MODERN VALVES FOR A MODERN NAVY

BY

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Historical Background

Ships engineers do not think too strongly about the low-pressure system* valves in their ships until they leak, then as likely as not they get severely and loudly cursed because invariably in a crisis it is vital that they hold tight.

How often is it that ships are put in jeopardy because these systems cannot be isolated at sea to work on the defective parts. The ship proceeds with everybody keeping their fingers crossed hoping that nothing worse will happen until she gets back to port. Even then, in these days, where there is often insufficiency of shore supply, some part of the machinery system has to be kept going to supply power and if the systems cannot be properly isolated then the Chief's life is made even more difficult. He may, out of desperation and anger, fill out an S.2022 and send it off but I don't expect that he has much hope of anything ever being really done about the offending valves. He has seen it all before—the valves in question are usually the old Admiralty faithful Wedge-gate sluice valves or old Admiralty screw-down isolating valves that have been in the Navy for very many years.

In the days of naval expansion before the First World War, a great deal of drawing office effort was put in by the dockyards to evolving a standard range of Admiralty LP valves and cocks that could be used in all the old *Dreadnoughts* and other ships and were, to a certain extent, rationalized within the hull group and the engineering group, although one set of valves was not used for the other service. Each dockyard was responsible for a certain group and produced all the drawings and patterns for that group. The valves were generally patternized and, in the case of the engineering range, were put in a 'Book of Cocks and Valves' which was distributed round the Home Dockyards and Main Machinery Contractors. They were all made locally.

The Constructive side had their own range of valves with different flanges and the two products went side by side, both being fitted in the same system, depending on which side of the engine room bulkheads they were.

The effectiveness of this system was amply demonstrated: all great ships of the Navy up to the present time have had valves in their LP fluid systems provided on this basis.

By and large, there were no spares provided for these patternized valves and Chiefs of ships have had to rely on the good offices of the dockyards to make such parts as were required by defect-list action. The only valves which escaped this tortuous system were HP steam valves which, by their specialized nature, were bought out from the manufacturers, and specialist HP air and hydraulic valves. Most of the hull and engineering LP fluid system valves which were designed by the Navy during the first years of this century have remained unmolested in their design with the passing of the years and have remained doing yeoman service in the ships of our present day Navy—20 or 40 years after. That these valves are not really suitable for modern pressures and modern pace of living and operation has been clearly demonstrated, but we are still building Y.160 *Leander* Class frigates with these valves in them as standard.

* 'Low Pressure' is defined as under 175 lb/sq in.

It must be remembered, however, that the basic ship chandlery and brasswear of the LP fluid systems in these ships was evolved with the Y.100 *Whitbys* in the 1950's and, at that stage, they inherited the Admiralty practice of the previous half century.

Although this range of Admiralty hardware for pipe systems and engine fittings seems ludicrously outdated, there are, in fact, very many virtues in it. Firstly, the designs were simple, that anybody could make. Spare parts could be made locally on board or in dockyards. Secondly, having an Admiralty design meant that very many firms could be invited to tender and this inevitably led to a very reasonably priced product to the Admiralty. Thirdly, with an Admiralty design it is very simple to patternize this, leading to easily available stocks of assemblies at all the Home Yards. Their lack of sophistication was their strength in that, in a time of conflict or in a time of rapid expansion, all firms could be enlisted. The Director of Contracts Admiralty List is still kept mainly for this purpose.

There are, however, very serious faults in the policy that has been pursued. Unless the early effort in the first years of this century were to be kept up, the Admiralty range of ship chandlery, and valves in particular, inevitably became dated and ever since there seems to have been better things to do than to up-date the old drawings. Many of those bronze valves patternized to-day have their roots back before the First World War still and the drawings date back to that time. Also, the standard of drawings produced during the first 60 years of the naval century in the LP fluid systems fittings and valves field were not conducive to interchangeability between one dockyard and another, or, indeed, between one small brass foundry and another. Even to-day it is quite common for a spare for one of these valves to be made in the dockyard or, possibly, held in SPDC and to require a very considerable amount of hand fitting before it can be of any use on board.

To have been completely up to date in the valve field with Admiralty Pattern valves would have meant the Admiralty setting up in business as competitive valve designers, and there never has been the capacity, nor is there at the present time the capacity, to do so. Unfortunately, very much the same can be said with a lot of the old traditional brass foundry firms on which the Admiralty have relied for equipment in the past, and many of their stock line products are articles that have been produced with very little change over a very large number of years.

Present Effort

During the last two years, the extension of the refit cycle for ships and the increase in running time and availability, has led to considerable rethinking about Admiralty policy regarding valves for ship service. This has been directed in particular to the LP systems field since there are no new construction ship projects in hand involving advanced HP steam conditions.

