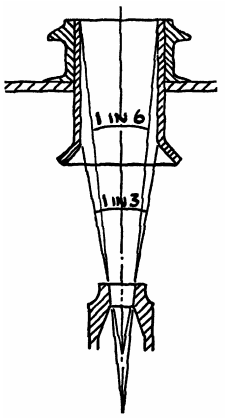
B.2 Model steam locomotive front ends

B.2.1 Introduction

Most of the steam locomotives in existence in 2005 have been built by model engineers and probably number in the tens of thousands. Since there is no basic difference in the function of the front end, most of the observations made in the foregoing texts are applicable to model steam locomotives.

B.2.2 Model front-end dimensions



Model steam locomotives often use a blastcap, orifice, with a diameter that is determined by ideas of Greenly[1] as used by "Curly" Lawrence (LBSC) or Martin Evans[2]: 1/7 of the cylinder diameter or determined by the cylinder volume. The diameter of the chimney is then determined by a conicity of 1:3 at the bottom of the chimney and 1:6 at its top.

In general the dimensions found appear to work properly, so that the model engineer is quickly satisfied.

Figure B.2.1 Greenly 1:3, 1:6 rule

These dimensions can be improved, however. As discussed in Chapter 6, a reasonably fixed relationship exists between the amount of steam evaporated and the amount of smoke gas that is produced by burning the necessary fuel. Even if only half the heat released by burning is used in a model locomotive to convert the boiler water into steam, about four kg of steam is being evaporated by one kg of coal at the pressures used in model engineering. As discussed also in Chapter 6, in theory about 11.5 kg of air is needed to burn one kg of coal which produces a total of 12.5 kg of smoke gas. To prevent the formation of carbon monoxide, excess air is needed which is held to a minimum of 20%, giving 15 kg of smoke gas as the final result. The 4 kg of steam mentioned earlier are added so that 19 kg of mixture are ejected out of the chimney. This ratio is more or less independent of the size of the locomotive.

To eject these 19 kg, the jet from the orifice, containing 4 kg of steam is used. The momentum, the product of the velocity and the mass flux of the jet, is transferred to the amount of smoke gas, forcing the mixture to flow out of the chimney. It must thus be clear that 4 kg of steam can move 19 kg of mixture at about 4/19 of the velocity of the steam from the orifice. The 19 kg mixture passes the chimney at 4/19 of the velocity of the steam jet and it will be clear that the size of the chimney must allow for this amount at a lower velocity. By this way of reasoning, a ratio of the chimney diameter to that of the orifice is defined, obviously having the same ratio as that of the steam to the mixture mass, that is, 4:19, just a little bit more than 1:5. In scale 1:1 this ratio is about 1:3, which is not a great difference.

In practical applications known to the author, unfortunately, a great deal of deviation from this logical ratio is found.