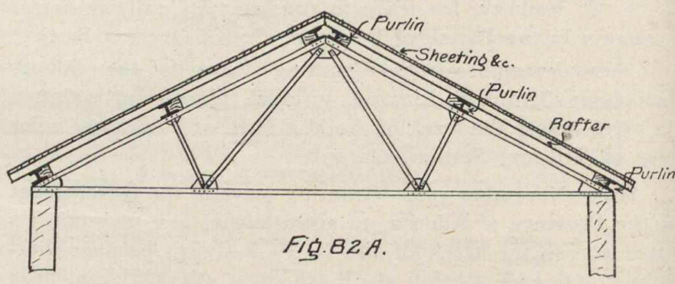

Fig. 82 A.

illustrates, for another form of roof truss, the method of laying down purlins and building on them.

There is also a form of bridge truss very commonly met with on country roads which is sometimes called a King Post Truss. The structure referred to has a heavy timber beam laid between the abutments, and the trussing above merely serves to stiffen this beam. In this case, the beam, which seemingly corresponds to the horizontal tie-rod of the ordinary King Post Truss, is not in simple Tension, but has both Tension and Compression existing in it, and these stresses cannot be found by elementary methods.

Required to find the stress in the members of the truss (Fig. 82).

Analytical Solution:—

The whole truss is a body acted upon by a set of outside forces. These forces, the two loads AB and EF,