The concept of maintaining an Admiralty pattern range of valves for ship fitting has been shown to be no longer viable, simply because the products will not stand up to continued use and remain reliable between refits, nor is there time or facilities on board to make the parts for repair. A much more sophisticated and reliable product has become vitally necessary. Admiralty policy has thus taken a complete change and now we hope to buy valves commercially only from recognized valve manufacturers and no longer maintain proprietary Admiralty designs. Both in the surface ship field and in the submarine field a tremendous amount of activity and effort has been going in to the LP fluid system components in order to make them more reliable than anything we have ever had in the past. Inevitably this has meant the demise of long-standing Admiralty contractors, much to their distress, and is perhaps the most regrettable consequence. Some of these firms have been providing

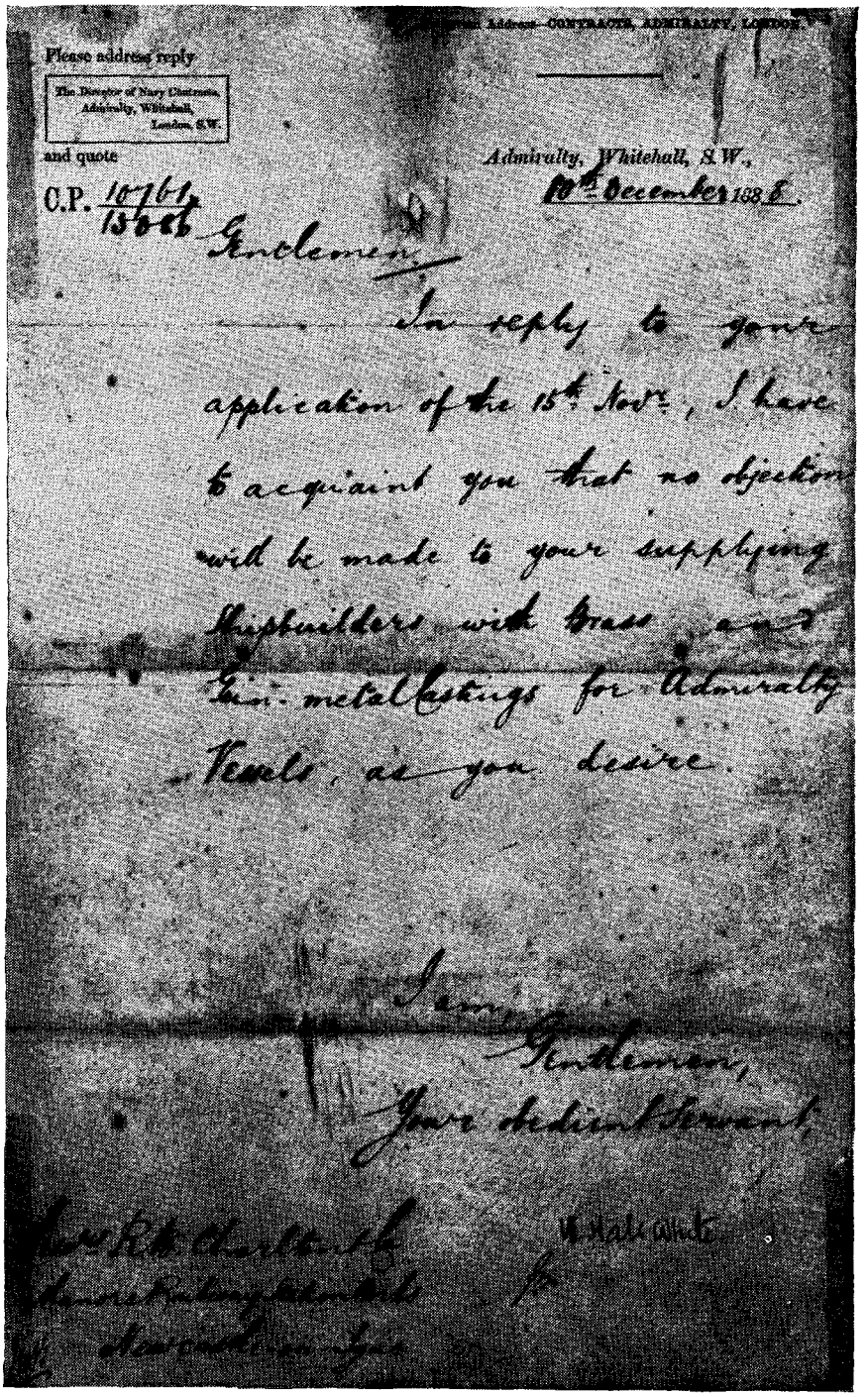
Please address reply
The Director of Navy Contracts, Admiralty, Whitehall, London, S.W.
and quote
C.P. 10761/13066
Admiralty, Whitehall, S.W.,
10th December 1938.
Gentlemen,
In reply to your application of the 15th Nov., I have to acquaint you that no objection will be made to your supplying Shipbuilders with brass and Non-metallastings for Admiralty Vessels, as you desire.
I am,
Gentlemen,
Your obedient Servant,
for

FIG. 1
Courtesy of R. Blackett Charlton & Co. Ltd.

high class valve fittings to the Admiralty for over 80 years, as the old contract letter (FIG. 1) certifies. Such an 'open franchise' contract letter would be impossible today.

