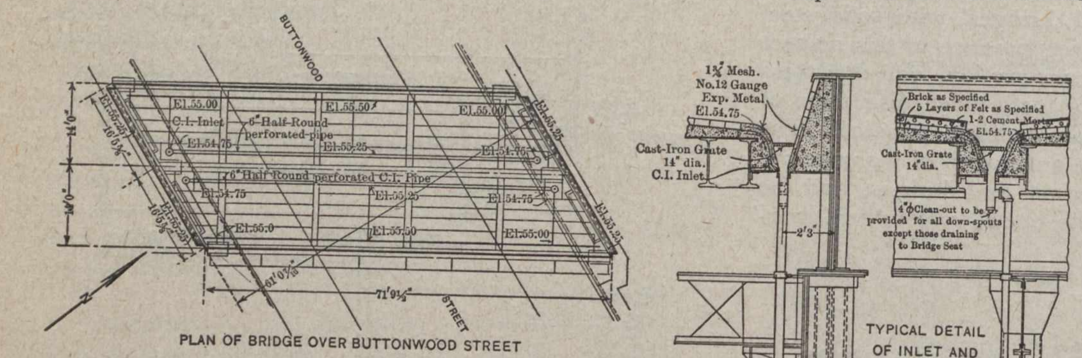
water running over the back walls is guarded against. It is believed that riveting a flashing angle to the web does not provide a satisfactory detail, as it is impossible to make it continuous on account of stiffeners and gussets. Placing a pocket of ductile, adhesive mastic (which will not harden in cold weather) as a joint between the water-proofing layer and the web is believed to give the best results, and in case of the deterioration of this asphalt, the detail is in a place where repairs can be made without interfering with traffic. The question of interference with traffic in making waterproofing repairs is one that is giving many railroad bridge engineers serious concern, and is leading slowly, but surely, to much more elaborate, effective, and expensive systems, in order that repairs may be postponed as long as possible. It is possible to make the proper kind of pure asphalt, unmixed with foreign matter, adhere to a clean surface of metal or concrete, and thus secure a tight joint. It has been found advisable to protect this pocket of asphalt with a layer of concrete to prevent the ballast, which may be carelessly thrown against the girder, from cutting into it. (See Figs. 8 and 9.)



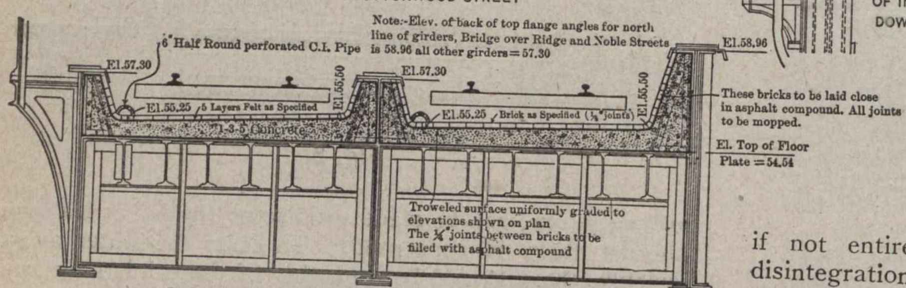


Fig. 4.

As to materials to be used for the solid bridge floor, it is believed that, after the question of durability is disposed of—as one of the most important items—the most durable material, which can be shown to possess adhesion and ductility at low temperatures, and at the same time be sufficiently hard to prevent running at maximum exposure temperatures, is the most desirable—say, temperatures generally between 0° and 200° F. Higher melting points are undesirable, for a number of reasons, and should not be used. The most critical time to test a bridge floor is during melting snow, and cracks which may develop at that time are sure to be channels for water.

Whether felt, fabric, or asphalt mastic shall be used, is a debatable question, and will depend somewhat on conditions. If hard pressed for head room in depth of floor construction, the use of asphalt mastic is indicated, and, though it is generally considered an undesirable material, it is believed that, with proper natural rock, proper flux, and careful mixing and placing, first-class results can be obtained, if the pure asphalt seal is used against the metal.

Felts or fabrics, of course, contain organic matter, and, if not entirely covered with asphalt, are subject to disintegration by rotting. It would seem, however, that if properly prepared and laid, these materials should form a very satisfactory membrane—more satisfactory, as far as elasticity is concerned, than the mastic. A felt of inorganic material—asbestos—has all the proper qualities, from the standpoint of durability. It is generally laid in combination with a layer of treated burlap to give it additional strength. Practice sometimes protects asbestos felt with asphalt mastic instead of brick or reinforced concrete. This is probably allowable with asbestos felt, but should never be used with any of the other felts. Experience shows that hot mastic, placed on a layer of felt, or fabric treated with asphalt, will draw the asphalt out of the felt and incorporate it as part of the mastic.

We further reproduce from Mr. Wagner's paper the accompanying illustrations of progress in waterproofing design. This should be considered and studied in the order in which they are numbered as the sequence represents what are considered to be improvements in each case.

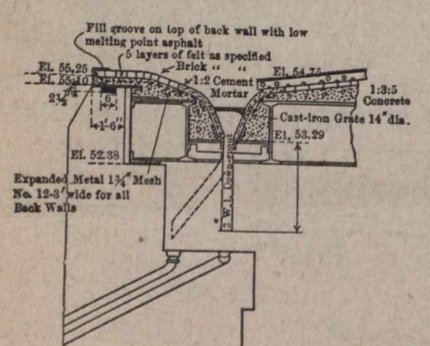


Fig. 5.

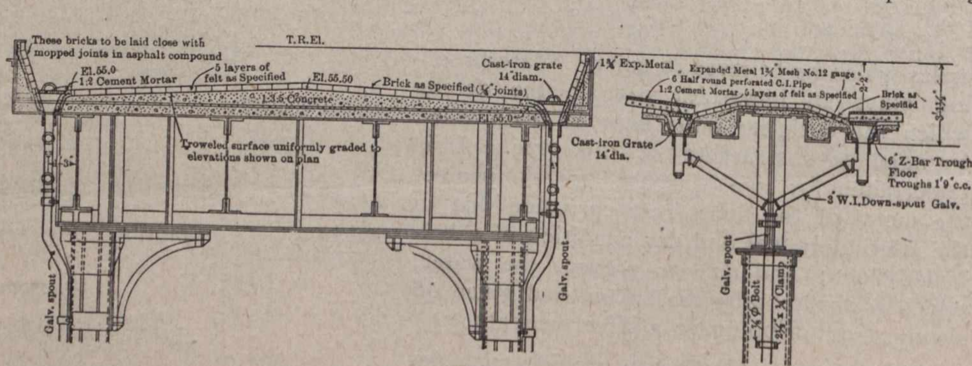


Fig. 6.

Fig. 1 shows half-through plate girder, with trough floor, with flash angles along webs between stiffeners and gussets. Waterproofing of asphalt mastic placed around entire surface of troughs. Each trough provided with nipple in centre, to which floor slopes. Concrete used as filler beneath mastic. Drainage beneath floor by gutters