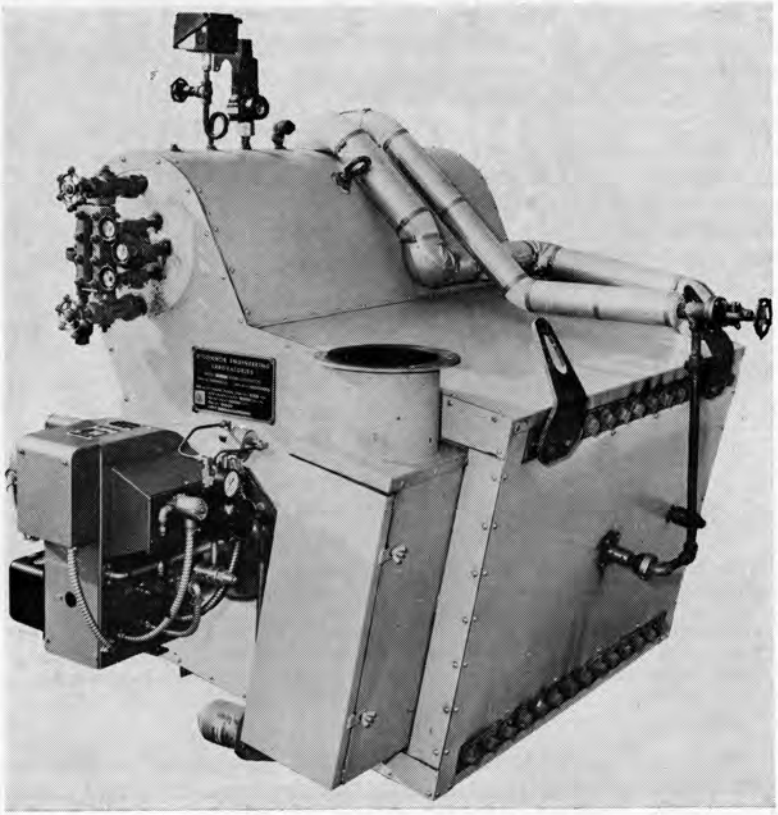
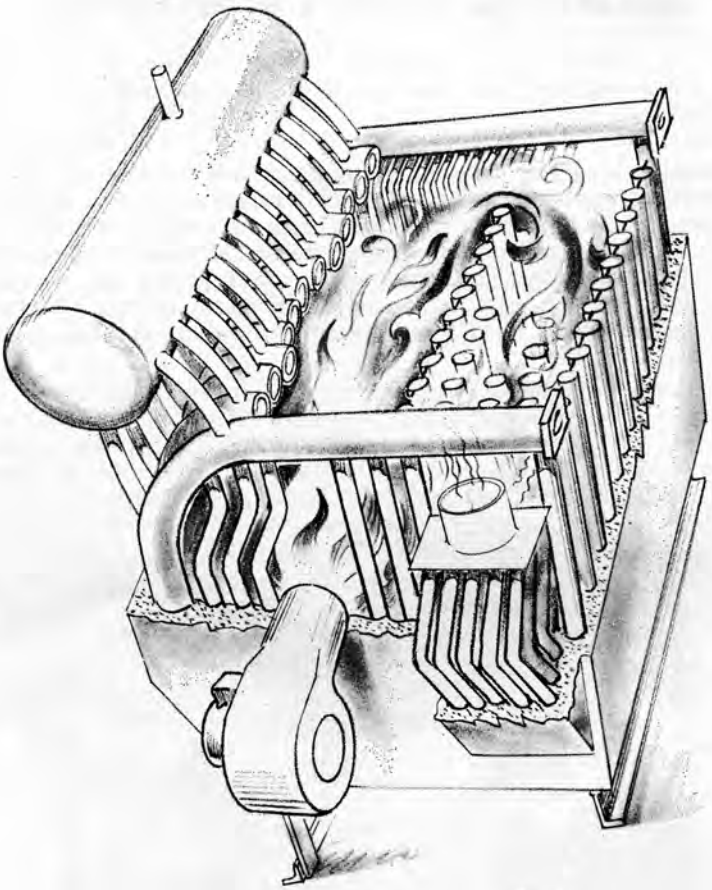
BOILERS AND ENGINES BY O'CONNOR

