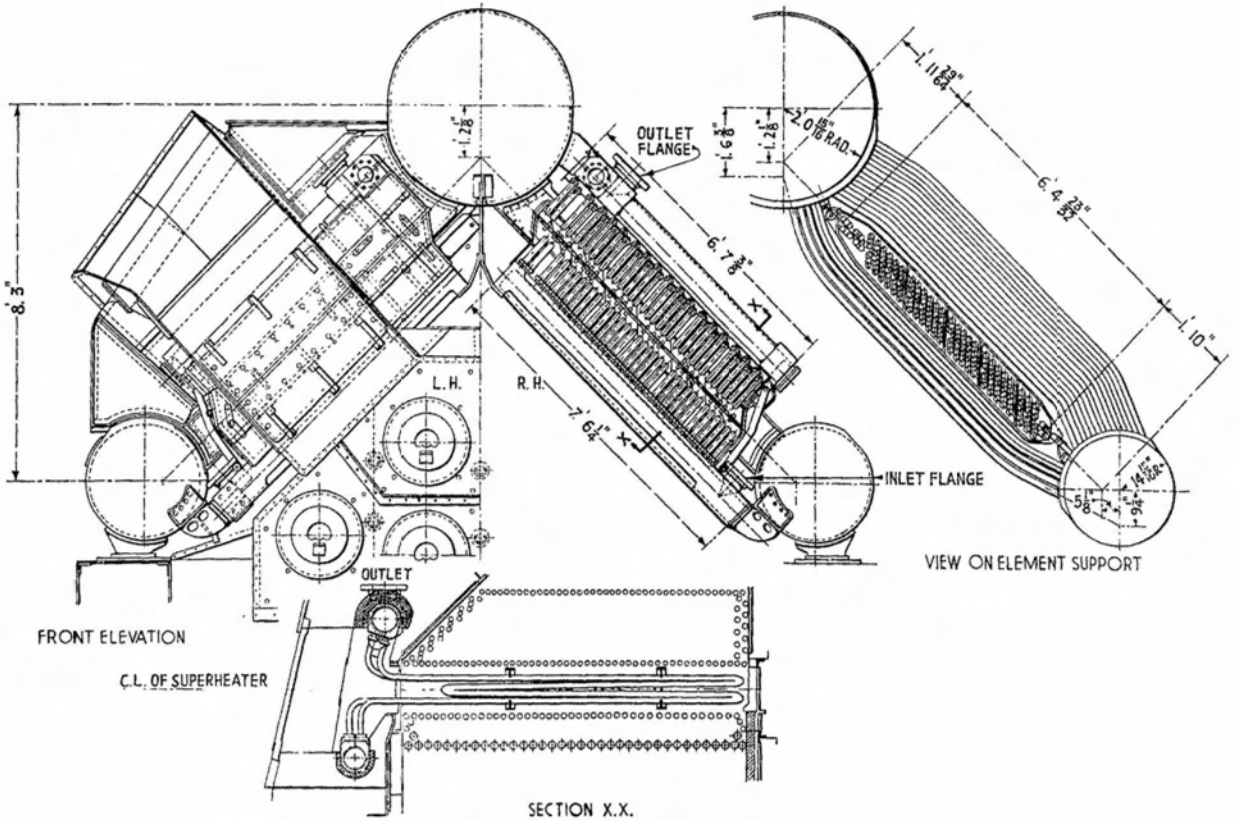

FIG. 1.—ARRANGEMENT OF MELESCO SUPERHEATERS AS FITTED TO BOILERS OF HUNT CLASS DESTROYERS

"MELESCO" SUPERHEATERS IN NAVAL BOILERS.

The MeLeSco superheater, first installed in power stations about 20 years ago, offered many advantages over the multi-pass expanded joint superheaters then in general use. Since then this type of superheater has been introduced to marine practice and vessels of many classes, including even trawlers, have been fitted.

