Maidstone Model Engineering Society

NEWSLETTER - SUMMER EDITION 1984.

FORTHCOMING EVENTS :-

Saturday	June 9th	Visit to Chelmsford Open Day.
Sunday	June 17th	Marathon Run - Mote Park.
Saturday	June 23rd	Visit to Sutton Barbecue.
Friday	July 6th	Evening Meeting - Open Day Preparation.
Saturday	July 7th	MMES Open Day.
Saturday	July 14th	Visit to Tonbridge Track.
Saturday	July 21st	Visit from Sutton club.
Friday	August 3rd	Night run and Barbecue - 7.30 pm.
Saturday	August 4th	Visit from Romney Marsh club.
Sunday	August 12th	Visit to Malden Open Day.
Saturday	September 1st	Visit to Welling Track.
Friday	September 7th	Night run and Barbecue.

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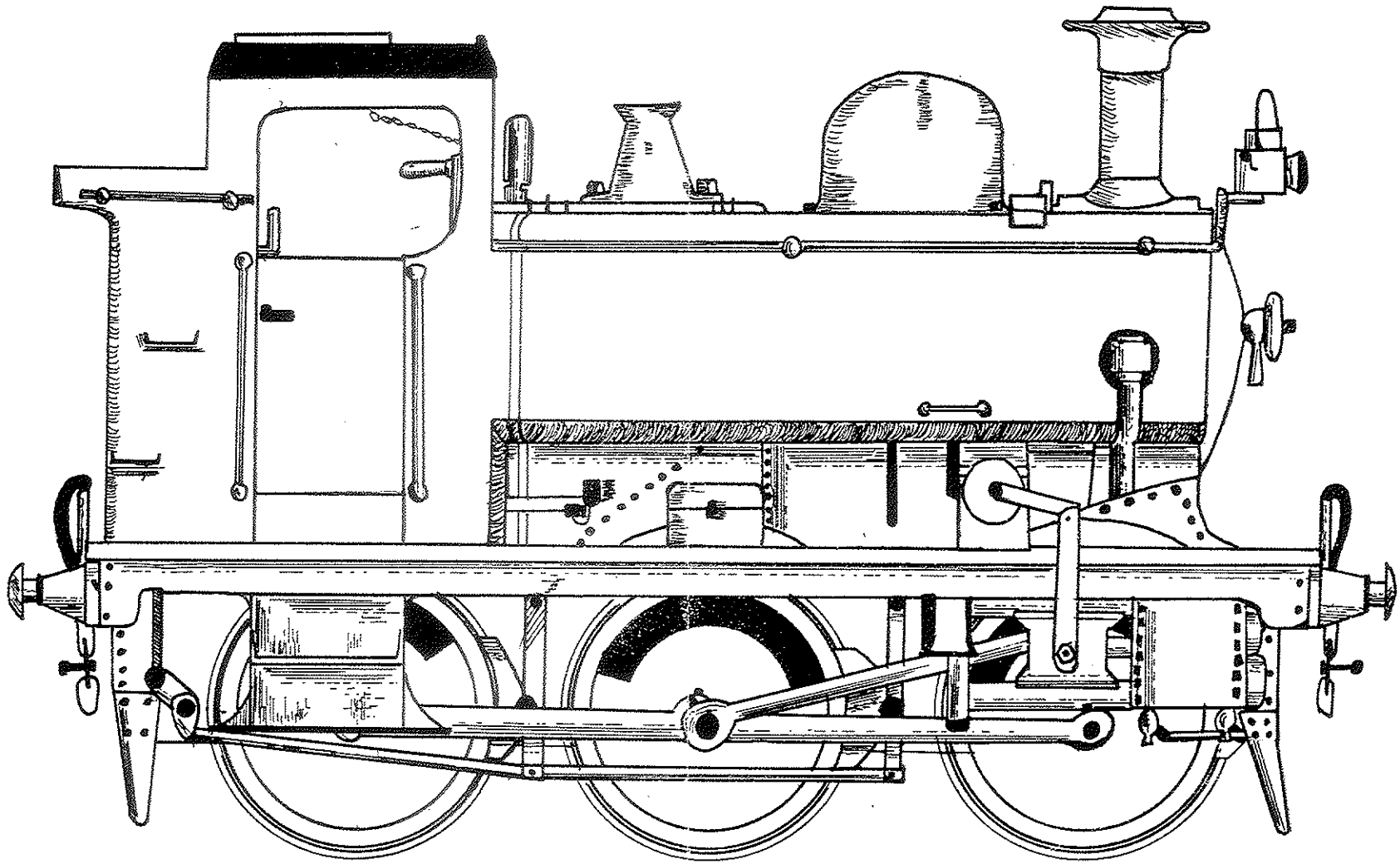
G.W.R. TANK LOCO.