Robust designs for long service and efficiency

Designs for water tube boilers must be more numerous than the many early attempts to create impossible perpetual motion or convert common metals into gold. Perhaps the most unusual feature of the O'Connor boilers is that they were quite recently designed especially for small steamboats. The first has been well tested and proved to give reliable service installed in the 38 ft. steam launch "Voyager" which was completed in 1970 for Disney World, Florida. This graceful



O'Connor oil-fired water tube boiler
These fully automatic fast-steaming designs supplied for launches, larger boats and stationary power are also suitable for the larger road vehicles. The size shown delivers 1,000 lb. of steam per hour at 350 p.s.i. and 550 deg. F.



Cut-away drawing of an O'Connor boiler

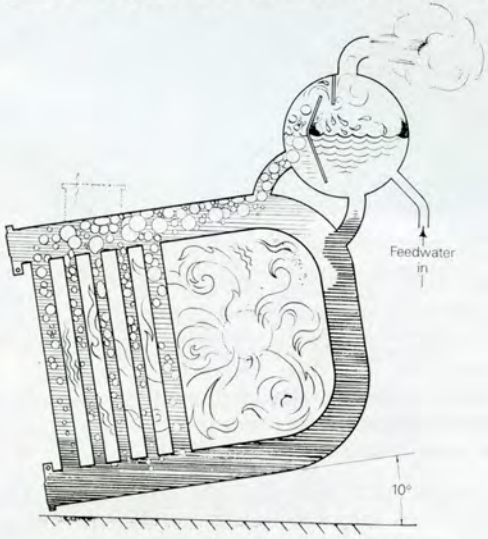
The oil burner fires into the left-hand water walled combustion chamber. Combustion gases are deflected at the end to return between many bent water tubes in the right-hand portion before exhausting up the flue adjacent to the burner. This view shows the horizontal 'U' header tubes at either end and with top section cut away from the intermediate tubes, also the horizontal steam-water drum at left.

craft has been designed to resemble the naval gigs of 1890 to 1900, with clipper bow, counter stern and distinctive threequarter length canopy. Unfortunately, for some unknown reason, our requests for photographs and other information on these handsome craft, for there is more than one, have gone unheeded. Anyone got a picture or two? It is known that "Voyager" was built of fibreglass and teakwood and launched in July, 1970, and that she can carry thirty-seven passengers.

Fortunately information on the boiler, engine and auxiliaries is not so meagre and similar boilers can be obtained if not " off the shelf," at least without long delay, which is a surprising fact for these days. What is more, we are given to understand that they are made in smaller and larger sizes.

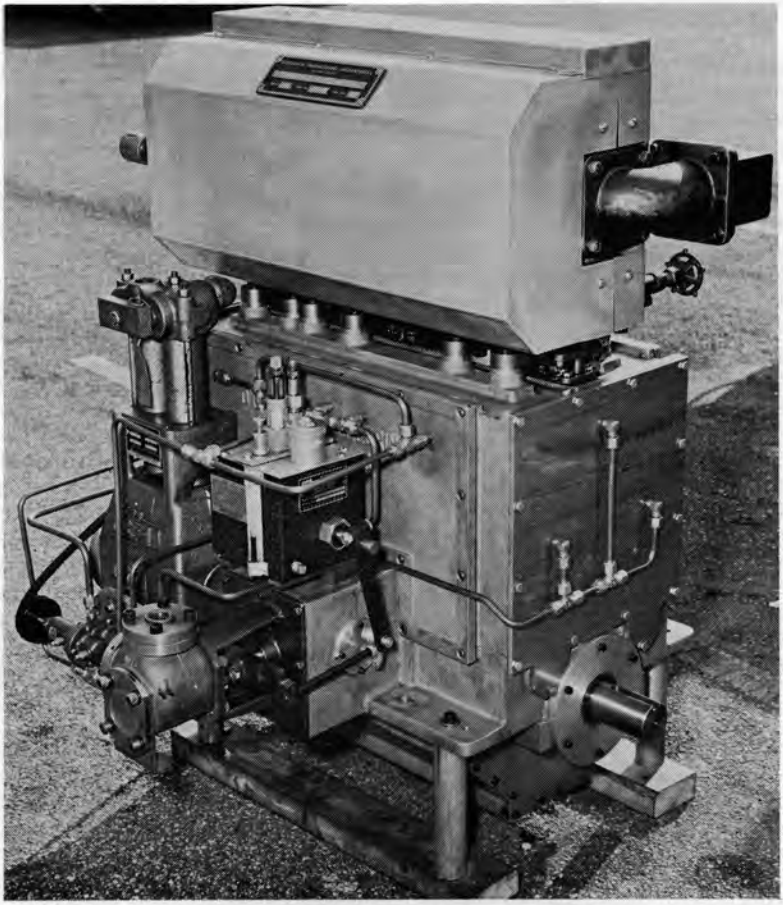
The boiler used in S.L. " Voyager " supplies all the auxiliaries including a steam turbine - electric generator, which is stated to need almost as much steam as the main engine and which supplies all the electric equipment aboard, including fans, lights, sound equipment, oil burner and its controls, as well as one of the two condensate air pumps (wet vacuum pumps). Working pressure is 300 p.s.i., though up to 350 can be used, and steam temperature 550 deg. F. Fuel is No. 2 diesel oil and 80 per cent. thermal efficiency is claimed. No dimensions are given.