So far as Naval boilers are concerned, the first MeLeSco superheaters were supplied for a Johnson 2-drum boiler fitted as No. 3 boiler in *H.M.S. Hyperion* in 1936. A year later, No. 3 boiler of *H.M.S. Imperial*, was fitted with MeLeSco superheaters; in this case, however, the boiler was of a standard 3-drum Admiralty type.

Since the outbreak of war many new vessels have been fitted with this type of superheater and since December, 1940, when *H.M.S. Blencathra*, equipped with MeLeSco superheaters, ran her trials, more than 200 vessels ranging from *H.M.S. Vanguard* to Hunt class destroyers have been supplied.

The MeLeSco superheater is of the single pass design, there being no internal baffles in the headers. Elements are either of the single flow or the bifurcated type, the latter being used when the single flow type would give too high a pressure drop. Single flow elements are shown in Fig. 1, which illustrates the general arrangement of superheaters in the boiler of a *Hunt* class destroyer, while the bifurcated type are shown in the superheater arrangement for a *Dido* class cruiser in Fig. 2. MeLeSco superheaters are manufactured by The Superheater Co., Ltd., at their works, Mosley Road, Trafford Park, Manchester. Much of the data for this article was supplied by the company to whom we are also indebted for the loan of blocks for Figs. 3—9.

Elements and headers

As may be seen from the arrangement drawings, the installation for an Admiralty 3-drum boiler comprises two headers for each tube bank, the inboard header receives saturated steam from the steam drum whence it passes through the superheater elements to the outboard or outlet header on which the main stop valve is fitted. Four or five rows of generator tubes are fitted on the furnace side of the elements which extend the full length of the tube bank. In *Hunt* class destroyers 68 elements $1\frac{3}{8}$ in. O.D. $\times$ 10 w.g. tubing are fitted to each boiler giving a heating surface of 725 sq. ft. and a final steam temperature of 645° F. at 300 lbs. per sq. in. working pressure. The number of elements varies in different classes of vessels, the boilers of *Tiger* class cruisers, for instance, are fitted with 84 elements with a total heating surface of 2,010 sq. ft. In this case the elements are of the 6-limb type as opposed to the 4-limb type installed in *Hunt* class destroyers. Headers of MeLeSco superheaters are machined from solid forgings, the centre portion of the end plug being removable for inspection purposes. Provision is made for the drainage of water from the headers by means of drain connections. It should be noted that the superheater tubes themselves cannot be completely emptied of water after once having been filled, as, however, the horizontal axis of the boiler drum is raked, some water is entrapped in the return " V " of the " W " form element (See Fig. 1). When raising steam in the boiler, care is necessary continuously to drain the superheater headers, in order to avoid entrapped water being carried over into the steam pipe systems and causing jointing trouble. Air may be released from the outlet headers through the air valves. Where no air valves are provided on the inlet headers, air release takes place through the elements to the outlet header.

It will be seen from Figs. 1 and 2 that different arrangements of jointing the elements to the headers are employed. In the boilers of *Hunt* class destroyers,