BY MARK WILLIAMS

SOME NOTES ON "O" RINGS

"O" rings may be used with a clear conscience; but they must be correctly selected from the many rubbers available and fitted properly.

In Industry "O" rings are here to stay. Their applications cover a vast variety of fluids with operating temperatures ranging between 70 and +200°C (sometimes more). Pressures commonly rise to 5000 p.s.i. and sometimes 10000 p.s.i. Under these conditions life is expected to be thousands of hours, or years.

The recurring problem in rubber seal design is the rubber material itself. All rubbers deteriorate with fluid immersion, air (ozone) attack, light exposure, and of course heat and mechanical damage due to pressure variations. Usually fluids cause swelling and softness, air and light cause cracking or hardening, heat causes softening or hardening but most important the rubber may remould itself to the shape of the parts with which it is in contact. Selection of the optimum rubber will reduce these effects to a level which will give acceptable and reliable life. After all our model is supposed to run, not be under repair all the time.

Of the large number of material compounds there are five in common supply both readily available and relatively inexpensive. Their operating temperature bands and fluid compatibilities follow.

Nitrile Rubber -40 to +135°C

An excellent general purpose rubber suitable for use in mineral oils and greases, EP and multigrade oils, water, sea water, water glycol antifreeze and pneumatics - In plentiful supply.

Styrene Butadiene Rubber (S.B.R.)

-40 to +100°C suitable for use in vegetable oils, ie castor oil and steam oil.

A somewhat limited application. Available in reasonable supply.

Ethylene Propylene - 50°C to +120°C

Similar application to S.B.R. but has a superior temperature range. May be difficult to purchase in small quantities.

Silicone -60 to +200°C

A high temperature material suitable for hot air but has only limited resistance to oils of any type. Only suitable for hot water up to 100°C. Whilst available to model engineers, this material is a dubious choice for hot oil or steam application. It is also relatively weak and breaks easily.

Fluorocarbon Rubber (KPM) -20 to +200°C (Viton or Viton A Dupont Trade Name)

A high temperature compound with good resistance to all oils, many chemicals, water and sea water. Has good mechanical strength and is available to model engineers as well as in relatively plentiful general supply.

..../Of the above

Of the above, it can be seen that Nitrile is best suited to a general application. For steam engine work we should use Viton to obtain resistance to both hot water and steam and mineral and vegetable oils.

A word of warning is now necessary. If the steam temperature exceeds 160°C, then expect trouble in the long run even with Vitons. Steam is the most difficult fluid for rubber to resist. However, this does not rule out "O" rings in the steam circuit. If they are static and undisturbed there will be far greater reliability than with gaskets. If they are dynamic a closer look is required.

Suppose a steam cylinder and piston has an inlet pressure of 110 p.s.i. plus 40°C superheat. The inlet temperature is (from tables) 208°C and a bit hot for Vitons. But the piston seal itself will see the mean expansion temperature, not the inlet value, and this temperature being very much lower than 208°C, Viton becomes acceptable. In the case of the associated piston rod, life is even easier as only one side of the cylinder cover is cyclically heated and the rod itself is relatively cold.

