Jottings from the Workshop by "Artisan"

Boiler Fittings

Having talked about pipes and pipe work in my first jottings I thought it might be appropriate to move on to boiler fittings this time and take the opportunity to comment on some of the questions I have been asked from time to time. First of all a few notes on boiler feed check valves and non return valves in general. Some time ago a member remarked to me that he could never get check valves to seal properly. Judging from the number of designs which appear from time to time employing flexible valve seating's or flexible valves using 'O' rings or Nitrile balls this is not an uncommon problem. When I started my model engineering career in my teens I rapidly became a disciple of LBSC. In those days neither 'O' rings or Nitrile balls had appeared on the model engineering scene and all of our non return valves and safety valves were based on rustles steel or phosphor bronze balls. The non return valve design promulgated by LBSC is still the most common to be found in service, is easy to make and, if properly made, will seal without fail.

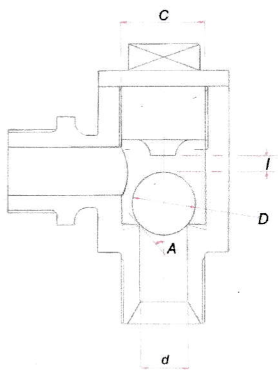


Figure 1
Typical Boiler Feed Check Valve

Figure 1 shows a typical check valve incorporating a ball as the valve element sealing onto a sharp edged seating. Exactly the same form of valve may be used in boiler feed pumps, mechanical lubricators, injector overflow valves and safety valves. The same comments concerning design and manufacture applies to all of these applications, although injector overflow valves may need some additional attention to design detail which we shall not be considering here. From the functional point of view there are four important inter related dimensions, namely the diameter of the ball seating *d*, the diameter of the ball *D*, the ball lift *l* and the diameter of the ball chamber *C*. Ideally the seating diameter and ball diameter should be chosen such that the angle *A* that the tangent to the ball at the point of contact with the seat makes with the centre line of the valve is between about 35 and 45 degrees – i.e. the ball diameter should be between 1.25 and 1.4 times the seat diameter. In practice the seating diameter will normally be chosen to suit the service flow required and the ball diameter will have to be selected from what is available commercially. In practice a ratio of D/d in the range 1.2 to 1.4 will produce a satisfactory result. The next important dimension is the ball lift allowed. It is usually suggested that this is limited to a quarter of the seating diameter since this ensures that the flow area between the ball and seat is the same as that of the seating bore. I usually allow a few thou more than this to compensate for the fact that simply equating flow areas does not allow for the losses which occur between the edge of the seat and the ball. Excessive lift must be avoided however as this can cause problems with re-seating the ball when the fluid flow stops. Finally, the diameter of the ball chamber *C* should not be too large. It only needs to be large enough to allow adequate flow area around the ball. If the diameter of the chamber is 1.3 times the ball diameter the flow area around the ball will always be larger than the area of the seat bore for *D/d* in the range 1.2 to 1.4. Making the chamber larger than this will do no harm within reason, but if it is made too large problems may be experienced with re-seating the ball. This can be a particular problem when the flow is intermittent as with the delivery from a reciprocating pump.

So much for the basic design of the working elements of the valve. It has already been mentioned that the ball should sit on a sharp edged seating – i.e. the ball chamber in the valve body should be formed with a flat bottom. Indeed, some designers have suggested that the seat should be undercut as shown by the dotted line in Figure 1. Personally I consider this an unnecessary complication. The object of the sharp edge is to enable the seat to be easily deformed to an exact fit to the ball. A suitable seating is easily formed at the bottom of the ball chamber with a simple "D" bit. If a "D" bit of the required size is not to hand it is only a few minutes work to make one up from a piece of silver steel. It is usually recommended that the bore of the seating is reamed. This is not to achieve a particularly accurate size but to ensure that the hole is truly round. I have to confess that I seldom ream the seating's of my valves. Reasonable care with drilling will usually produce a satisfactory job. Drill slightly under size, form the ball chamber to depth with a "D" bit and then finish the seating bore with the correct size drill.