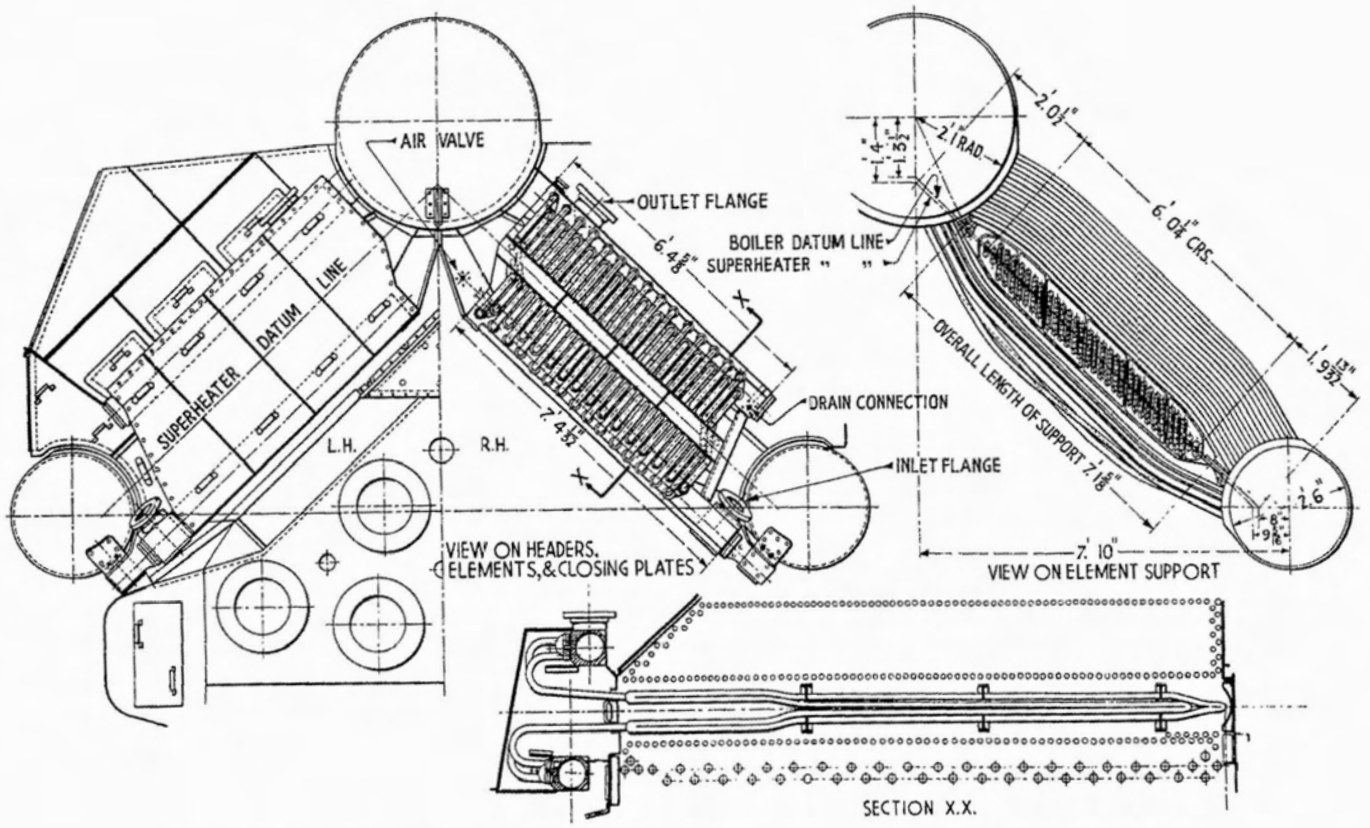

FIG. 2.— ARRANGEMENT OF MELESCO SUPERHEATERS AS FITTED TO BOILERS OF DIDO CLASS CRUISERS

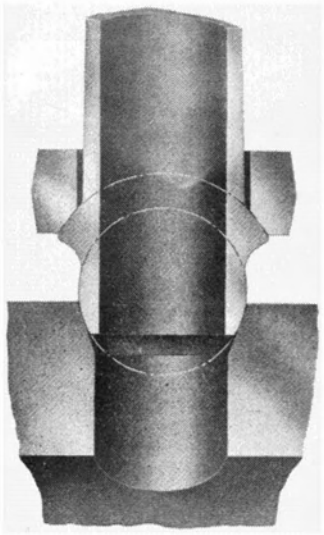

FIG. 3.—ELEMENT BALL END AND HEADER CONE SEAT

the elements are jointed to the side faces of the headers, while in the *Dido* class front jointing is arranged. A notable feature of this type of superheater is the arrangement of headers outside the gas path, thus the joints of the elements to the headers are not subjected to the direct heat of the gases. Closing plates of heat-resisting steel are also provided as a further protection. The attachment of elements to the headers is effected by ball and cone joints the joint spherical in form, contacting with a ground conical seat in the header, thus making a line contact joint (Fig. 3). Alignment is obtained by the use of spherical washers, the elements being held in position by drop-forged steel clamps and high tensile steel studs and nuts (see Fig. 4). This system permits the withdrawal of any individual element and considerably reduces the work in carrying out a superheater overhaul.