Less effort has gone into the improvement of major HP steam valves because these have always been bought from proprietary sources and the integrity of the manufacturer relied on to a great extent. Also, as noted above, there is less incentive, since the nuclear submarine steam conditions can be adequately coped with by the latest commercial designs and there are no surface ship projects published with HP steam propulsion.

In the LP fluid systems field, two major policy decisions have helped in the

rationalization of pipeline products. Firstly, the amalgamation of the old DME and DNC Design Sections has meant that a suitable range of valves can be employed throughout the LP fluid systems of a ship. Secondly, one single pressure range has been standardized on, so there is now only one set of flanges and flange tables to work to. This pressure conforms with Admiralty Pipework Standard 3 to a nominal pressure rating of 175 lb/sq in. This is roughly equivalent to British Standard 10, Table E. It might be argued that it is wasteful to standardize on all valves to be suitable for 175 lb/sq in. when very many of them are only in the 10 lb/sq in. service. However one looks into the design of valves it is very difficult to manufacture a valve that will, in fact, only be suitable for up to 10 lb/sq in. simply because you cannot cast parts of valves that thin. By the natural manufacturing process, valves are, in fact, strong enough to take the upper pressure limit. Old practices die hard, however, and it is very difficult to stop manufacturers only marking up the pressures required by the customer on their drawing when they know that the valve will take many times more. This quite often needlessly limits the valve's application and leads to duplication where none is necessary.

One other benefit drops out from the policy of standardizing on a pressure of 175 lb/sq in. for LP fluid systems in that it ensures all valves are adequately strong, or likely to be adequately strong from a shock point of view. This is particularly important for hull valves.

From exhaustive tests that have been carried out by the Admiralty over the last few years, it has been clearly established that the modern spherical plug valve, more commonly known as 'ball valves', and the latest types of butterfly valve are very much more superior in the duty of LP fluid isolating and control than the old Wedgegate valves and Globe valves have ever been.

It has therefore become general Admiralty policy that for LP fluid system isolation, ball and butterfly valves only will be fitted. This also includes hull valves, fire hydrant valves and throttling valves where the turn down is not greater than 4 : 1.

About 3 or 4 years ago a programme of exhaustive commercial evaluation of selected manufacturers' products was embarked upon, rather on the lines of a *Which* report, to select the best available valves for naval use in the future. The aim has been to establish between two and three manufacturers of each type of valve and nominate them exclusively for naval use.

Coupled with this has been complete documentation of all parts and all materials used in the manufacture. The modern documentation of these commercial products has proved, in many cases, the greatest difficulty because even in this day and age, many firms do not produce General Arrangement drawings for individual products but rely on an omnibus sheet with x y z dimensions marked up on the Table. Thus one drawing number often serves a complete range of valves and it is quite impossible to describe any single product by a single number without adding two or three sentences of description after it. Some of the largest manufacturers of valves in this country are the worst offenders in this respect. It has been common practice to raise a new drawing (with a new number) for a different class of ship, even though the product is substantially the same. This has led to multiple spares holdings of the same parts under different numbers and is very difficult to eradicate unless the firm changes its ways. To impose such a change is not easy today when the Navy is becoming such a small proportion of most firms' turn-over. Very few will do it for the 'honour and glory' of Admiralty work now if there is no money in it.

The aim in producing this range of valves has been several fold and briefly they are as follows:

(*i*) To produce a valve that will cope with all the possible LP fluids that are in present use in the Navy

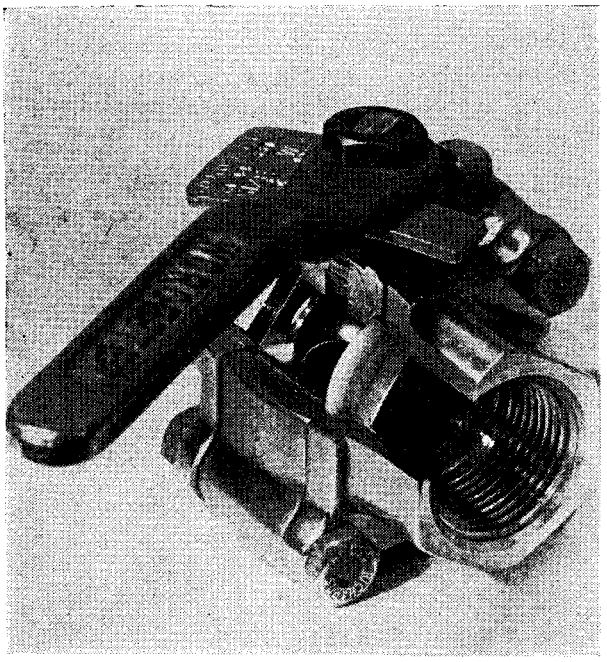

FIG. 2—SECTIONED SMALL-BORE BALL VALVE
(Courtesy Worcester Valve Co.)

