FOUNDED 1929

Maidstone Model Engineering Society

President:
JOS. N. LIVERSAGE

NEWSLETTER '76

SUMMER EDITION

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SUMMER EXHIBITION

The Summer Exhibition will be held in Mote Park as last year, so anyone who wishes to exhibit a model should appear, with their model, during the morning of Sunday 29th. of August.

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Our thanks to the various Societies, to numerous to fit this space, for your Newsletters, which are of continuing interest to our members.

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EDITORIAL

I wish to devote some space in this column to comment upon what I, and others whithin our Society, have observed "over the fence", during our visits to other societies so far this season.

It is far from my mind to decry what others do, after all it is their own business how their affairs are run, but with the advent of common insurance within the Southern Federation, especially the third party risk policy, I feel more' attention should paid to safety of operation especially where the general public have even a remote chance of coming incontact with our operations. I stand to be corrected, but it is my thought that even visiting club members, and their families, would be considered third parties, in the advent of any serious mishap, caused by a Society's poor operational methods or poor equipment.

We are fortunate at Maidstone because we operate in a public place and in consequence have had to become safetyconcious in every move we make. There is no excuse for a train to be signalled on by a man with a green flag, when some ten yards further round the corner stand a number of stationary trains, similarly, a little thought and enginuity would prevent a number of traversers I have seen from being pushed in front of an oncoming train.

At least two tracks we visit have no guard rail or anti-tipping device, which I think most Societies today, that give a regular public service, agree is an absolutely essential device, while if we take none of our own trucks, which may not fitthe track in question for one reason or other, we are generally confronted with a"roller skate" driving truck. These are, in my experience, due mainly to their design, are normally highly unstable devices with insufficient braking capacity for an engine plus driver, let alone a two car train which I have seen loose coupled to the rear of such a device.

The above observations I beleive, demostrate the need for a common safety code to be observed by all connected with the Southern Federation's insurance scheme. Whilest some Societies may infer from the forgoingthat I am trying to put the Maidstone Society on a pedestal, I can assurethem that I do not, in that our arrangements, in the light of an accident concerning the guard rail, are not entirely 100% and there is still the human element in any accident.

But less of these introspective ramblings. This edition, I hope, contains a useful cross section of literary and engineering genius to delight even the most fastidious palette. My apologies to Ray Wilkinson for not including an excellent article, but I haven't got the drawing back yet from the printer, and my deadline for publication looms ominously close.

Talking of deadlines, articles for the next edition must be with me by September 26th. <u>LATEST</u>. So with that thought I pass you on to our Chairman for his bit.

CHAIRMAN'S NATTER SPOT

In the last newsletter, Easter was just around the corner, with a mass of work to complete. I'm pleased to say that all this wo work is done, apart for odds and ends, thanks to the efforts of our members.

August looms around the same corner but we are now the proud owners of a new coal store and some of the best steaming bays in the south.

I'm pleased to say, despite expenditure due to our rebuilding programme, the finances of the Society are sound. This again is due to the hard work put in mainly by the ladies of the Society; Driving our trains etc.

We hope to run our usual August 'show' at Mote Park on the 29th, of August. With all the new and old models on show ,plus the stationary steam engines. We hope the sun continues "on the day".

Speaking of the sun, during this long spell, the track suffered from expansion. Two rather nasty kinks appeared in the rails but these have now been put to rights.

We now have a system for blowing down engines and the disposal of ashes. There are trays made to catch 'dumped' ashes but when blowi blowing down, please make sure that these trays are clear of the steam. The air linescan be used to empty the smokebox of ash using an eejector fitted to the air line, with a bag to catch the ash. Also, please keep the steaming bays clear of oil by making sure your loco wheels areclean. Finally, make sure that all the water cranes, notices, etc. are put away after use. In other words take care of the new setup.

I hope you will all enjoy the rest of this, our 26th, year at Mote Park.

Thanks for reading,

A.H.W.Payne (Jack)
Chairman

FOR THE DIARY

The undernoted eventsare additional to those listed in the last issue of the Newsletter:-

AUGUST. 7th. M.M.E.S. to visit Tonbridge Society.
21st. Tonbridge visit Mote Park.

SEPTEMBER. 18th. Chingford visit Mote Park.