Solid cold drawn mild steel tube is used in the manufacture of the elements, the ball ends being formed by mechanically up-

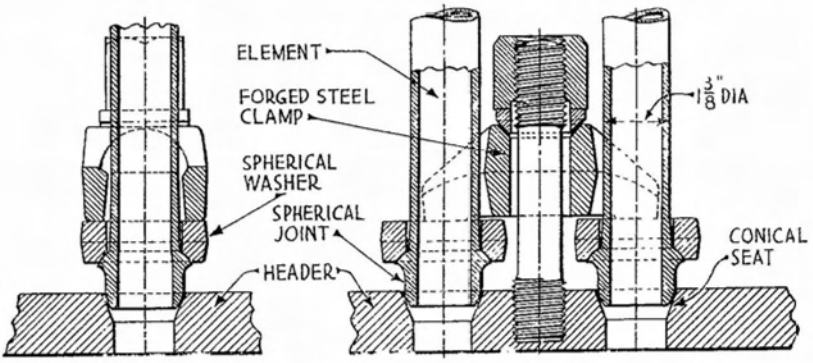

FIG. 4.—ARRANGEMENT OF ELEMENT ATTACHMENT TO HEADERS

setting the tube ends as illustrated in Fig. 5. The manufacture of the return bends is an interesting process as they are machine-forge welded from the tubing, the various steps being shown in Fig. 6. After manufacture, the elements are dried internally with hot dry air and sealed by rubber plugs, which with the metal cap protect the machined faces of the ball ends. These protecting devices are only removed when the elements are required for fitting in the boiler.

Tightness of the joints may be tested by water pressure which shows up a leaky connection by the emission of a fine spray. It is useless to attempt to eliminate such leakage by tightening the joint nut. The joint must be remade by withdrawing the element to give access to the header seats and the element ball ends ; since the neighbouring joint will also be disturbed, the companion element should also be withdrawn. When replacing an element, the utmost care must be taken to avoid bruising the ball ends, either on the angles of the boiler casings or on the edges of the coned holes of the headers. A slight

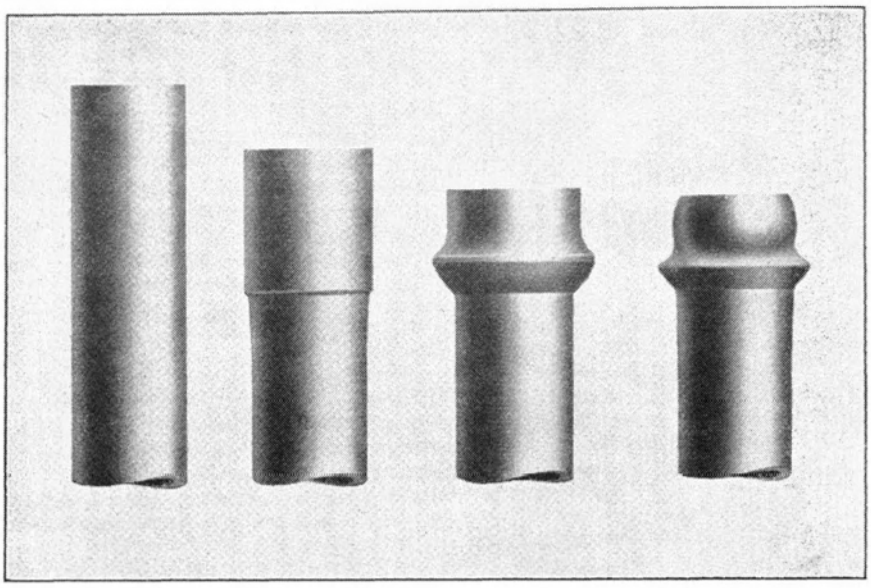

FIG. 5.—STEPS IN UPSETTING BALL FNDS

scratch or indentation across the jointing seat face will cause leakage under test.