Whilst discussing steam engines we must not overlook the vicious attack vegetable oils make upon rubber. Again the use of S.B.R. or Ethylene Propylene is a must for cold or warm applications. For hot cases only Vitons stand any sort of chance.

From all this we can see a confusion of different materials emerging. However, we must now be practical. The material covering all our requirements and in small quantity model stockist supply is Viton or Viton A and used throughout, say, a steam locomotive will give excellent service. In such a case with the locomotive used regularly, the seals should last several years, certainly well beyond normal overhauls provided proper fitting techniques are used.

Turning now to correct "O" ring fittings. It is essential to trap the "O" ring in a properly formed groove or seal housing. In order to seal, an "O" ring requires an initial compression or nip, the pressure will then deform the rubber section to improve the seal, ref. fig. 1. The value of compression is expressed as a percentage of the seal cross-section diameter and to cover seal moulding tolerances should not be less than 7% of this figure or leakage may occur. Neither should it be greater than 20% or it simply will not go together as an assembly no matter how hard it is pushed.

To eliminate the masses of tolerances for diameters and eccentricities, etc, found in seal catalogues the fundamental figures can be presented as in table 1 and apply to all groove forms in figs. 2, 3 and 4. By using these, fig. 5 and table 2 for corner seals, all normal requirements are met. The quality of the job is important and all dimensions should be as close to size as possible with smooth surface finishes and no sharp corners.

TABLE 1 "O" Ring Housing Grooves for Shaft and Face Applications. Dimensions in inches.

Seal Cross Section dia. d (nominal)	Groove Width W ± 0.010	Depth H at 7% C	Depth H at 20% C	Rad R max	Lead Chamfer L min.
0.04	0.065	0.037	0.032	0.015	0.025
0.07	0.095	0.065	0.056	0.030	0.04
0.103	0.125	0.096	0.082	0.030	0.06
0.139	0.170	0.130	0.111	0.135	0.085

..../H should be held

H should be held as close as measurement permits to the desired compression figures.

C is the % seal compression. For low friction use 7% C. For general static work between 10 and 20% is quite satisfactory.

Surfaces should always be a good polished finish.

TABLE 2 "O" Ring Housing Grooves for Corner Applications.

Seal Cross Section dia. d (nominal)	Spigot Length L min.	Groove Width M 0.005	Spigot Radius R max.
0.07	0.190	0.095	0.03
0.103	0.250	0.145	0.04
0.139	0.320	0.195	0.06

Many seals, particularly high pressure or reciprocating piston seals, fail by extrusion. The extrusion gap "e" must always be held as tight as possible and in any case never more than 0.003 in. for hot or high pressure and 0.006 in. max. for cold and low pressure. On a diameter basis this is 2 x e as a clearance between fixed and sliding part and gives a nice easy fit.

When fitting, always observe scrupulous cleanliness; in general, we modellers are a dirty lot. Wet the parts and the seal with the working fluid (or steam oil if it's a steam engine) before assembling. If the seal will not stretch easily on to the shoulder and into its groove make a "taper bullet" and slide it up and over - banish all screwdrivers, prodders, etc, at this juncture. Finally at overhaul fit a new one. If all these features are obeyed, "O" ring troubles will virtually cease.

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Further Reading "Model Engineer" Vol 130 Numbers 3256, 3257, 3258
1 Sept - 15 Sept - 1 Oct 1964