NORTH LONDON S.M.E. VISIT MOTE PARK

We were hosts to the North London Society on Saturday, 10th. of July. Although the party was relatively small, they made up in quality what they lacked in numbers. The engines in action were:-

3½" G. Princess Marina	T.G.Luxford
3½" G. Netta	T.G.Luxford
3½" G. Brittania	R.H.Roberts
3½" G. L.B.S.C. Mona	P.J.Roake
5" G. L.N.W.R. George the Fifth	G.M.Cashmore
5" G. L.B.S.C. Terrier	D.C.Chisnall

After an early lunch the first engines were soon in steam. We fairly quickly had new problems caused by the sun, which has been roasting the track. However the permanent-way gang soon pulled back the gauge from 5¼" to5⅝" and scewed down the loose bits. Wewere then treated to a display of continuous, trouble free, running until early evening. It was difficult to pick out any one engine but the George the Fifth probably had the edge. I think an enjoyable time was had by all, helped no doubt by the flow of refreshments from our remarkable lady members.

Barry Lawson.

IS THIS ANY BUSINESS OF YOURS?

LORD KELVIN (I quote)

"When you can measure what you are speaking about and express it in numbers, you know something about it; but when you cannot measure it, your knowledge is of a meagre and unsatisfactory kind".

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Whilst we are generally inclined to associate measurement only with technology, the full significance of this axiom will be realized if we analyse a normal intelligent conversation; for in it measurements are often expressed as comparative values, as code words and as accepted values needing no further description.

For example, in describing an object that is"heavier" you are using a comparative value which implies a knowledge of the basic unit and its weight. The expression "today" is a code word for the 'x'year, the 'Y'month, the 'z'day.

A further example in describing position, such as "Mote Park" using the expression as acode word for 'x'degrees lattitude, 'y'degrees longitude, and 'z'feet altitude.

The more abstract forms of expressions involving colours, sounds, temperatures, etc., are all code words that qualify some frequency, amplitude, direction or wavelength of a generating system, and which can be classified exactly by numbers.

It is amazing the amount of data that the human mind can store in measurements and numbers; to be able to pick out a known person from a huge crowd involves remembering the person's physical measurements in detail, his colour in light frequency, his voice in timbre, pitch and amplitude, his weight and measurement and angle of stride; before the advent of recorded pictures both the observer and the observed had to be in range at the same time.

E.G.Rix.

MODEL BOILER PROPORTIONS

INTRODUCTION

On going through my files some weeks ago I came across an essay, which was written nearly 40 years ago. Knowing that the Editor is always ready to accept anything of interest for the Newsletter, I offered it to him for comments as to whether he thought it suitable for publication.

You will notice in the text that a complete analysis of the proportions of model locomotive boilers is mentioned and it is from this that any ratios given, are taken. All the dimensions for heating surface, grate area, etc., were either measured or taken from designs given in the Model Engineer over the years, together with some others given to me by friends. The ones from the M.E. are, of course, mainly L.B.S.C. designs and are therefore mainly 2½" gauge.

The whole exercise was actually a"hobby within a hobby" and entailed quite an amount of work, the lot covering, if my memory serves me correctly, about four foolscap sheets of figures.

About this time there was a considerable amount of correspondence in the M.E. on this subject and I had quite an amount of correspondence privately with several people. One gentleman with whom I corresponded at some length, was at that time the Chief Draughtsman of the Avonside Engine Co. of Bristol. He kindly sent me a complete set of calculations for a typical industrial loco as were made by Avonside, and in addition, some time later, carried out the same idea for a typical 5" gauge loco.

In actual fact, locos were designed from experience and empirical rules varying from company to company, depending on the main type of traffic, and it was only after work with the British Railways Standard locos that some scientific approach was possible.

So here it is. I hope that at least some of you will find it interesting.

Model Boiler Proportions

In preparing the design of any model locomotive some knowledge of the characteristic features and details of previous designs, which have proved successful is of considerable assistance.

With this in mind and in order, if possible, to arrive at some definite factors and empirical ratios, for use in the design of model locomotives, a study of the characteristics of as many models as possible has been made extending over a number of years and all the information possible, gleaned from various sourses providing material and information for the use of model engineers, in the making of model locomotives.

The main difficulty in reaching these figures and ratios at the present time is to know which model locomotive has been successful or otherwise, is the number of designs published in the model engineering papers. Some must be better proportioned than others.

I have, so far as possible, included models made to 'free lance' design particulars, which have been given to me by their builders, together with what I consider to be a fair and unbiased opinion of their performance. In addition, I have seen some of the locomotives under steam and have, naturally, formed my own opinions.

With published designs this is not generarbly possible as they are not all made by aquaintances to whom one could apply for information. From all accounts, the published designs are, in the main, successful, as the numbers of engines built and running definitely shows, particularly the Fayette, Dyak and Princess Royal series designed and

(cont'd opposite)

described by L.B.S.C. Others, I understand, are not quite so good.. At any rate, taking them on the whole, we can say that the proportions are satisfactory, and if a model to any other design or type is chosen, a successful locomotive will emerge if the ratios of existing designs are adhered to, within certain limits.