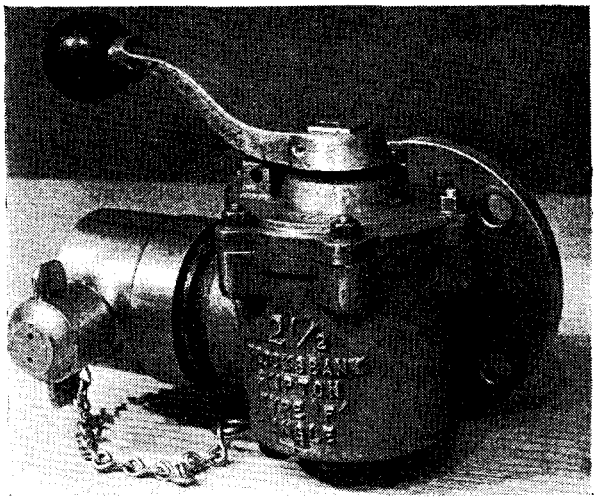

FIG. 3—UNLUBRICATED ROTARY PLUG VALVE ADAPTED FOR FIRE HYDRANT DUTY
(Courtesy Brooksbank Valve Co.)

(*ii*) To produce valves that will give the minimum pressure drop

(*iii*) To produce valves in materials which will give the greatest resistance to the most demanding of the LP fluids in service (usually sea water)

(*iv*) To produce valves which are easily maintainable and which are inherently completely reliable

(*v*) To produce valves whose documentation is complete in every detail and the spares support for which is completely organized.

The result has been that the LP fluid systems for the future will contain mostly valves which are 90 degrees on/off, either ball or butterfly valves. Very few of the old traditional screw-down globe valves will be fitted. All the valves in this field selected have been put through testing which includes 20,000 cycles at full pressure and various other environmental tests such as shock testing on underwater explosion rigs and in shock testing machines, and endurance salt water flow tests.

The use of ball valves has also been extended into the HP fluid field. HP fuel and HP hydraulic isolating valves are now all of this type. This will make welcome reading to the engineer officers of ships burning Diesel oil in their HP fuel systems, at present controlled by lubricated plug cocks, which cannot be made to hold tight with this type of fluid.

A certain amount of scepticism still exists that butterfly valves cannot be made as tight as the old 'lapped-in' Wedgegate sluice valves of the past. This, however, is completely wrong, for the butterfly valves that have been selected for naval use have gone through the very rigorous testing previously described, and it would certainly be true to say that no Wedgegate valve would ever stand up to 20,00 cycles imposed under the same conditions as that which the butterfly valves were tested and came through without leakage.

Again, a great deal of scepticism exists that one valve can be found to handle all the LP fluid systems in the Navy from salt water to high volatile fuels. Our early experiences with the elastomer high acrylo-nitrile seats of most of these ball and butterfly valves has led to the scepticism. However, tests have