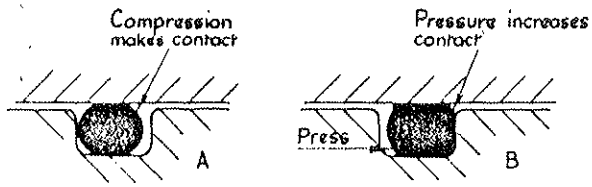


FIG. 1 'O' Ring
A Unpressurised
B Pressurised

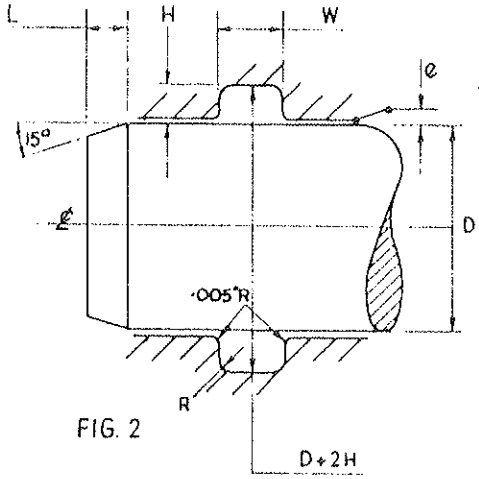


FIG. 2

ROD TYPE SEAL

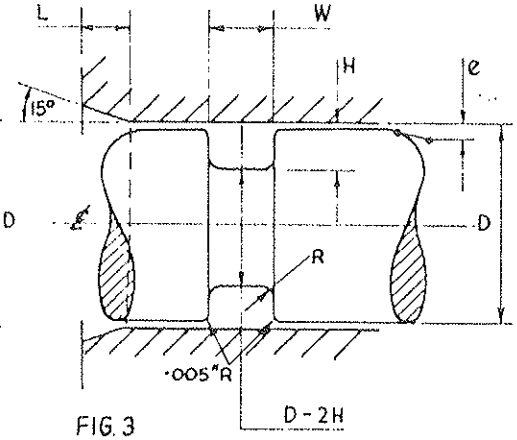


FIG. 3

PISTON TYPE

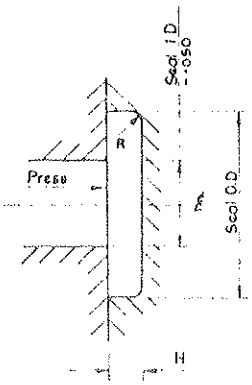
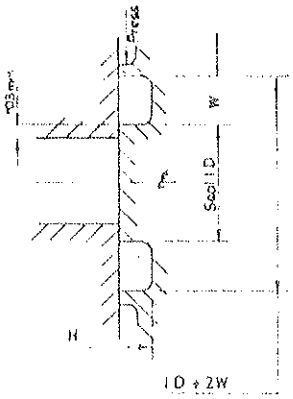