Some latitude is of cause allowable but the ratios should keep within those specified for the type of loco. chosen, whether freight, mixed traffic, or express. Again, it must not be assumed that any design outside the range shown will be a failure, as some other detail may have been developed by the designer, which may have a considerable bearing on the success of the completed design. In other words, the tables given may not be complete.

It will be seen that 2½" gauge models are well represented. With the 3½"gauge, the same ratios are, I think, satisfactory, but with the 5"and 7¼"sizes some latitude may be allowed, due to lack of sufficient information from which to draw definite conclusions.

Before describing,in detail, the various ratios necessary for an estimate of the model locomotive'sperformance, a few words on what the boiler is supposed to do would not be out of place. It must be able to provide steam at working pressure to the engine at all usual speeds with a stated load, to do which, it is necessary to burn a certain amount of coal. It is the duty of the firebox to consume as much fuel as possible with as low smokebox vacuum as possible. The more fuel consumed, the higher the evaporation,or steam production,rate. The conditions governing boiler performance are, therefore :-

1. the efficiency of heat production or Combustion Efficiency
2. the efficiency of heat absorption
3. the maximum steaming capacity.

The first is dependent on the rate of firing, the volume and surface of the firebox. The second is govered by the length and diameter of the tubes, plus, to some extent, the rate of gas flow through said tubes. The maximum steaming capacity is related to the total area through the flues.

Tractive effort, a measure of the power of a locomotive, is directly proportional to the cylinder volume and boiler pressure, and inversely proportional to the wheel diameter. The value obtained by these proportions alone are further reduced by a percentage which varies according to the percentage cut off in full gear, plus an assumed all allowance for pressure drop between boiler and steam chest. This percentage is generaly stated as 85% of boiler pressure for valve gears giving a cut off of about 75% of the stroke in normal working, and at 75% of boiler pressure for a cut off in the region of 50% in full gear.

For our purpose, a general value is chosen, of 85%. As the figures are used for comparison, its value is not critical, giving only the maximum power at slow or starting speed. Providing the same constant is used in all the calculations,a direct comparison between one engine and another becomes a simple matter of figures, showing the respective,maximum, power outputs.

The tractive effort in pounds force (lb.f.) is given by :-

$$T.E. = \frac{D^2.L.N.P.}{2\cdot35d}$$

Where:-

D = diameter of cylinders (ins.)
L = length of stroke (ins.)
N = number of cylinders
P = boiler pressure (lb.f./sq.in.)
d = driving wheel dia. (ins.)

The value given is reduced by the entry of the 2·35 dividing constant. In the design of any locomotive the tractive effortis important and forms the basis for most of the calculations necessary. From it the boiler capacity may be computed, leaving the arrangement and details of the heating surfaces to be fixed later. The formula also denotes the amount of "pull", dependent upon the lever arms of the piston and the wheels, and, therefore, a measure of the drawbar horsepower at any given speed.

Horse power varies according to the speed, and is given by the expression :-

$$DBHP. = \frac{T.E. \times V}{375}$$

Where V is the speed in miles per hour

The tractive effort is restricted by certain external influences and cannot exceed the weight on the coupled wheels, multiplied by the coefficient of friction between the wheels and the rails, a factor varying considerably accordingly with the materials and the state of the weather and the rails. In full size practice the coefficient varies from about 0·25 to 0·3, giving as a"factor of adhesion", the reciprocal,ie. 3·33 to 4, meaning the adhesive weight must be at least 4 times greater than the draw bar pull or maximum tractive effort.

It will be seen that in the formula for tractive effort the amount of steam that a boiler can supply is not shown, but it is obv obvioustha t at higher speeds the amount of steam a boiler will produce has a considerable bearing on the sustained effort. The boiler can supply sufficient steam totthe cylinders to produce maximum theoretical tractive effort only at low speeds, but with the same cutoff and mean effective pressure, the work performed as the speed increases would soon drain the boiler.

The maximum speed at which the boiler is able to maintain steam to develope maximum tractive effort is referred to as the "Critical Speed". As the speed rises above critical, the boiler becomes the main partner in the tractive effort and the formula must be modified accordingly, the cylinders having now only a small part to play compared with their proportion at starting.

For models, the critical speed must be reached shortly after starting, owing to the restricted steam spaces and water capacity of the boiler, but as the maximum speed is comparatively low, it does not appear necessary to reduce the tractive effort figures to allow for the increased speed and shorter cutoff.