The cut-away drawings show construction. The flame is directed into the completely water-walled combustion space at the water-steam drum side of the boiler, the hot gases then turn back to flow between many water tubes connecting top and bottom headers before emerging from the flue by the side of the burner. Top and bottom headers are installed at 10 deg. to the horizontal. The steam rises into the innermost pipes connected to the horizontal steam-water drum, in which a baffle separates out water droplets before the steam emerges from the top. A zig-zag tube superheater is fitted just behind the closely-



Water circulation in one ' U ' tube

Cold feed water from the steam-water drum at top right sinks down the nearly vertical section or downcomer of the horizontal ' U ' Steam formation is shown by the rising bubbles, which reach the drum where baffles separate water droplets before the steam passes to the superheater, if fitted.



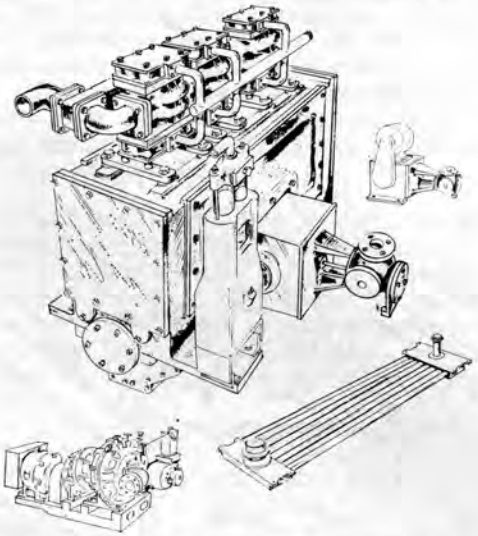
The three cylinder enclosed double-acting engine
This type of semi-uniflow engine with cylinder wall exhaust ports and special piston valves, is used in the steam launch 'Voyager." Steam pressure is 300 p.s.i., temperature 550 deg. F. The engine driven vertical water pump, horizontal condensate air pump and cylinder lubricator are well shown in this view.

spaced water tubes forming the end wall of the combustion space. Lightweight refractory material, installed behind the superheater, is attached to the steel plate furnace seal.

Feed-water is pumped into near the base of the drum to circulate down connecting pipes into the nearly vertical downcomer portion of the header ' U ' tubes.

The reciprocating main engine is a three-cylinder double-acting design with cam operated piston valves and cylinder wall exhaust ports. The outside admission piston valves incorporate special arrangements

which cause compression release to vary with the cut-off, which can be adjusted from very short to all the stroke. As the photo shows, the engine is exceptionally clean in outline, all moving parts being enclosed. Apart from having proved capable of continuous operation delivering 25 s.h.p. at 350 r.p.m. and 300 p.s.i., no other information is available. Without doubt larger powers will be possible at higher r.p.m., up to 700 being the makers' recommendation. A higher steam pressure may also be used, but no figures are available. The steam engine's reputation has not been belied, these engines have proved reliable in long and arduous use with unskilled crew.



