In Control

Malcolm Beak describes a method of automatically controlling a gas fired model marine steam plant

More and more people seem to be taking up the challenge of building radio controlled model steamboats, some at a fairly basic level, but a surprisingly large proportion seem to be interested in putting together a fairly sophisticated plant. This article is aimed primarily at the second group. One of the goals I have been aiming for is to be able to build a steam boat that will run reliably for as long as there is fuel on board (several hours). This means that there must be automatic control of both the water level in the boiler and the furnace. And if I succeed? Will it not be just as boring as if fitted with an electric motor? I jolly well hope not! I get a great deal of satisfaction from knowing that I built all the machinery and that it's working as it should.

Of the several types of fuel available for firing model steam boats, LPG in the form of butane or propane appears to offer the most advantages. It is clean, reasonably easy to handle, and lends itself ideally to full control. By full control I mean that the flame should be consistent, not being affected by changing pressure in the gas tank. Also that when working boiler pressure is attained, the flame will shut down to its lowest stable working condition. When the throttle is opened and the steam pressure drops, the flame must quickly return to its former glory.

Many of you will have seen my 36in. open launch *Cyril* which is based on Vic Smeed's *River Queen* design. *Cyril* has had these automatic control systems fitted for well over a year now, and apart from the occasional hiccup has been very reliable - and I still look forward to every outing.

The method of sorting out the water level was described in the Nov/Dec issue od *Radio Control Boat Modeller* - but if you intend to make one be warned - there were a number of errors that crept in, so for goodness sake also get the Jan/Feb issue which has the corrections in it!

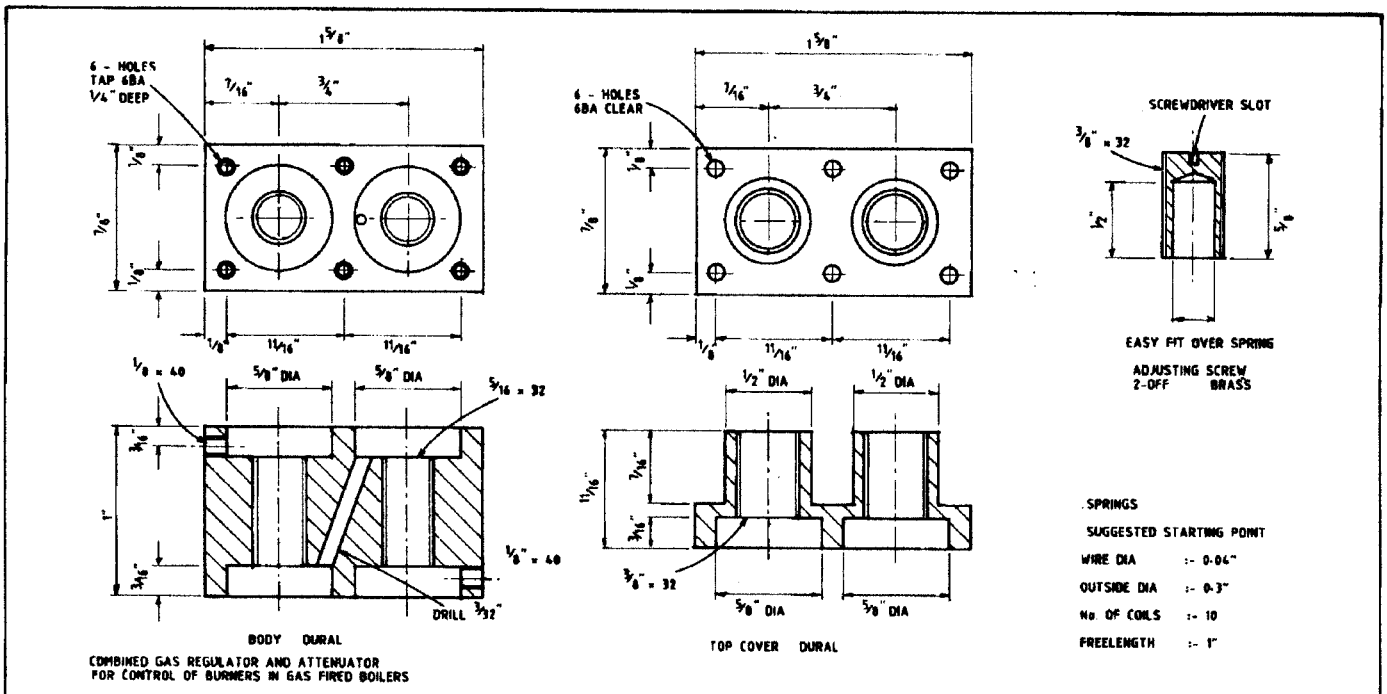
The Method

This article describes an automatic control system for gas fired boilers. I can claim no originality for the basic design; that came from an article written by Christopher Leggo and published in the American magazine *Live Steam* in January 1987. Christopher described two devices. The first was a gas regulator which, as I am sure all readers know, takes gas at variable high(ish) pressure and delivers it at a constant (and in this case, adjustable) lower pressure. The second device takes the constant pressure gas, and allows it to pass on to the burner unchanged until the boiler pressure rises to the working pressure (again, adjustable) when it then cuts down the flow. Mr. Leggo calls this the attenuator - so we will do the same. All I have done is to take the regulator and attenuator and fit them both into the same casing. I've no intention of describing how it all works - that sort of thing makes my brain hurt sometimes - just let me assure you that it does in fact work quite nicely.