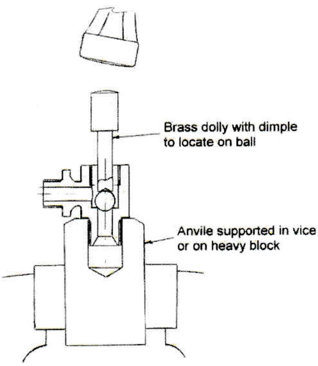


Figure 2
Seating the Ball

The most important operation in making a non return valve of this type which seals reliably is seating the ball. It is a simple enough procedure but must be done correctly. I mentioned earlier that the sealing face is formed by deforming the seat to an exact fit to the ball. In most cases the easiest way to do this is to follow LBSC's procedure – give the ball a whack with a hammer – but not "just like that!" Most of the non return valves we make will be formed in a fabricated body (like a "clack" valve) or a casting (like a pump body). It is essential that for a satisfactory seat to be formed the job is properly supported so that not only does it provide a solid base to absorb the impact of the hammer blow

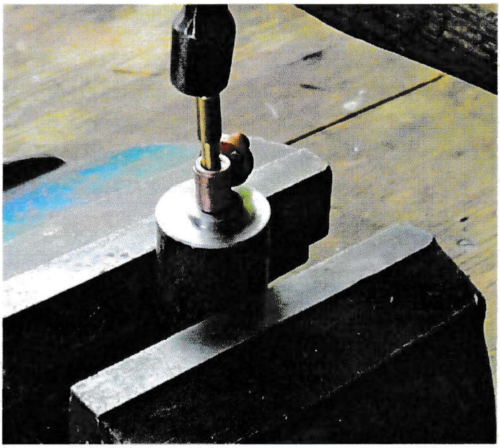


Figure 3
Seating a Check Valve Ball

but that distortion of the assembly does not occur. Taking our boiler feed clack as a typical example a suitable anvil should be made to support the valve body and absorb the impact of the seating blow. This does not have to be an elaborate affair – figure 2 shows a suitable arrangement and figure 3 shows such a device in use. It should hardly be necessary to mention that the ball and internals of the valve body must be scrupulously clean before attempting the seating operation. Any dirt present between the ball and seating will result in a leak path being formed across the sealing face. Once such a leak path has been created the only satisfactory way out is to re-cut the seat with the "D" bit and start again. If the work has been properly prepared a single blow from the hammer should be sufficient. If you are considering re-seating an existing valve the assembly must be dismantled and removed from the boiler (if it is a feed clack) or the engine (if it is a pump). NEVER under any circumstances attempt to seat or re-seat a valve in situ. Not only will the attempt almost certainly be unsuccessful because the body of the valve or pump will not have had a sufficiently solid support but serious damage will probably be inflicted on the supporting structure.

There are occasions when whacking the ball with a hammer blow is not a suitable method of forming the seat – the overflow ball valve in an injector body is a typical example. There would be a high risk of distorting the injector body and upsetting its ultimate performance. In cases such as this the most suitable technique is to make a screwed insert to engage the thread intended for the ball chamber sealing cap and jack the ball down onto its seat.

It is usually recommended that the ball used for the seating operation is not that which is destined to take up permanent residence. Ideally an ordinary steal ball bearing of the correct diameter should be used, but I have to confess to having used the actual valve ball without problems when a ball bearing has not been available.

Some authorities recommend burnishing the seating by securing a ball to the end of a rod and rotating it against the formed seat. I have tried this but it has never proved successful for me. The basic LBSC approach has always worked best for me.

