and scale by blowing the boilers regularly.

LOCATION OF BLOW OFF COCKS.—We find there is no uniform practice in regard to the location of blow off cocks. Two members advise that they use four or more, which are located one in the throat sheet, one or more in the side water legs, depending upon the size of the boiler, one in the belly of the boiler near the throat sheet, and in some cases additional blow off cocks in the belly of the boiler at the centre. One of these members advises it has been found by using a sufficient number of blow off cocks and insisting upon their use at regular intervals the amount of boiler washing has been cut down considerably, as well as giving greater life to the flues. Another member advises that they have been experimenting with the blow off system, by which one blow off cock in the throat sheet draws mud from along the mud ring and the barrel of the boiler by means of slotted pipes, and this has worked out satisfactorily in service. Some of the members favor locating the blow off cock right above the mud ring and another locates them about one foot up from the mud ring.

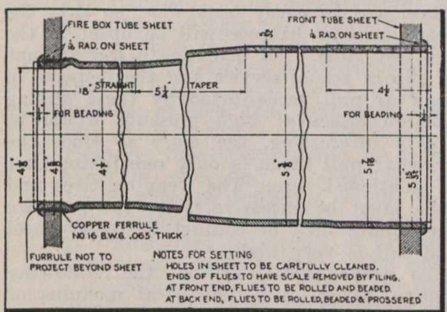

Fig. 32.—Method of Setting Superheater Tubes.

Your committee has no recommendation to make in regard to the number or where the blow off cocks should be located. The number and location of blow off cocks depends on the quality of water used.

FILLING OF BOILERS.—One member advises that they have had a number of side sheets cracked by filling through blow off cocks located in the water legs. They did not state whether they used cold or warm water. They are now filling through the blow off cocks located in the barrel of the boiler. Another member advises that they have had considerable experience with sheets cracking from the filling through blow off cocks with cold water. They now fill boilers through injectors when using cold water.

It seems to be the consensus of opinion of the members that it is most advisable to fill the boilers from the blow off cocks in the water leg, providing warm water is used. If cold water is used it should be filled through the valve on top of the boiler or through the injectors, and your committee recommends that this practice be followed out.

WASHING OUT AND FILLING UP OF Locomotive Boilers.—The reports regarding washing out and filling up of locomotive boilers and the use of blow off cocks were so at variance with what is generally considered good practice, your committee would strongly recommend the appointment of a special committee to report thereon.

LOCATION OF FITTINGS.—Gauge cocks and lower column cock should be located so that they will not come directly back of gusset plate or stay angles, and not to be located directly over arch tubes.

Figs. 3 and 4 show the type of boiler used by one of the members from an anthracite road, which is submitted for your consideration.

For the consideration of the members of the Association in this report you will find a tabulated statement showing the different sizes of fireboxes, as well as a number of tubes and size of cylinders that the different members reported as giving good service for passenger, freight and switching service.

Additional illustrations are given on pages 548 and 549.

Suggestions and Deductions From Steel Passenger Cars.

By A. Copony, Chief Draughtsman, Car Department, G. T. R., Montreal.

The first portion of this article was given in Canadian Railway and Marine World for October.

COST AND WEIGHT.

The cost of any type of steel car will depend on the type of car, the seating capacity, the inside finish, the equipment, insulation, etc., but we must not forget that the cost of a car built of a certain material, in this case steel, will be in a sense direct proportionate to the weight of the car, and for this reason the selection of the type of the car will be of utmost importance. The selection of an economical type of section which combines the greatest strength, not forgetting shear, with the least area, will naturally keep the weight of the car body within certain desirable limits.

The avoidance of a great number of differently pressed parts will also have a definite bearing on the price of the car, and if we have to consider that a light car (avoiding, of course, extremes which would impair the life of the car for length of service), is in two ways desirable from the railway standpoint, the first being initial cost and the second and most important point being that the hauling expenses per car will diminish, despite the fact that the traction force per ton will increase for light weight cars. For this reason we are showing in the diagram that the weight of a car is also of interest to the motive power department. In the tables giving the details of steel passenger cars a column shows the dead weight of car per passenger, and although this value is fluctuating we will have to admit that it ought to be within reasonable limits for certain classes of cars.

In looking back upon the history of transportation we find that a horse drawn carriage will weigh about 1,500 to 2,500 lbs., seating at an average four passengers and a driver, which brings the dead weight per passenger from 300 to 500 lbs. This vehicle will move at a speed of 6 to 8 miles an hour over a roadbed not comparable to the worst kind of railway track. An automobile, weighing 5 tons, seating 7 passengers, and containing its own power plant, moving with almost the same average speed as a passenger train over a far inferior roadbed compared to a track, will bring the dead weight per passenger to 1,428 lbs. The dead weight per passenger of a steel railway car amounts to from 1,200 to 1,700 lbs., and admitting the points of superior comfort and safety to be balanced by the poor roadbed and the weight of the power plant of automobiles we must ask the question: "Is there no possibility of getting below the automobile limits of dead weight per passenger, and is this reduction possible without sacrificing safety and comfort?" The possibility to obtain better results is certainly within our grasp and it is a matter of application to attain better results with the superior material we employ in the construction of the car today compared to the inferior bulky material of the wooden cars of yesterday.