FIG. 4

FACE SEAL FOR INTERNAL SEAL PRESSURE



FACE SEAL FOR EXTERNAL SEAL PRESSURE

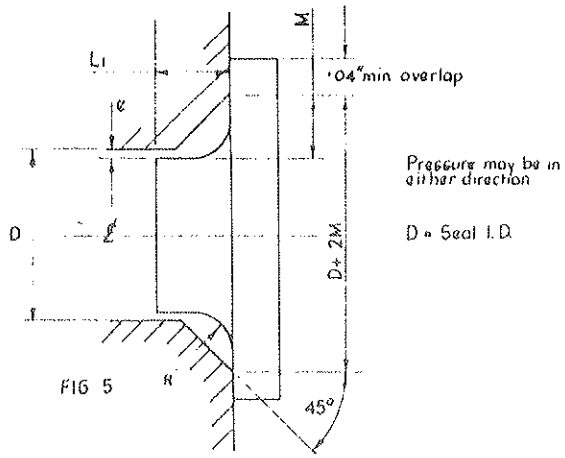


FIG 5

CORNER TYPE FACE SEAL

Dangerous Safety Valves

by

J.Ewins

The emotive tone of the title of this article has been deliberately chosen to draw attention to an unsatisfactory aspect of model locomotive "design" as practised by a number of contributors to model engineering publications. That safety valves in general terms are not unduly dangerous is evident by the low incidence of catastrophic boiler failures. On the other hand, that safety valves are badly designed is evidenced by the widespread difficulty observed when boilers are being tested in conformity with the Southern Federation test proceedure which, (whatever ones views on that proceedure may be) must be complied with. Many years ago I remember taking part in a discussion among leading members of the Society of Model and Experimental Engineers during a Model Engineer Exhibition at the Seymour Hall. The result of this discussion was a general view that some tests should be carried out to determine criteria upon which safety valve design could be based. As a result of these discussions I commenced making and gathering together equipment to carry out a suitable investigation. In the fullness of time I eventually got around to completing this work and wrote a paper on the results which was published in the S.M.E.E. Journal Vol.4 No 7. 1979, and afterwards in the Southern Federation Newsletter No 2 1980. In addition a summary of the results was published as part of a series I wrote in Engineering in Miniature. Apart from some correspondence with several friends during the preparation of this paper I have had not a single comment from any member of the S.M.E.E. which is supposed to be a body of people interested in the experimental side of model engineering. It was like casting one's efforts into a bottomless pit,- there was no echo! Also one would have thought that in view of the ready availability of this material, popular designers would have taken advantage of its content instead of still just guessing when it came to safety valve design. It is pathetic to see valve designs with just the wire dia given with no mention of the other critical spring particulars. It is possible that these "designers" don't think much of my efforts in which case why don't they challenge the results and give reasons for not using them? It is also possible they cannot understand the technical details set out in my original paper and it is for this reason I gave the abstract mentioned above with worked examples. Of course there may be other reasons but whatever they are it is to me frustrating that my efforts to improve details in design should be ignored by those who are chiefly responsible for disseminating designs among the bulk of model makers. During

the time I have been active in model engineering (about 55 years) I have seen come and go a number of characters who have dominated the model literary scene at one time or another and it is a fact that the most prominent of these are those least equipped to add to the know-how because they spend so much of their time producing "designs" and writing books that they seldom get around to making models and using them. One of my American correspondents said they do little more than see that the various parts don't bump into one another,- unfortunatly they don't always do even this! Posh designs on paper are seldom as good on the track but it is these designs which attract editors with their insatiable quest for copy. In the early days we had to endure H.Greenly and latterly his arch disciple K.N.Harris. L.B.S.C. was the exception he having much difficulty in breaking the established barrier. It is a great credit to Percival Marshall who realised the potential in L.B.S.C's approach and backed a winner to the great advantage of us all. Now we have to endure the latter day "yours trulys" who seek to emulate the one and only Curly. Another regrettable effect of the present state of affairs is that a number of competent model engineers both past and present have their ideas swamped by the mediocrity of what I have described as the "propagators" of model designs. It is even more regrettable that sometimes these plagiarists filch good ideas without recognising their origin. This would not be so bad if they applied such ideas with a sound knowledge of the reason behind them. Instead they modify them and dish them up implicitly as their own without trying them out to check that the alterations they have made are satisfactory. This is a digression, now back to safety valves.

How can a badly designed safety valve be dangerous? Oddly enough the spring, unless it is so badly designed that it becomes coil bound when adjusted to the release pressure, does permit an ever increasing discharge as pressure rises and sooner or later an equilibruim is reached which albeit grossly above that laid down by Southern Federation rules appears rarely sufficient to cause a failure. No, the greatest danger occurs when the valve fails to open <u>at all</u>. This is when it gets stuck shut due to the accumulation of scale where the spindle passes through the adjuster at the point 'X'shown in Fig 2. where the usual treatment is to make the adjuster a solid plug with a close fitting long hole in the centre for the spindle and similar holes around this for the steam release which unnecessarily impede the discharge. There is no need for a close fit to the spindle nor for more than the shortest holes both in the centre and for steam release as shown in the diagram. I have witnessed a close thing with a boiler subjected to a gross overpressure due to poor design here and were it not for a chance glance at the pressure gauge (with its pointer hard against the case) whilst the engine was being steamed up and left unattended an explosion