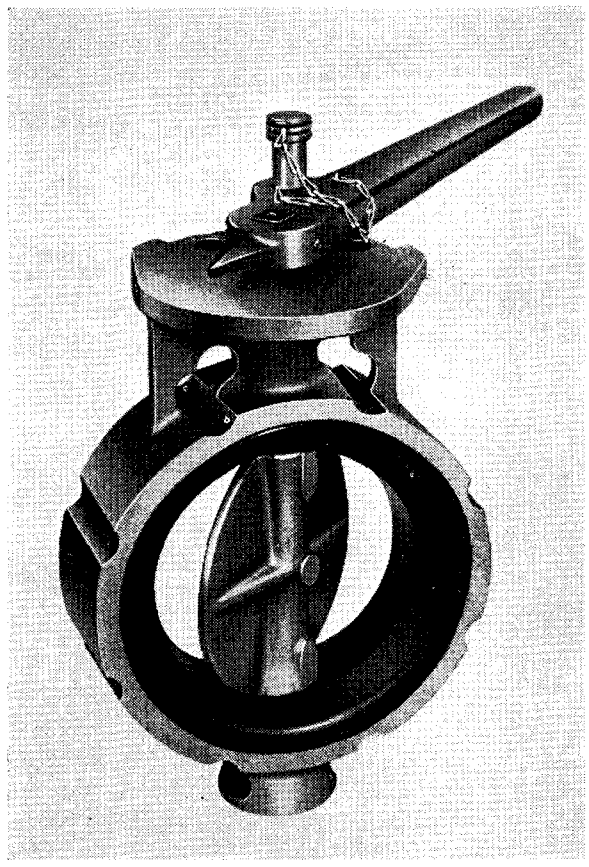

FIG. 4—LEVER ACTUATED BUTTERFLY VALVE OF THE 'WAFER' TYPE WITH NITRILE BONDED BODY LINER

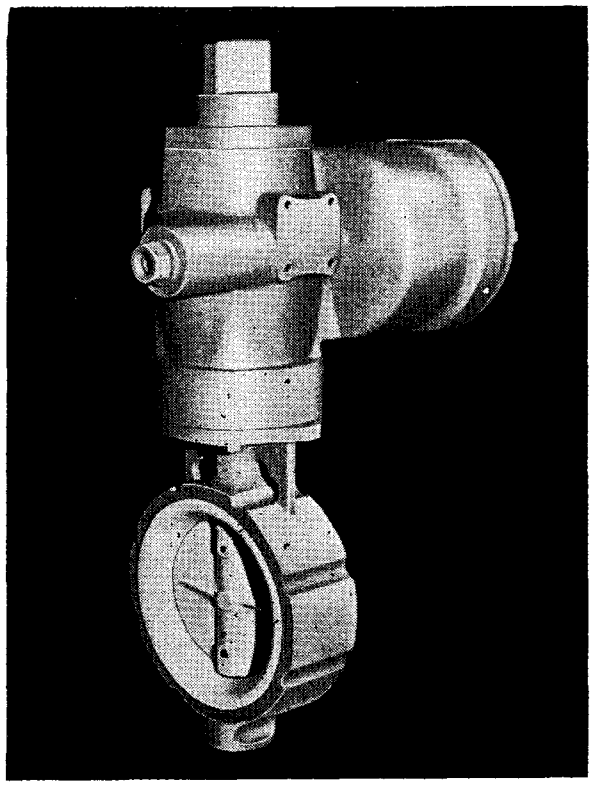

FIG. 5—PNEUMATICALLY ACTUATED REMOTE CONTROL BUTTERFLY VALVE—FOR FUEL CONTROL, FLUIDIC MACHINERY CONTROL SYSTEMS, ETC.

shown that, provided the chemical composition of the sealing elements is very carefully specified and controlled, these valves will cover every service.

Illustrations of typical ball and butterfly valves are shown in FIGS. 2, 3, 4 and 5. FIG. 3 is a rotary plug variant which has been adopted as the new standard fire hydrant.

In the LP steam-valve field, work has progressed along two fronts. Firstly, in the traditional field of bronze globe valves, a large rationalization programme has been undertaken whereby a survey of all the suppliers of Admiralty valves of the past has been made and a study of their reliability history compiled. From this, and other data, three manufacturers have been selected and their products brought up to the latest Admiralty specifications from the material and documentation aspect. In future, only these three manufacturers' products and only those products which are specifically identified by drawing numbers will be fitted in LP steam systems.

On the other hand, a programme of research has been conducted to develop an Admiralty range of bellows sealed steam valves which will be reliable for the life of a ship without ever requiring gland maintenance. These are of necessity much more expensive than the traditional globe valves, but, from the through costing point of view, are very much an economic proposition. Such a valve is shown in FIGS. 6 and 7. It is most people's experience that the greatest maintenance load of a steam system are the glands of the LP pressure systems and not the HP steam which seems to be of a very much higher quality of manufacture and less prone to leakage. The valves are of steel-based materials which increases their

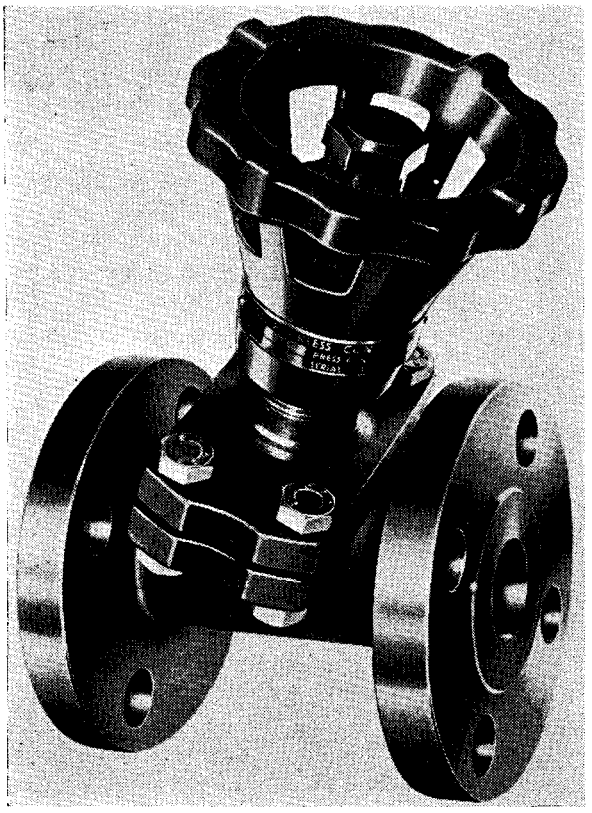

FIG. 6—BELLOWS SEALED STEEL C.P. STEAM GLOBE VALVE
(Courtesy Midland Industries Ltd.)

steam temperature range and versatility with heated fuels.