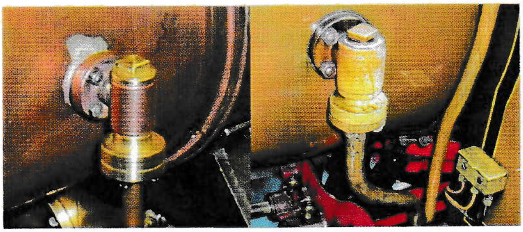


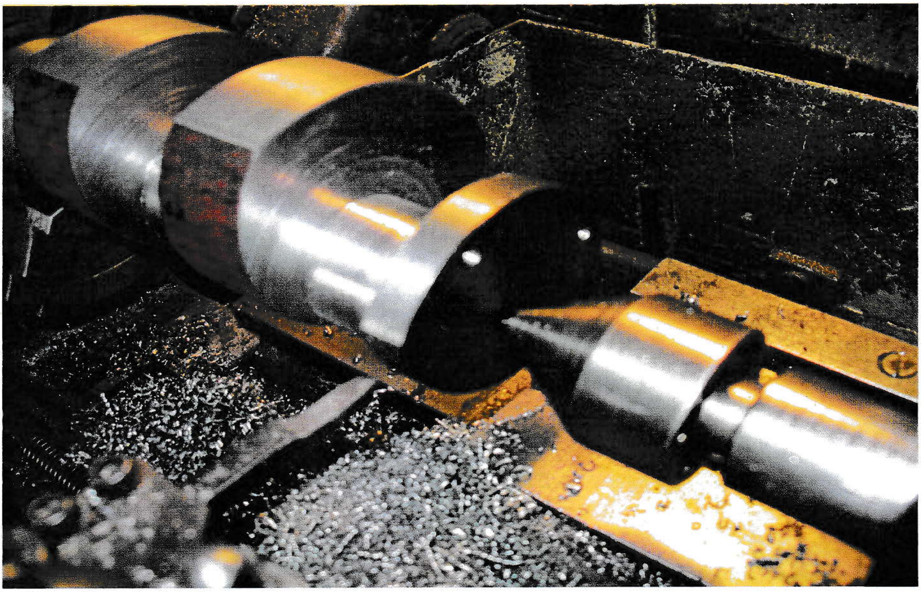
Figure 5
Comparison of Model and Full Size Check Valves

Before leaving the subject of boiler feed check valves a few words on their appearance will be appropriate, particularly the variety found on the side of a locomotive boiler at the forward end. It is common practice in model applications for these valves to be screwed into bushes in the side of the boiler and for the feed pipe to be connected with a union employing a hexagon nut. This arrangement is perfectly satisfactory from a functional point of view but totally unrepresentative of full size practice. Full size feed check valves are secured to the boiler with flange connections using studs into the boiler nozzle whilst the pipe connection is made using a four bolt flange joint. There is, of course, no reason why the same arrangement cannot be used on a model. The bolts and gaskets involved would be rather small and fiddly however and the joints prone to leakage. My own solution is to screw the valve into a boiler bush in the usual way but to incorporate a flange with dummy studs and nuts in the valve body fabrication. The pipe connection is made using a normal union with an olive on the pipe (see my notes in the last edition of LINK) but to fashion the union nut in the form of a dummy bolted flange.

Figure 6
Special spanner for
Check Valve union

The sketch in Figure 4 shows details of the arrangement and an example is shown in Figure 5, the picture on the left being the model interpretation of the prototype on the Bluebell line, shown on the right. The details can be easily adjusted to match those of the prototype being modelled. It is, of course, necessary to provide some means of tightening the union. If the flange joint being simulated employs square flanges this is no problem since a spanner of suitable size can be used. In the case of the example illustrated it was necessary to make a special spanner to engage with the dummy flange bolts as shown in Figure 6.

It had been my intention to move on to discuss questions I have been asked about steam valves and to offer some comments on water gauges but I seem to have gone on rather and space does not permit adequate treatment of any more subjects. I don't wish to upset our editor, or KBP (Knight of the Blue Pencil) as LBSC always referred to him, by "overstaying my welcome" so further comments will have to wait for another edition of LINK.