Great care must be taken when removing or fitting elements to ensure that damage to the ball end does not occur when passing the stud or an adjacent dog or nut, and the use of the rubber protection caps supplied, usually to be found fitted to the blank plugs provided, is recommended.

All naval vessels fitted with MeLeSco superheaters are provided with a tool box containing the necessary accessories for maintaining the ball joints in good condition. The firm also includes in this kit a useful booklet describing the various operations. The following information concerning the testing and adjusting of ball joints is extracted from the booklet.

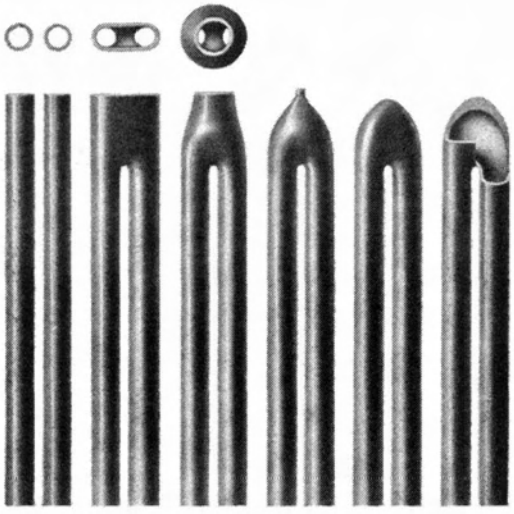

FIG. 6.—STEPS IN MANUFACTURE OF MELESCO MACHINE FORGED RETURN BENDS

The header seats should be treated with the ball gauge (Fig. 7), using as little marking paste as possible. If the seat is defective, it should be corrected with the tools shown in the assembly (Fig. 8), only using the cutter if the seat is so badly damaged that the Aloxite cloth is ineffective. Remove as little metal as possible and then retest with the ball gauge. Any corrosion marks

that may exist in the cone seat need not necessarily be removed unless they are on the joint line.

The element ball ends should be cleaned and tested with the cone gauge (Fig. 9). A thin witness line should result. If the ball end is damaged, correct with the special tool provided, removing as little metal as possible. Great care must be taken when using this tool as it easily " digs in." If a deep " dig in "