Having decided on three proprietary manufacturers as the sole suppliers of LP steam bronze globe valves for the Navy, the old Admiralty Pattern range, which was one of those which had its roots in antiquity, has been deleted. This particular exercise raises one problem which is common to all the latest commercial products, in how they are to be provisioned for naval service. As mentioned earlier, with an Admiralty proprietary design, it is easy to patternize and go out to tender on that pattern, picking the most competitive of the tenders for Admiralty supply. In this way, the Admiralty ensures that it gets value for money. If spares were ever provided for this patternized range, they were patternized items as well and also bought under competitive tender from any firm that was willing to supply.

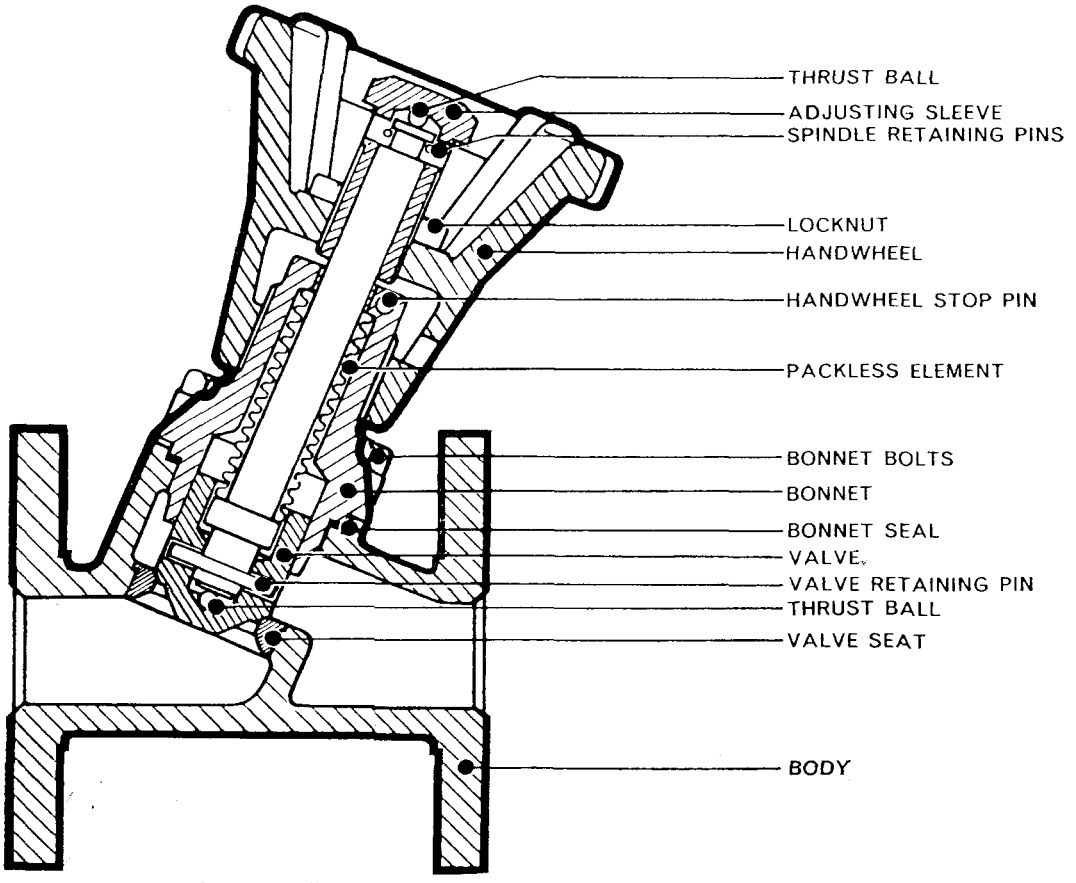

FIG. 7—CROSS-SECTION OF TYPICAL BELLOWS SEALED VALVE
(Courtesy Midland Industries Ltd.)

With the case of the very much more sophisticated ball and butterfly valves, the matter is quite different. If a single range of flanged ball valves, for instance, was patternized under a single pattern number, and each of the three preferred documented manufacturers was invited to tender for this, it would mean that, against any one particular pattern number, size of valve, any one of three manufacturers' products might be held. Now the philosophy which justifies the use of expensive ball valves in LP fluid systems is that they are very easily refittable with a seat and seal kit which, again, is a proprietary item and, of course, is not interchangeable between each of the three manufacturers' products.

Therefore, if these ranges of valves from three sources are to be properly supported, if patternized, each and every one of the seat and seal kits for each of these ball valves would also need to be patternized.

However, in service, it would not be possible to easily recognize from which manufacturer the particular valve came, and hence, it would not be possible to obtain viably the right kit of parts to refit it. To patternize one manufacturer's product to the exclusion of the other two, would be to give a monopoly which is not altogether in the public interest. The same problem exists with the LP steam valves, having deleted the very outdated Admiralty Pattern LP steam globe valves and nominated the three preferred manufacturers in lieu. One is faced with the dilemma of supporting those three manufacturers' products if one patternizes them under a single number, giving a monopoly to one manufacturer, or holding all three products and all their spares under different numbers, either in Naval Stores or at SPDC.