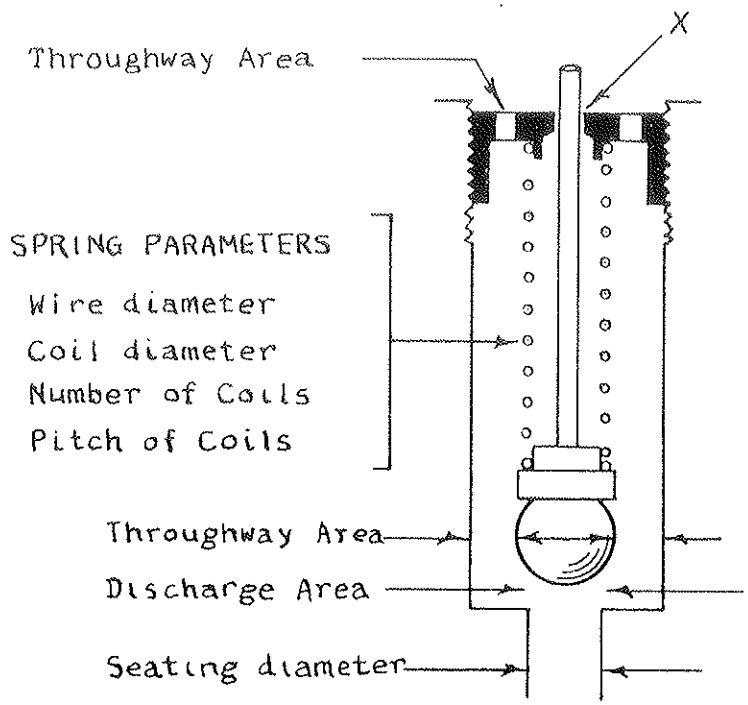
may well have resulted. As it was the pressure was above 180 p.s.i because soft solder was running out from various joints on the outside of the backhead and eventually when the boiler had been removed for inspection the inner firebox crown was found to have dropped. A repeat of this scenario can be made very unlikely by making the adjuster as shown in Fig2 and eliminated altogether if at the conclusion of each steaming session a drop of cylinder oil is fed into the valve as the boiler cools down. Incidentally this latter procedure prevents the spring from rusting and keeps the whole of the valve interior free from scale.

In order to help members to make safe safety valves the following notes explain the use of the table of Fig 1. This specification has been drawn up in relation to the size of grate in the boiler it is intended to protect. This is clearly the best basis upon which to work since the bigger the fire the greater its potential to produce eat which has to be released at the safety valve in order to hold the pressure within the limit. My experiments were concerned with establishing the maximum production of heat from a given size of grate and relating this to the various valve parameters. In selecting a valve from one of the four sizes given one should take the grate area and divide it by the number of valves to be used and select this value from the table. Incidentally when more than one valve is provided for in the design all should be set to release at the same pressure.

Having selected one of the specifications, the design of the valve body should be such that the throughway areas as indicated at the various points in Fig 2 should be at least that given in Fig 1. It is not necessary for the constructor to concern himself about the discharge area indicated as this has been taken care of by the spring esign given in Fig 1. When making the spring use ordinary piano wire and wind it on the lathe with a suitable gear train set up whilst the wire is fed through a groove filed in a piece of brass clamped in the tool post. In this way the wire is pre-stressed giving it the necessary elastic properties. In addition to the number of active coils specified one should provide one close spaced coil at each end. An effective way of doing this is to wind four extra coils and then heat the last two coils at each end with a fine hard flame until they are red hot quickly pressing these turns against a flat surface so as to close them down. Finally the extra unwanted turn at each end can be ground away square by locating the spring in a vee-block clamped perpendicular to the side of a grinding wheel. For reliable action of any type of spring valve it is essential that the spring be true.

