portion of the shear (right side of Fig. 4*b*), and the other in which the stirrups are designed to carry all the shear (left side of Fig. 4*b*). The second case, that of all shear being carried by the stirrups, will be treated first. Since it happened that in this T-beam the value of j is 7/8, it will be permissible to use the chart in Fig. 2. In choosing a value of a_s, the area of the stirrup, a value should be so chosen that the last useful spacing, projected from the last full value of M_1 at the vertex of the moment curve, does not exceed in general 3/4 d, and never more than d. It is possible to estimate by inspection a value of M_1 that will give this final spacing. Entering at the right of Fig. 2 with this estimated value, then over to the line of fiber

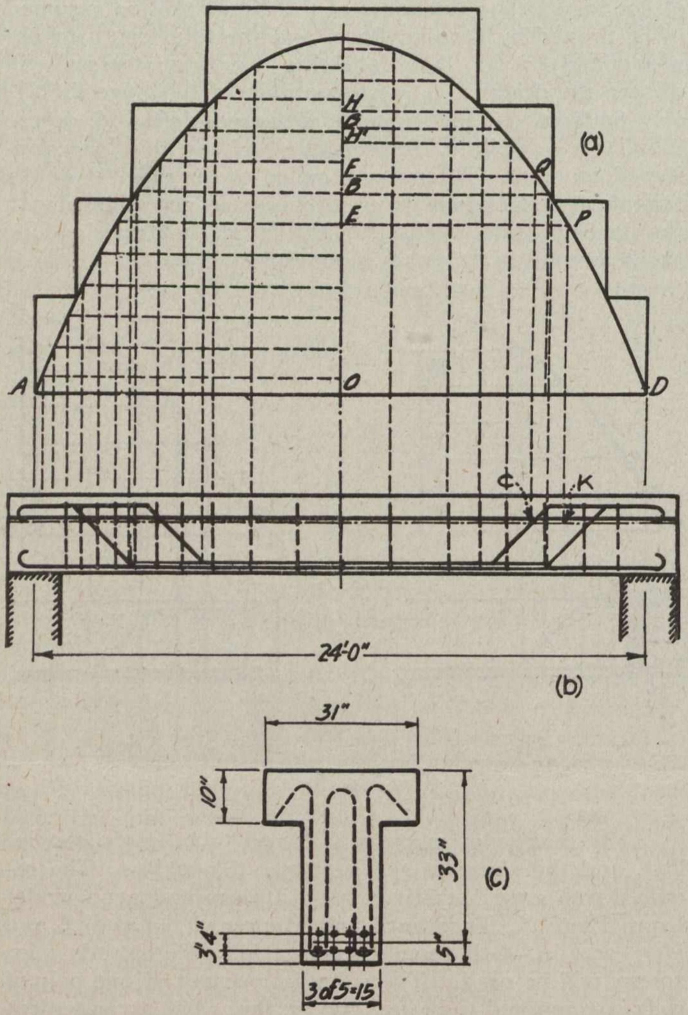

Fig. 4.

stress, and next down to the intersection with a horizontal line from the depth d, gives a tentative value of a_s which may be adjusted slightly to meet the commercial dimensions of the steel. With this corrected value of a_s, and passing through the chart from the left, a final value of M_1 may be obtained very close to the desired value. The adopted stirrup is shown in Fig. 4*c*.

Following the suggestions relative to Fig. 3*b*, half of the value of M_1 as determined above is first laid off; then the full value is laid off repeatedly until the vertex of the moment curve is reached. The intercepts on the moment curve, when projected onto the beam, determine the positions of the vertical stirrups.

The numerical value for the 3/8 in. round stirrup, in terms of the moment increment, is 300,000 in. lbs. They develop sufficient bond to cause a tensile stress of 12,500 lb/in.²; and in addition they are hooked and bent to develop the full stress. At the bottom they pass below the horizontal steel.

In the case where the bent-up rods carry a part of the shear, investigation as to their strength in shear resistance must first be made before the point of bending can finally be fixed. Considering a pair of these rods as an inclined stirrup, a moment increment may be determined for the pair from eq. (7). This was found to be 1,960,000 in. lbs. This value is laid off vertically, as OB, Fig. 4*b*. The distance s corresponding to the pair of rods is much greater than d. The pair is then excessively strong to take the shear; and since the spacing given for bending the rods is also greater than d, the second pair of rods will be turned up, as shown from the bending diagram, while the first pair will be bent up at an arbitrary distance jd toward the centre from the bending point of the second pair. The arrangement is shown in the right half of Fig. 4*b*.

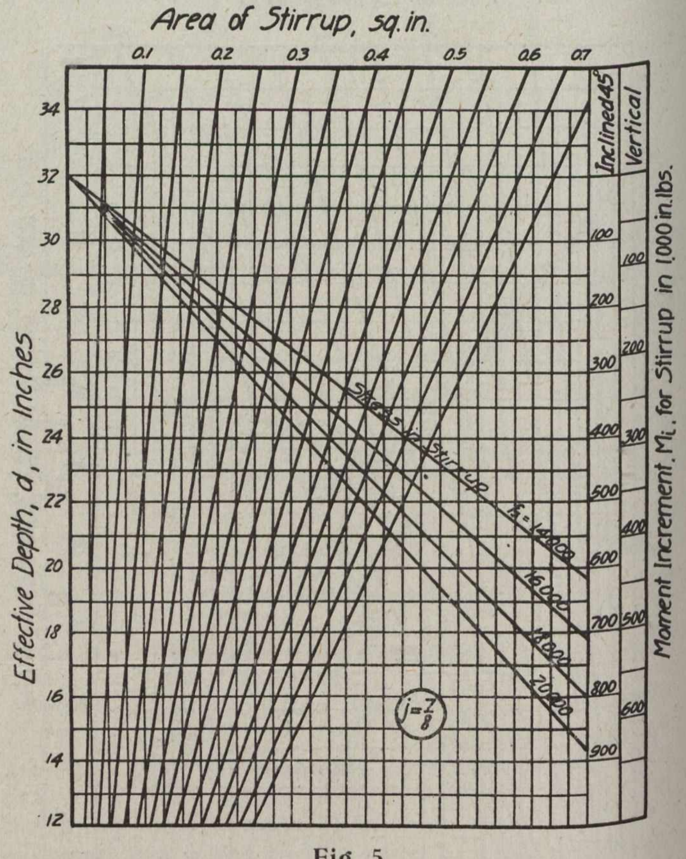

Fig. 5.

Point K represents a point midway between the intersections of the two pairs of bent-up rods with the neutral plane. The projection of K upon the moment curve is P, thereby determining the chord EP. Point C is the intersection of the first bent-up pair with the neutral plane, and its projection on the moment curve is Q, thus establishing FQ. EF, therefore, is half of the actual increment ascribed to the first bent-up pair, on the basis of spacing. EF is then laid off again, as FG, thus completing the increment EG. The portion of the curve from O to G, therefore, is cared for by the bent-up rods. Since OB is the permissible value for one pair, it is seen that they are amply strong to carry the shear, and that their placing was determined by the approximate maximum spacing.

Beginning with G, the stirrup increments are laid off, the first being half value, (GH), as previously explained. The intersections with these and the moment curve determine the positions of stirrups through the region between C and the centre of the beam. It is noted that the stirrup