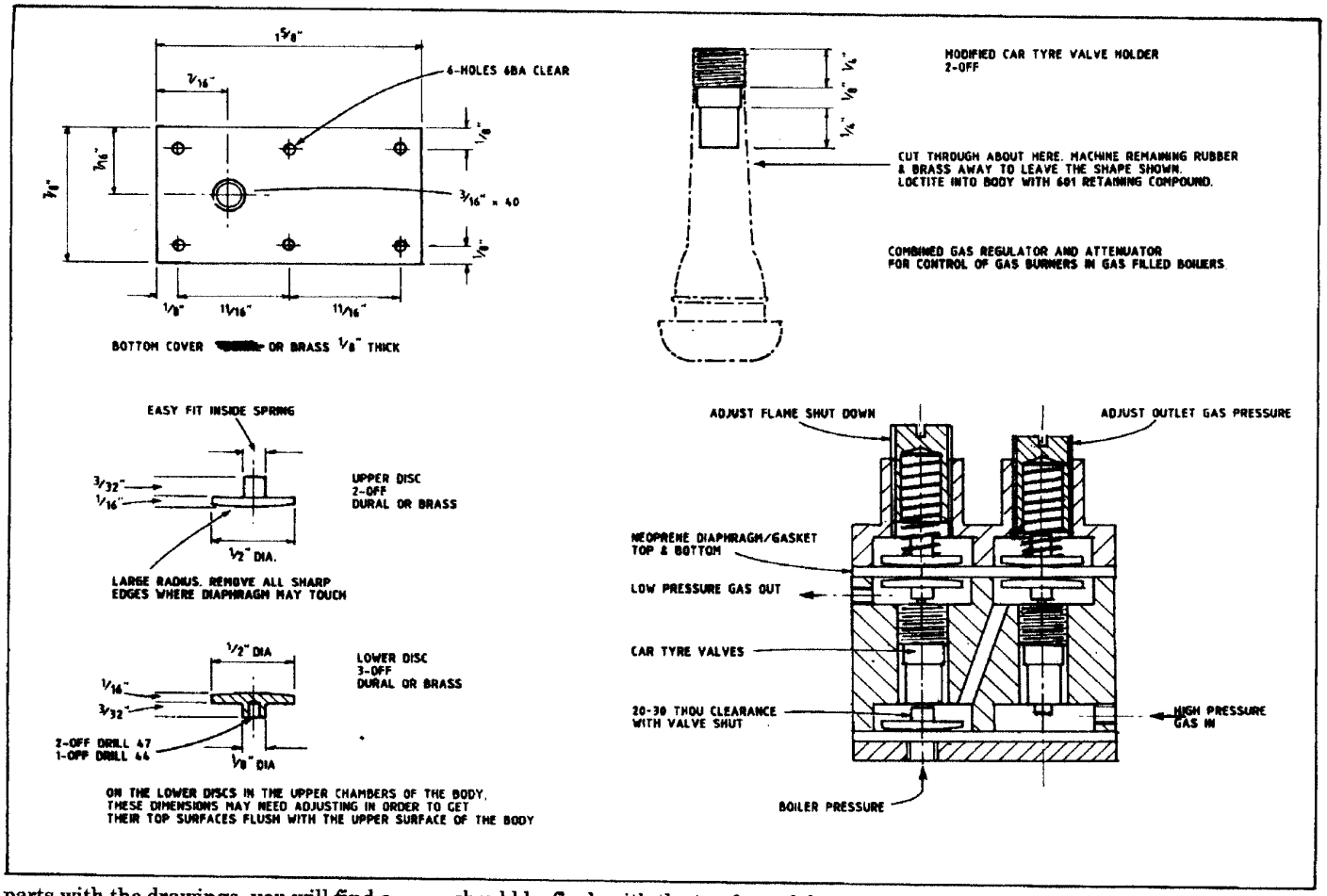
Modification to the car type valve holder. The holder is gripped for machining in a split collet threaded 9/16in. × 32tpi.

The heart of the thing lies in the two valves and these are bought or scrounged. They are in fact car tyre valves with the outer parts modified a little as shown in the photograph. As far as I can make out there are three different designs of the actual valve which is the inner component. These are shown in the photograph. It's the one on the right we want, the others would probably be OK, but the component sizes would have to be altered to suit. The outer part is that which usually resides in the rim of the wheel. They are all the same inside so the valves are interchangeable. A word with the chap who changes the tyres at the local garage should result in an enormous supply - you will probably find that only about 30% of the valves are the correct ones, but as they are free don't complain.