Boilers arranged to supply steam for a maximum tractive effort at all speeds usually encountered on short,staight,tracks, should, if called upon to work on a long or continuous track, be well within their capacity, since the engine will be run notched up as far as possible with the regulator fully open.

The boiler output at any time is dependent on the speed and tractive effort obtaining at that speed, and is represented by what is known as the Boiler Demand Factor, which is the ratio between the tractive effort and heating surface :-

$$\text{Boiler Demand Factor} = \frac{T.E.}{H.S.}$$

this gives the amount of heating surface per unit of tractive effort at any given speed,in miles per hour, and is proportioned to the horse power per sq.ft, of heating surface.

If this ratio is multiplied by the diameter of the wheels- a better ratio for our purposes- it gives H.S. on a revolutions per minute basis. This ratiois based on the assumption that the H.S. is a measure of the steam production and therefore of boiler horse power. This to a great extent is true, but some differences may occur due to flue and front end design.

Steam production actually depends on the amount of gas liberated at the grate per sq.ft. of heating surface and the efficienc of the boiler at a given output is governed by the firebox volume and the grate area. The ratio T.E./H.S. varies between fairly narrow limits, depending on the type of traffic the locomotive has to perform. With full size engines the ratios are generally in the region of:-

20 for freight engines
17 for mixed traffic
14 for express locomotives

In models the same applies but with a greater variation between individual units. thus Fayette, a typical express locomotive with ample boiler capacity, has a ratio of 15·9, Simple Sally, Ussa Maximus and Kingette with 17·4, 16·0, and 17·3 respectively. A e Boddie is an exception, with large driving wheels with a figure of 22·5, an exceptionally large value, showing a small H.S. compared with other engines named. Lady Kitty, Mary Ann and the Southern Maid, give typical freight figures of 31·6,32·0 and 41·9 respectively and Dyak a mixed traffic loco. gives 30·3.

In comparison with full sized locos. models have a much smaller heating surface giving, with scale size cylinders, figures for the T.E./H.S. ratio slightly higher than the corresponding prototype. Asaa fai average th following can be taken for 2½" gauge model locomotive.

28 & up freight engines
20 to 28 Mixed traffic
15 to 20 Express locomotives

One or two exceptions will generally be seen,as it must be noted that a low figure does not necessarily infer an unsuccessful locomotive or a high figure an excellent one. All things being equal a low figure denotes a speedier and usually lighter model, not able to pull the loads that engines with a high ratio could manage easily. With, say, the same size boiler the engine with the higher ratio will haul a greater load, but, it must be remembered, may lose steam in so doing, owing to the greater number of revolutions of the smaller driving wheels or increased volume of the larger cylinders.

On an up and down track such as is usually found in model engineers' gardens and Societies tracks,the drainig of the boiler may not be noticed as time will be given at each end- during reversing- for the steam pressure to regain some lost ground.

The ratio of firebox heating surface to total,seldom reaches 10% in mainline engines, one or two noteable exceptions being the L.M.S.R. class 8F 2-8-0 freight engines, with 10·6%, and the Shire class, 3 cylinder engines of the L.N.E.R. with 12·26%. By far the lightest percentage is reached in a German tank locomotive, with a boiler pressure of 300p.s.i., in this engine the firebox cotributes 29·8% of the total heating surface. This of curse shows where the heating surface should be for high pressure engines(and no less so for lower working pressures).

As stated previously, the H.S. of a model is deficient compared with the full sized engine, more particularly due to the necessary reduction in the number of flues and of their overscale size. This is more tha counterbalanced when we lookat the ratio of firebox surface to the whole, being never less than 25% and in some cases as much as 50%.

In full size practise a firebox H.S. of only 10% of the total is responsible for at least 40% of the total evaporation so that in models, with from 30%to 50% in the firebox,it must be considerably more and probably in the region of 70% to 80%. This figure we shall be unable to verify until a model boiler is made which is divided into its seperate compartments such as the one for the French Railways some considerable time ago.

In this particular test it was found, with a boiler divided into equal compartments, the evaporations were:-

Firebox 34·7 lb sq.ft. H.S. per hour
1st.comp. 9·6)
2nd.comp. 4·5) 19·1 lb sq.ft. H.S. per hour
3rd.comp. 3·0)
4th.comp. 2·0)

The steaming power of the heating surfaces depends on their relation to the grate area and the size of the firebox, the greater the percen percentage of heating surface provided by the firebox, the greater the steaming capacity. Another important ratio- probably one of the best for model work- is :- $\frac{\text{Heating Surface}}{\text{Grate Area}}$ this, in full size practice, gives the total heat receiving surfaces, including the superheaters, in relation to fuel burning area.