My New Crankshaft

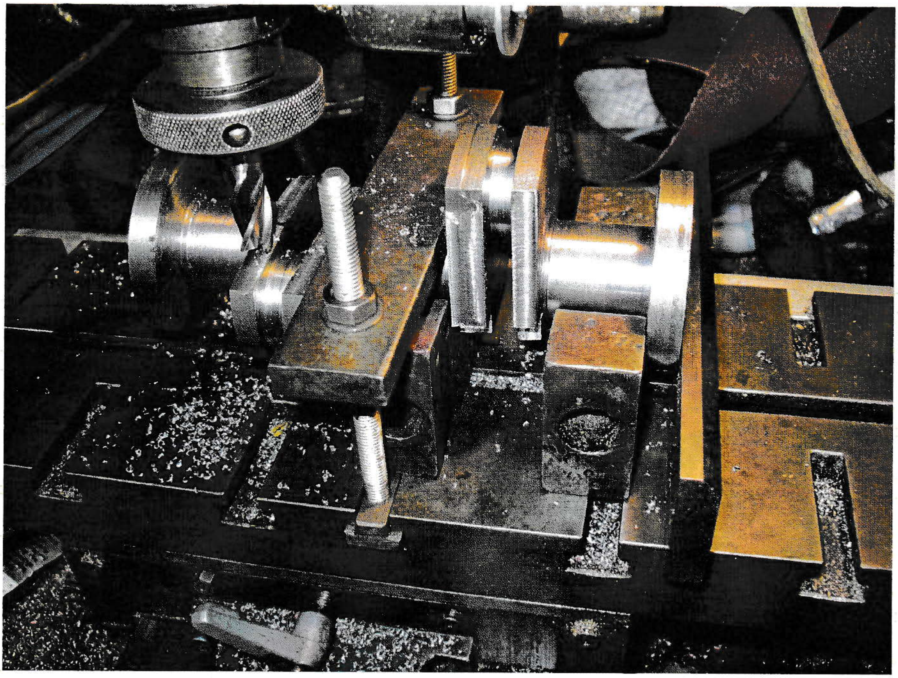
As many know from the report in the last Link, the crankshaft in my Stirling Single wheeler failed when we went to the Chelmsford invitation day. I then learned that others have had the same thing occur, on Robert's Pansy it has happened twice. Andy then said that he had it happen on his A3 when he was at Brighton. When we went down to Canvey Island one of the Chelmsford members enquired how I was getting along with the repair, and that the same thing had happened to his loco. The decision was made to turn one from a solid bar of material, knowing that failure of built up crankshafts was more common than I realized.

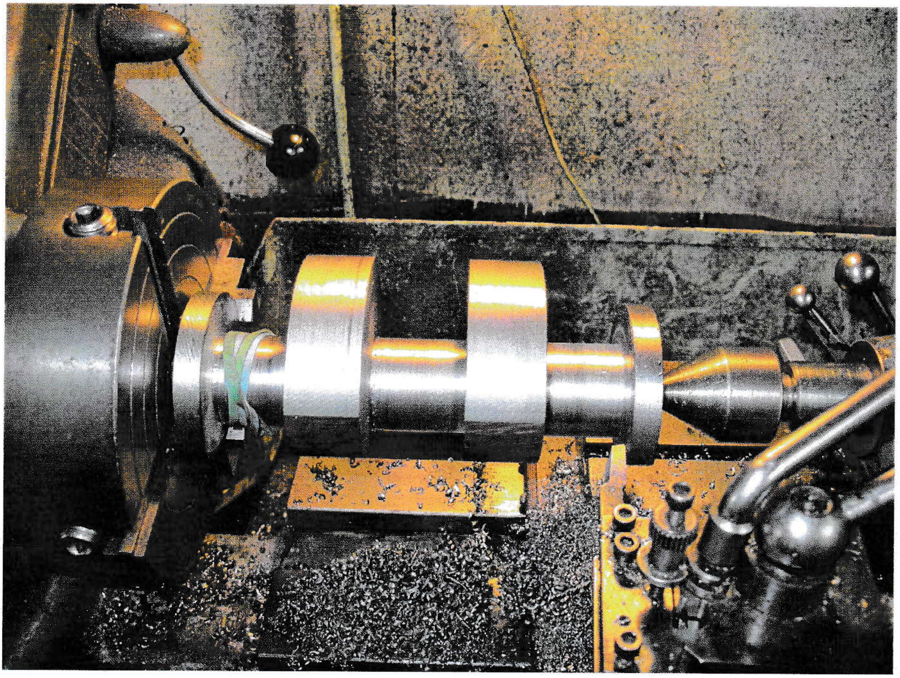
A piece of EN8 high tensile bar was obtained about 3" in diameter and of sufficient length to make the crankshaft, plus enough for centres to be provided at each end to turn the crank throws, which can be turned off when the crankshaft was finished. EN8 is a mild steel with some additional additives to make it about twice as strong as ordinary mild steel, but the penalty is that it is more difficult to turn and a good finish is much harder to obtain. Someone on the Wednesday gang suggested that I weighed the metal blank before and after machining so that the amount of swarf generated was known. This was done, and the answer is below.