Grate Area sq. inches	5	10	15	20
Ball Dia inches	3/16	1/4	9/32	5/16
Seating Dia inches	1/8	3/16	1/4	9/32
Minimum Throughway sq. inches	.015	.030	.045	.060
	Spring Specification			
Wire Dia S.W.G.	25	22	20	19
Outside Dia inches	.170	.215	.280	.290
Winding Mandrel Dia inches	.110 35 drill	.136 29 drill	.173 17 drill	.182 14 drill
Number of Active Coils	9	10	10	14
Winding T.P.I.	24	16	14	12

SAFETY VALVE SPECIFICATIONS TO CONFORM WITH THE 10% RULE Fig 1.
(Working Pressure 80 p.s.i.)



CRITICAL PARAMETERS OF A SAFETY VALVE

Fig 2

It is not generally understood that well designed safety valves assist in the reliable working of injectors. This comes about due to the fact that any injector has a definite upper limit of pressure above which it will not work. If the safety valve allows the pressure to rise above this the injector will not start which is particularly inconvenient because it is just when the pressure is high that water feed is most needed. In addition, warm feed water has a lowering effect on this upper pressure limit causing trouble in hot weather. The reliable operation of injectors depends not only on the design and manufacture of the injector itself but also in the context in which it is used which includes apart from that mentioned above such things as pipe-work, steam and water valves, steam turrets, delivery clacks, filters etc. It is little wonder that injectors bought commercially and just plonked on an engine fail to give satisfaction. Perhaps this is a subject for another 'epistle', as is also some notes on 'pop' safety valves?

Sue's Spot

My thanks to Jim and to George for providing articles for this edition of the newsletter, and also thanks to Mark, Chris Williams son, for the illustration of a G.W.R. tank engine.

Work has been continuing around the traction engine bay, with a gate installed at the top of the steps, the edge of the bay covered in tarmac and the banks have been turfed, the grass looking greener here than anywhere else in the Park. The workshop is slowly growing equipment-wise, and we are grateful to Frank who has given us some lathe tools and chucks, and Gordon who has donated a grinder.

Easter was glorious this year with many members making the most of the weather and the facilities at the track. The video show on the May club night consisted of a compilation of various film and video clips from 1965 to 1984 of team in all shapes and sizes, including a lot of footage of Mote Park and the activities here - many of you were stars! For those who unfortunately missed this showing or who would like to see it again perhaps we will have a repeat performance some time in the future. After the wet and miserable Whitsun holiday we were very lucky the sun shone just in time for the evening run and barbecue on June 1st, although I do think that the amount of wine consumed also played a part in lifting everyone's spirits (no names mentioned here!) and everyone certainly enjoyed the occasion.

There is a barbecue and evening run organised for each club night in August and September, so that those with holidays around this time of year should be able to catch one of these dates. You will also see from the list of coming events on the cover that there are a few visits to and from other clubs arranged - do come along and join in the fun.

The arrangements for the Marathon Run on Sunday June 17th are much the same as for last year. We intend to run for the public from approximately 9 a.m. until 5 p.m. with donations to be taken in aid of the Maidstone Family Support Service. The main entrance to the Park in Mote Road will probably be closed from about 9 a.m. but there will be access all day through the entrance at Willington Street. The more people the merrier - it is all for a good cause.

Now to the Open Day - again your co-operation is requested. Kindly complete the tear - off slip further down this page and return it to me, or post it to any of the gents mentioned below who will pass the information on. Please can you let me know by Sunday July 1st.....and talking of deadlines, the closing date for items to include in the Autumn Newsletter is Sunday September 2nd.

Have a super summer one and all,

Sue

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OPEN DAY - SATURDAY JULY 7TH

You may offer your services for any or all of the following if you so desire:

a) Bringing food (Please state)_____

b) Tea making and washing up duties_____

c) Preparing food at the Clubhouse in the morning_____

d) Bringing a model for display_____

I will contact you later if necessary.

Gents/Ladies please supply one teatowel and one or two pints of milk (you may need to take one back).

_____ name

_____ telephone number