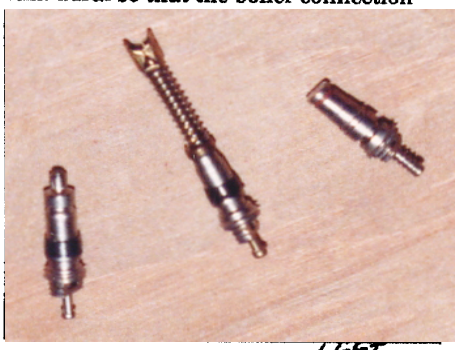
Nothing is either difficult to make or requires particular accuracy. The first one took me a couple of good evenings' work. The resulting piece of equipment is fairly compact at 2in. high and long by 1in. wide. Although the drawings show the main body and top cover to be machined from solid, there's no reason why fabricated components should not be used. If you compare the photo of the component



CONNECTIONS can obviously be positioned where is most convenient. Use 3/32in. copper pipe for the High Pressure Gas if using Propane. If using Butane, push on plastic will probably be O.K. for the inlet. For Low Pressure outlet, thick walled silicone tube should be adequate. For the Boiler Pressure Line use 3/16in. copper pipe.



parts with the drawings, you will find a number of slight differences. The most obvious is in the positioning of the three inlet/outlet connections. This was altered to give a more suitable arrangement of pipes in the particular installation that this control valve is destined for. In particular, the bottom plate is made from ¼in. dural so that the boiler connection



Three common types of car valve. Right-hand one is the design required for the gas controller.

could be screwed into the side. The springs are also obviously somewhat smaller than those suggested (although just as strong). I found that the strength of the springs required was surprisingly high. It is almost certain that some experimentation with spring sizes will be found necessary.

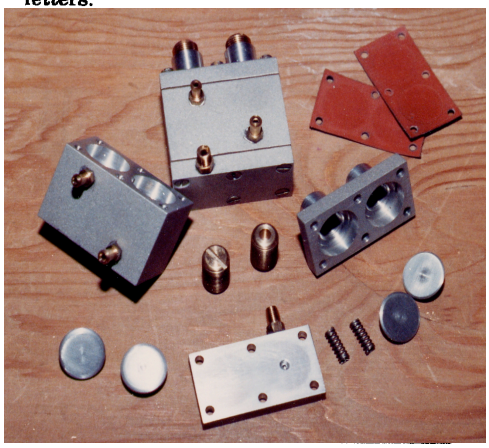
Assembly and Adjustment

While manufacture of the actual component parts should present no problems, a few notes on the assembly and adjustments will not come amiss. When Loctiting the valve housings into place, do use enough Loctite – there must be no leakage of gas through the threads. The discs that sit on the valves and spread the load on the underside of the diaphragm should be flush with the top face of the body. The diaphragm itself is fairly stiff, and if they are proud, it is quite likely that the valve will not shut even with no spring pressure above it. On the other hand, if the disc is much below the face, most of the load applied by the spring will be taken up in deforming the diaphragm rather than opening the valve. The disc in the lower chamber of the body should have about 20 thou clearance between itself and the lower diaphragm when the valve is in the closed position. If there were no clearance, the attenuator valve would be held shut.

The diaphragm should be made from material that is not attacked by LPG. This means definitely not natural rubber. Neoprene is OK, and I fancy that most of the synthetic rubbers are as well. I managed to get hold of some 1/16in. neoprene sheet, a bit on the thick side, but it works fairly well. Whatever you manage to get, it should be smooth on both sides preferably, although one side would do, but Loctite plastic gasket may then be needed on the steam connection. The screws holding the top and bottom covers should not be much more than finger tight otherwise some rather odd effects could be produced by the diaphragm material being extruded into the valve chambers.

When carrying out the initial setting up, screw the attenuator adjuster fairly well down. Now with the gas tank and burner connected, open the regulator valve until you hear gas coming from the burner jet, light the burner, and adjust the regulator for full flame. Remember that screwing the adjusting screws down opens the valves. To adjust the attenuator, the boiler must be connected and steam raised (an alternative would be to use an air line with the same pressure that the boiler is intended to work at). When the applied pressure reaches working level, the attenuator adjuster screw is undone until the flame dies away to the lowest stable flame you can manage. The safety valve should now be on the point of lifting as if the pressure continues to rise the flame will go out. If the pressure is now reduced (by running the engine for example), the flame should return to the full flame condition. If you are using butane, there is not much point in trying to run the burner at above 10lb./sq. in. gas pressure as when the gas container starts cooling, the pressure in it can easily drop to the same sort of value. Some means of keeping the container warm is a good idea, but if using the commercial disposable types, not above 50°C please.

Well that's about it. If you have any problems, don't hesitate to contact me. The phone number is 0923 672341. If you must write rather than phone, please include your telephone number as I hate writing letters.



Two gas controllers, one stripped to show component parts (note valves are assembled into the body).