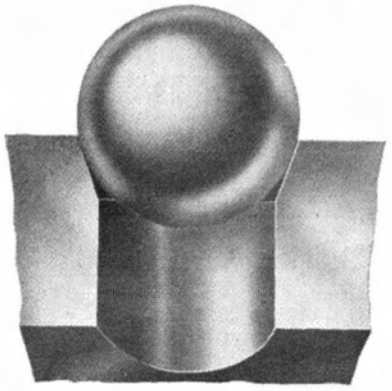

FIG. 7.—BALL GAUGE FOR HEADER SEAT

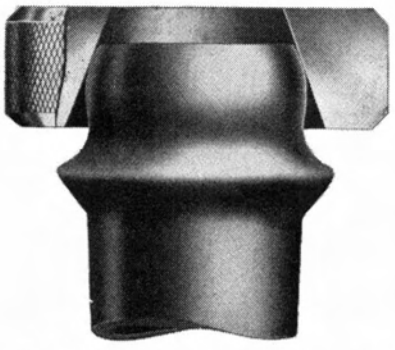

FIG. 9.—CONE GAUGE FOR ELEMENT BALL END

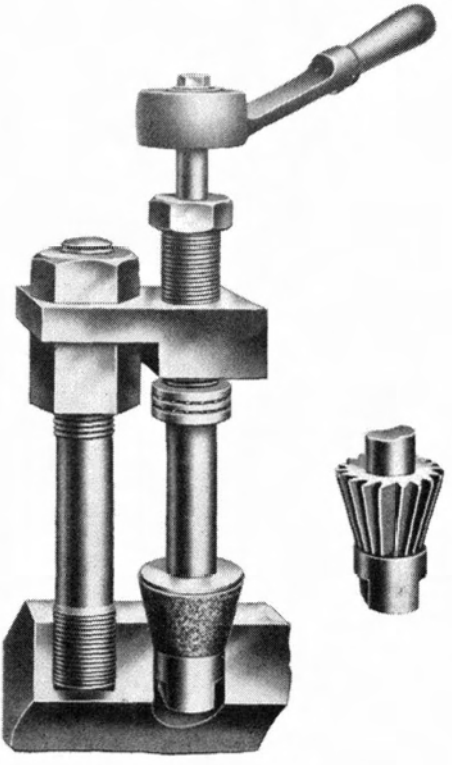

FIG. 8.—TOOL ASSEMBLY FOR RE-DRESSING HEADER CONE SEATS

occurs a spare element is needed. Finish with the grinding wheel, lubricating with machine oil and revolving from the axial position until the whole of the ball end surface is clean.

The following points on the maintenance of MeLeSco superheater ball joints which are the result of experience gained in H.M. Ships should prove of interest.

Correct alignment of the individual elements with the cone seating is of primary importance because if the element does not register correctly into both seatings, there is a very great danger that, when tightening down the second joint, the ball end will ' drag ' down the cone and produce a score. This alignment can readily be tested by holding the lower ball end in position and then lifting the upper one, which hangs down a little by its own weight, into position. Should the upper end fail to register correctly, even to the extent of being 1/16 in. out, the end can be reset by means of a small " Jim

Crow " type of clamp on the straight length between the ball end and the bifurcation ; errors of $\frac{3}{8}$ in. have been rectified readily by this method.

In order to obtain satisfactory joints under perfect conditions of alignment, both mating surfaces must be of mirror-like finish. Meticulous care is needed in truing up ball and cone seats in order to obtain true thin witness lines by the gauges supplied. It is possible, by malapplication of the re-seating tool, to make the cone seat oval. The marking which shows a line contact will be thin for a part of its circumference if the seat is oval. Experience has shown that if the adaptor nut (Schedule No. 75) securing the guide for feed screw to the stud adaptor (Schedule No. 74) be set up hand tight only so as to allow the cutter, or cone seat grinder body, to align itself in the header hole when using the tool assembly for redressing header cone seats, much will be done to obviate the tendency towards the seating becoming oval.

It has been found advantageous, in some cases, to cut approximately 4—6 inches off the mandrel (Schedule No. 70) in order to operate the ratchet more conveniently.

The speed of the portable electric or pneumatic drilling machine used for driving the grinding wheel should be carefully observed and should not exceed 300 r.p.m. ; a speed of about 100 r.p.m. will give the best results.

Element dogs and studs

Element securing dogs and studs should be examined to see that the hole for the stud is central in both planes and that the jaws of the dog have a 1/16 in. clearance all round the tube. The dogs are drop forgings and in some cases it has been found that they were not sufficiently ground out in the throat of the jaws to produce the specified clearance when erected. In some cases, the dog was pressing on the tube, tending to throw it to one side and to produce scores when tightened up, due to dragging the ball end down the cone with excessive pressure in one place. In this connection, the correct alignment of the tubes should be checked before suspicion is cast upon the dog, because if the tube element ends are out of alignment, this may automatically reduce the clearance between the tube and the jaws of the dog.

Element studs should not be removed from the header unless necessary, as the fit of the root end of the stud may suffer. When renewing element studs care should be taken to ensure that the end of the stud does not bottom in the hole on hardening up otherwise the header may be bulged internally.

A small number of elements of each type are supplied to cruisers and larger ships as " on board " spares. No spare elements are carried in destroyers. All ships carry plugs to enable the tube holes in the headers to be sealed in the event of a defective element. If circumstances preclude the possibility of removing the defective elements the ball ends can be cut off to admit of plugging the holes in the headers. Stocks of spare elements are held at principal repair bases at home and abroad. When ordering replacements care should be taken to furnish on the demand the appropriate schedule number shown on the drawings.

In general, the MeLeSco " Concen " ball joint needs care and careful workmanship to ensure tightness ; but, once made tight, it will last well and no useful purpose is served by attempting to tighten up defective joints once they have been pulled up, when cold, to the normal degree of tightness.