In the values given here, the total heating surface does not include the superheaters, as these, in many cases, do little more than dry the steam so that at the steammchest all that is received is dry saturated steam, more especially in the smaller gauges. I have been led to this conclusion from many facts and figures published in articles on models in several papers and also the temperature of the smokebox of a number of small gauge engines when running. Again, the apearance of the exhaust is to some extent an indication of the superheat, and from observation, Idoubt the efficiency of the usual spearhead type superheater.

Alow value of the H.S./G.A. factor generally indicates a free steaming boiler with a good grate area in comparison with the total heat receiving surfaces, a high ratio means a lower evaporation per sq. in. of heating surface with a corresponding rise in efficiency.

Efficient combustion depends on the volume of the firebox and is one method of calculating the boiler outputs this alone is used, no account being taken of the heating surface of the box. This method of calculation gives results which are very near to results obtained from experimental tests. Proper mixingof the gases is essential and determines the completeness of the combustion, a very important function of the boiler at the higher rates of working.

The efficiency of heat absorption of a locomotive boiler remains constant over a very wide range of firing or working rates, but the overall efficiency is reduced in direct proportion to the firing rate so that the actual reduction is due simply to losses in the combustion process and the loss of fuel through the tubes and out to atmosphere through the smokebox and chimney. This is seen in the difference in the amount of ash found in the smokebox after a turn of light or heavy duty. In other words the boiler efficiency is governed by the capacity of the firebox ahd grate to produce heat.

By dividing the Firebox Surface / Grate Area a value is found which indecates how the amount of grate area stands with regard to the amount of fuel fired. The factor varies but should not be less than 4; a figure of between 6 and 8 being obtained with engines with the fire-box between the frames where the grate area is restricted. A high figure should not be artificially obtained on any account by restricting the grate area, a revision of the surfaces should be made and the design altered accordingly. For a wide firebox type loco. in the larger gauges the lowest ratio that should be used is 3·5. More firebox surface can be given by the provision of a combustion chamber which is part of the firebox and gives added volume where it is essentially required, I am of the opinion that the value of 3·5 is rather small and should be increased by the addition of extra volume in the firebox. In all cases whatever the type of loco. the grate area should by as large as possible without detracting from the scale appearance. There are many reasons for keeping the grate area on the large side, not the least being, the lower rate of firing, which increases the efficiency proportionaly. The efficiency, being proportional to the firing rate, at all rates, the heating surfaces are always sufficient and able to absorb the heat given off.

The furnace must under all conditions be kept at the highest temperature possible- nearly white heat- as only at these dazzling heats can the radiant heat do its work efficiently. It is well known that the firebox surfaces receive their heat by radiation and the tubes by convection and conduction from contact with the hot gases passing through to the smokebox.

In many cases I have seen, the radiant heat effect in the firebox is entirely forgotten or neglected, as time after time on $2\frac{1}{2}$" gauge locos., the firebox is loaded with fuel up to the underside of the firehole, probably 1" to $1\frac{1}{2}$" thickness of fire, so that the firebox is simply filled with flame from the burning coal and not the incandescent mass that it should be. This does not usually occur with the larger size, as the grate is larger and the thickness of the fire is, with reasonable skill, kept to a minimum. With the tiny fireboxes of the smaller gauges, drivers can easily overload the grate in an effort to force matters and increase the rate of firing to keep pace with the steam demand necessary for passenger hauling.

Never the less, it is remarkable what the $2\frac{1}{2}$"gauge engine will do in capable hands when the firebox is allowed to obtain it's heat by radiation and not conduction. The overloaded firebox filled with flame brings the coal fired boiler down to the level of a methylated spirit firing, a system that cannot be forced, except within very narrow limits.

Jos.N.Liversage.

EDITORIAL NOTE I included theforegoing article because, in my opinion, it contains information which I, in all my reading on the subject of model locomotives, have never come across, and which is just as pertinent today as when it was written.

THANKS

By the time you read these notes the compressed air distribution system in the steaming bays will be complete, and a little more work in the building line will see the project finished.

Our Chairman has already thanked those assisting in the work, but I would like to thank all those who have sometimes been infrequent visitors to the park, but have given great assistance to the project by providing factory space, the loan of plant, and lots of material without charge to Club funds. This made a difficult task that bit easier.

They say that the camel is a horse designed by a committee. E Well, as far as our present facilities are concerned, I like to think that, not only has our Society produced a horse, but a thoroughbred at that.

In conclusion, may I remind members that we started with clean rails and surroundings. Please try to keep it that way.

Barry Lawson.