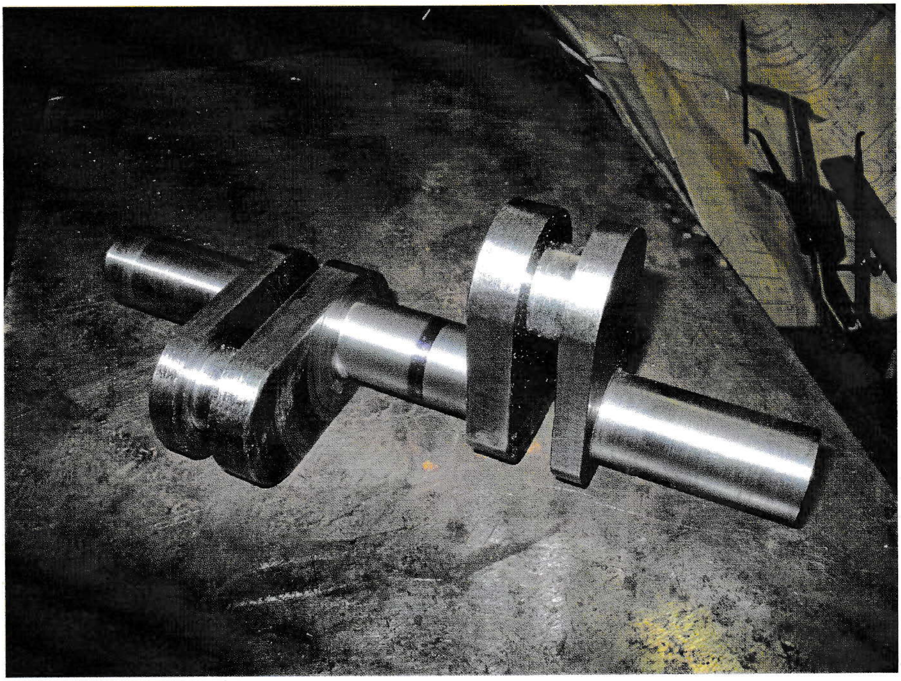
Picture No. 1 shows the first stage of roughing out the crankshaft. The centres for turning the throws can be seen in the end of the material. Picture No. 2 shows the crank webs being machined off in the milling machine. Picture No. 3 shows the crankshaft finish machined and picture No. 4 when the split eccentrics have been fitted ready to put the wheels on. I started with a piece of steel weighing about six kilos and finished with a crankshaft weighing less than one kilo.

A LOT OF SWARF.

Geoff King







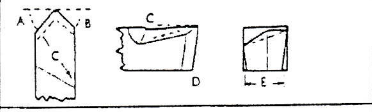
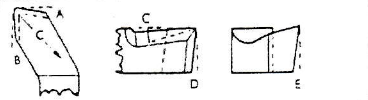
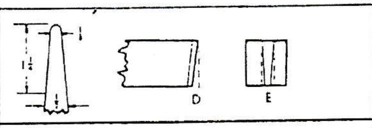
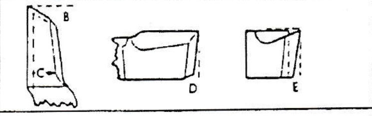
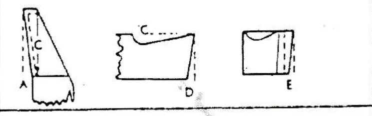
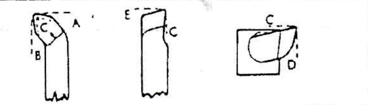
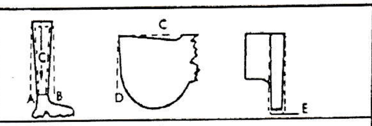
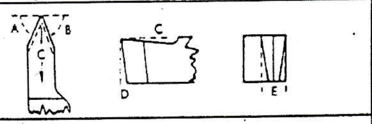
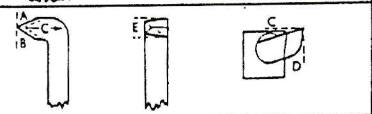
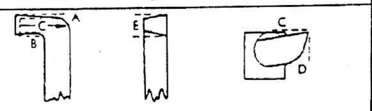

RA 5

Kipling, Wadsworth and Co, modern day writers are alive and well to usurp the throne. The CSMEE "Poet Lauriate" shares this view of the club scene. Do you see it in a different way or not. Suitable words from scribes of literary talent will be welcomed, even 'dogeral,' for these pages and would I'm sure generate further verses to entertain us.