Whichever method of supply and support is considered, the one great factor that is kept in mind is the benefit that bulk ordering gives. No firm wants orders in penny numbers, and very few will stock-hold expensive valves against those possible orders just for the glory of it. Naval orders are getting fewer and our credibility to dictate special requirements is becoming more difficult to uphold if a reasonable price and delivery is also required without monopoly. Several long-standing suppliers, recently having been subjected to take-over or rationalization, have refused to do Admiralty business any more unless it is on their terms and not ours.

Future Policy

Faced with these contradictory considerations, the following action has been taken to equip the Fleet of the future with the preferred ranges of commercial-based products:

(*i*) Identify and publish all the preferred valves and associated equipment, detailing each with a unique drawing number. This has appeared as DGS/TP/899 and is being widely distributed.

(*ii*) Ensure by contract action that valves to be fitted in new design and new construction are only chosen from DGS/TP/899.

(*iii*) Raise omnibus PILs for each manufacturer's range, and bulk order on that PIL complete assemblies and all associated spares to be held at SPDC against first issue and spares demands. Show those PIL numbers in TP899.

(*iv*) Where only one manufacturer supplies a range of valves for one reason or another, and they are widely used, to patternize them and their spares support.

The latter has been done, for instance, with a rationalized range of aluminium bronze small-bore needle valves for general instrument and gauge duty, these being suitable for all fluid, steam and gas media up to 1,200 lb/sq in. general (4,000 lb/sq in. in some cases) and 450 degrees F static conditions. An illustration from one of the range is shown in

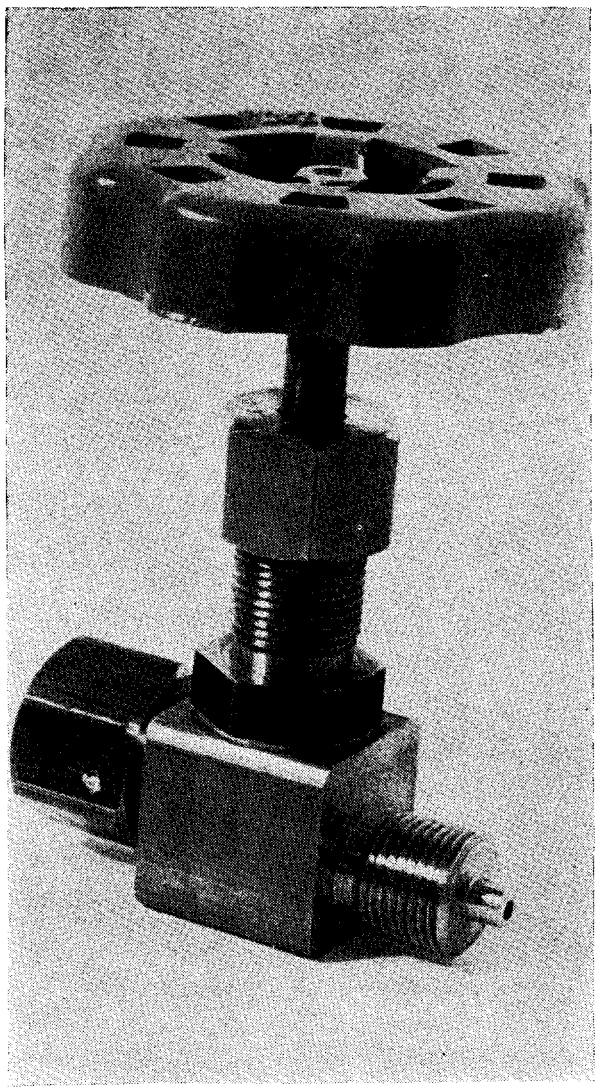

FIG. 8—RATIONALIZED SMALL-BORE ALUMINIUM BRONZE NEEDLE VALVE FOR GENERAL USE—ONE OF A PATTERNIZED RANGE
(*Courtesy Ermeto Valve Corp.*)

FIG. 8. This range has the great virtue of having all but one part (the body) common to all, making patternization of spares a very simple matter. They are being universally specified in such new construction as Type 82, 42, SSNO7, etc.

(*v*) For the Type 42 frigate project, et seq, to conduct a rationalization exercise to further limit the number of suppliers listed. In this case it is the aim to settle on the basis of one maker for one type and size of valve throughout the ship, the considerations being current cost and delivery, since all listed are of equal technical merit (i.e., all LP 4 in. ball valves, irrespective of position or service, to be from one maker, and possibly 3 in. similar valves from another maker). Since, size for size, spares are not usually interchangeable, this policy does not have a spares holding duplication penalty. It has the advantage of giving bulk orders for one size to one manufacturer, but still keeping the full list of preferred manufacturers interested, and yet still buying the least expensive.