DRAFT RESISTANCE.

Until quite recently it has always been our aim to meet the natural demand for faster and larger trains, with an increase in power and speed developed by our locomotives, until we have pretty nearly reached the limit by the natural limitations of the grate surface. The next step to take to prepare for further demands for further increase of speed or length of train, would naturally be the reduction of draft resistance per ton of dead weight.

Draft resistances are made up in the main of air or skin resistance, friction resistance in the bearings, flange friction resistances, rolling friction resistances between wheels and rails, power losses caused by unbalanced wheels, and last, but decidedly not least, slip.

Flange friction resistances are to a certain extent avoidable, rolling friction resistances between wheels and rails are unavoidable and a reduction of this resistance cannot as yet be considered possible, although there are some products on the market that claim to overcome this trouble of flange friction resistances to a certain extent. The power losses by unbalanced wheels, although small, could be avoided and the effect of unbalanced wheels on tires shall be here entirely neglected.

Next in importance is the question of skin friction or air resistance. Leaving all theories of wave lines for passenger trains unconsidered, the following theory is advanced by scientists: A smooth surface offers more resistance, in form of skin friction, to an air current than a comparatively rough surface, because air is held in the cavities of the rough surface for a certain length of time, thus only permitting

SWITCH ENGINES																				
Railroad	Size of Cylinder Inches	Boiler Pressure Pounds	Length of Fire Box Inches	Width of Fire Box Inches	Depth of Fire Box Front – Inches	Depth of Fire Box Back – Inches	No of Flues	Size of Flues Inches	Length of Flues	Dia of Boiler at First Course – Inches	Grate Area Sq Ft	Heating Surface of Fire Box – Sq Ft	Heating Surface of Tubes – Sq Ft	Flue Heating Surface / Fire Box Heating Surface	Total Heating Surface / Grate Area	Flue Heating Surface / Grate Area	Fire Box Heating Surface / Grate Area	Sq Ft of H S per each Cu Ft of Total Cyl Vol	Fuel	o Estimated
S	19x24	180	71 1/8	34 1/4	72 1/2	71 1/4	213	2	14'-0"	58	17	117	1552	13.3	98.1	91.4	6.8	212	Bit. Coal	
M	19x26	180	108 1/8	42	64 3/8	61	280	2	14'-6"	65	31.5	152.1	2343	15.4	79.2	74.5	4.83	292	"	
G	19x26	175	108	40 1/4	69 3/8	60 1/8	237	2	11'-6"	65	30.2	140	1417	10.1	51.6	46.9	4.6	182		
E	19x26	175	108	40 1/4	64 1/8	60 1/8	237	2	15'-0"	63 7/8	30.2	158.4	1860	14.3	66.0	61.7	4.3	233	"	o
P	20x26	180	108 1/8	90 1/4	47	34	259	2	11'-7 1/8"	62 1/8	67.7	150.6	1572	10.4	25.4	23.2	2.2	187.5		
O	20x26	190	98	40 1/8	69 1/4	67	264	2	12'-9 1/2"	66	27.4	148	1772	11.95	70.1	64.7	5.4	.203	"	
C	20x26	180	108 1/8	42	68 5/8	65 3/8	280	2	11'-0"	66 1/4	31.5	152	1600	10.5	55.6	50.8	4.82	205.	"	
B	20 1/2x26	180	120	41	71	64 3/4	311	2	11'-0"	68 1/2	34.1	194	1798	9.27	58.4	52.7	5.7	201.5	"	
Q	21x26	200	84	66	76	74	400	2	11'-0"	80	38.5	169	2286	13.5	63.8	59.4	4.38	240		
F&N	21x28	180	72 1/8	65 1/4	69 3/8	67 3/8	304	2	16'-0"	68 3/4	32.6	136.9	2703	19.78	87.2	83	4.13	252.9		o
M	22x24	205	90	66	62 3/4	53 3/4	325	2	11'-0"	67 1/4	41.25	155	160047	10.3	42.6	38.8	3.76	166	"	
A	20x26	180	72	78	57	57	300	2	13'-4"	63	39	143	2112	14.8	57.8	54.2	3.67	238	"	
T	18x24	180	82	40 3/8	70	67	199	2	11'-10"	60 1/8	22.99	122.9	1224	9.96	58.6	53.3	5.34	183	"	

Passenger Locomotives.—Dimensions of Fireboxes Reported as Giving Good Service.