This is a tale of Colchester club
In our circle of leisure it is the hub
Some members are silly, some have brains
But all just love to run their trains.
The money is cared for by David Cocks
Kept under the bed and stuffed in socks.
We also have the Hon Sec Jon
Who likes to know what's going on.
There is a difference we have found
Some people run down on the ground
They run their trains to a timetable
That's as far as they are able.
I suppose their efforts should be praised
But we prefer the track that's raised.
Because we have to face the facts
Our running is dictated by our backs.
Then there are mates Rip and Mick
Who between them never miss a trick,
If your whistle sticks or engine fails
You can rest assured they will tell the tales.
Then surrounded by levers and interlocks,
Poor old Andy is in the box.
All the others are having fun
Taking the mickey from "Es" B1.
That's all that I have got to say
So I will shut up and go away.
Some will clap and some will cheer,
But I don't care I'm having a beer..........or two.

Tool sharpening

The chart on page 22 was submitted by Mike Gipson in response to questions regarding angles, clearances etc. Many will have a copy from other sources such as that given out by Mike Chrisp at his presentation some 4 years ago. Enlargement will be necessary for workshop use or borrow the original to copy.

TYPE	PLAN PROFILE / SIDE VIEW / FRONT VIEW	ANGLES IN DEGREES					
		MATERIAL TO BE MACHINED	MILD STEEL	ALLOY STEEL	CAST IRON	BRONZE	COPPER & ALUMINIUM
FRONT ROUGHER		A	45	30	45	45	45
		B	40	30	40	40	40
		C	16	16	8	8	20—30
		D	6	6	3—5	6	6
		E	6	6	3—5	6	6
RIGHT HAND SIDE ROUGHER		A	15	12	15	15	15
		B	10	8	10	10	10
		C	12	8	10	8	20—30
		D	6	6	3—5	6	6
		E	6	6	3—5	6	6
BRASS ROUGHER			FOR BRASS ONLY D=6 E. 1				
RIGHT HAND KNIFE TOOL		A	0	0	0	0	0
		B	21	21	21	21	21
		C	14	12	12	12	20—30
		D	6	6	3—5	6	6
		E	6	6	3—5	6	6
FINISHING TOOL		A	3—5	3—5	NOT SUITABLE		
		B	0	0			
		C	15	12			
		D	6	6			
		E	6	6			
BORING TOOL		A	2½	2½	2½	2½	2½
		B	2½	2½	2½	2½	2½
		C	5	3—5	3—5	3—5	10—15
		D	6	6	3—5	6	6
		E	6	6	3—5	6	6
PARTING TOOL		A	1	1	1	1	1
		B	1	1	1	1	1
		C	5	3—5	3—5	3—5	15—25
		D	6	6	3—5	6	6
		E	1	1	1	1	1
EXTERNAL VEE THREAD TOOL		A	62½	62½	62½	62½	62½
		B	62½	62½	62½	62½	62½
		C	10	6	3—5	0	10
		D	6	6	3—5	6	6
		E	6 — LEADING EDGE 3 — TRAILING				
INTERNAL VEE THREAD TOOL		A	62½	62½	62½	62½	62½
		B	62½	62½	62½	62½	62½
		C	5	3—5	3—5	0	10
		D	6	6	3—5	6	6
		E	6	6	6	6	6
RECESSING TOOL		A	3	3	3	3	3
		B	3	3	3	3	3
		C	5	3—5	3—5	3—5	10—15
		D	6	6	3—5	6	6
		E	3	1—3	3	3	3

A : FRONT ANGLE
D : FRONT CLEARANCE
B : SIDE ANGLE
E : SIDE CLEARANCE
C : TOP RAKE IN DIRECTION OF ARROW