Having carried out this rationalization exercise, to then bulk provision for the whole first batch of the class and any other ship classes concurrently requiring the same type of equipment. This policy gives the manufacturer a tremendous incentive to put in a competitive price in the anticipation of bulk orders.

(*vi*) To review all currently patternized valves to see whether their retention is still warranted, or whether any re-design is needed.

(*vii*) To review all previous non-patternized 'Admiralty Standard' designs to up-date or delete them.

These last two tasks are enormous and unlikely ever to be done without a sweeping reform, like the Type 42 exercise, with the present capacity at Headquarters.

Concurrently with rethinking MOD(N) valve policy, a considerable re-design has been taking place in the allied field of rod gearing. This subject has virtually stood still for thirty years and has resulted in gearing that has been much heavier, bulkier and more costly than necessary. The latest design, published as DGS Spec. 77, results in rod gearing which has up to 50 per cent savings in weight, bulk and cost for a given service. Due to increased torque capacity of knuckle joints and other components, one 'size' smaller gearing can be used in general. The gearing runs have also been designed on the 'sealed for life'

FIG. 8—COMPARISON BETWEEN OLD AND NEW ADMIRALTY ROD-GEARING JOINTS

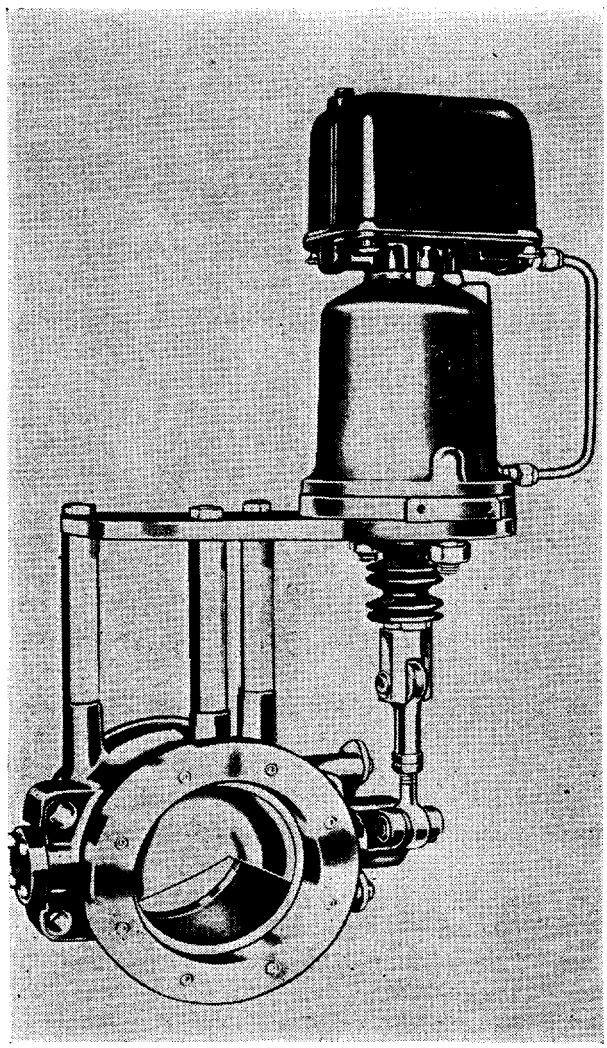

FIG. 9—FISHER 'V' BALL MODULATING CONTROL VALVE FOR LP FLUIDS
(*Courtesy Fisher Governor Co.*)

principle, with routine maintenance eliminated. An illustration of the type of re-design carried out is shown in FIG. 9, the old and new knuckle joints of the same nominal rod size. The new design takes twice the torque of the old.

Rod-gearing assembly, which used to be laboriously done with taper cotter pins and subsequent split-pinning, is now done by flush drilled spring pins, giving a much cleaner and neater appearance and making assembly a very simple unskilled task.

Mention has not been made in the foregoing of specialist control valves, power actuation, or allied pipe-line equipment such as steam traps and strainers. All these, however, have been or are being similarly treated, and a lot of the results where they are universally applicable are published in TP899. One such modern fluid modulating control valve recently brought into service after extensive tests is the Fisher 'V' ball valve, shown in FIG. 10, used in County Class lubricating oil automatic temperature control system. This valve has a turn-down of 100:1 compared with the 8:1 of the original valve fitted. Steam traps now have their isolating and by-pass valves *en bloc*, thus eliminating countless drain line joints. The latter reform has greatly benefited the nuclear steam engineer and 'drain alley'.

It is hoped, in this way, that for the first time we will have complete support and documentation for all the valve equipment going into a ship at the ordering stage, and not some time after as at present.

On the basis that adequate spares support and documentation is three quarters of the battle and the other quarter is ensuring that the product is right in the first place, then the Engineer Officer's problem at sea should be negligible in this field in the future. Let us hope it will be so.