Sketches of engine and auxiliaries
Removal of the cylinder covers shows the steam admission and exhaust connections. Below left is the turbine and electric generator, and right a view of the keel condenser. Above right is shown the electric motor driven condensate air pump for use in port.

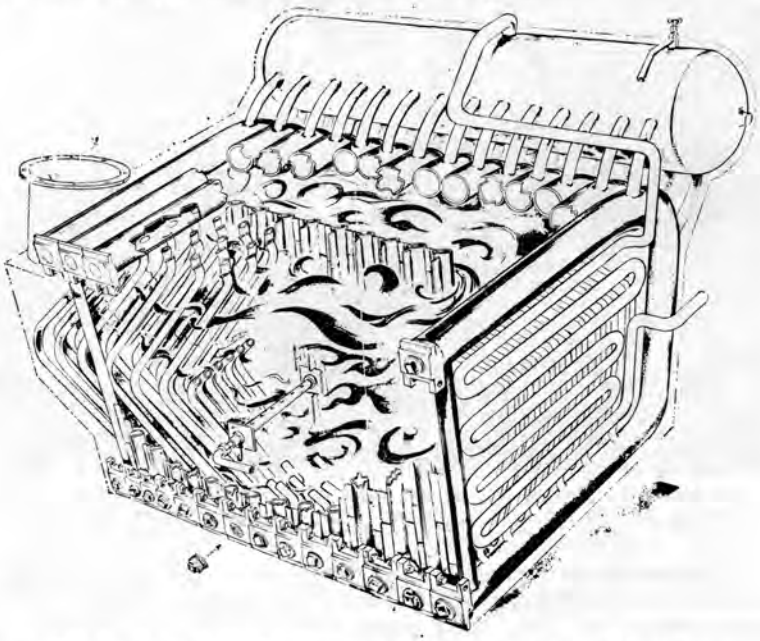
The auxiliaries include a keel condenser of O'Connor design, an engine-driven feedwater pump and one condensate air pump, a separate duplex steam 'donkey' feed pump and the electrically-driven condensate pump for use in port. There are also miscellaneous tanks, filters, valves and a complete control system for automatic operation. In fact, here is all the high-class equipment you may need for a steamboat of your choice. What is more, similar but larger quick-steam raising boilers could be suitable for pollution-free steam buses and trucks (lorries).

The following comments are extracted from the makers' brochure: The principle of the O'Connor boiler is quite similar to that of the large units used by industry and the major utilities. They consist of water wall enclosed furnaces, screen tube protected superheater and

convection section, water-cooled screen walls between furnace and convection section, essentially vertical tubes for free steaming and a separation drum at the top of the unit.

The headers as shown here completely surround the furnace or fire-box, making a gas-tight enclosure. The steam is bled off the highest point in the header. The circulating water then continues around the furnace to make another pass through the convection section, picking up the colder feedwater on the way.

The main drum arrangement prevents any carry over with all normal boiler water, increases steam purity, keeps the main drum completely out of the hot gas passes, eliminates the need for gas baffles, provides a pressure-tight furnace and eliminates the need for a lower drum, only a blowdown header being used.



Cut away view of the two pass boiler, showing superheater
The burner fires from the left, the flames being prevented from diverging straight up the flue at left by the finned tube interior water wall. The series of bent water tubes in the right-hand or return pass section are shown part cut away.

As shown on the cutaway drawing the headers are bolted together to make a complete envelope of water. The hot gasses pass through the full length of the boiler then turn 180 degrees and return through the convection section. This arrangement presents the water-cooled surfaces to the hot gasses throughout the boiler.

The " target wall " or back end of the furnace is lined with closely spaced water-wall tubes. Behind these tubes is the superheater (when required), which gets both convection and radiant heat to maintain the temperature nearly constant throughout the load range. It should be noted that the superheater can be readily removed without removing any pressure parts.

To maintain an even temperature on the back side of the superheater tubes, the lightweight refractory is placed outside the superheater. This is held in place by an external steel plate which also serves as a furnace seal. It is bolted with a gasket to the pressure parts. Each header can be inspected through plugs or hand holes in the headers.

In addition to the usual required safety features, all O'Connor units have complete flame monitoring systems and an explosion door to remove any excess pressure in the furnace area, as well as the inherent safety designed into the pressure parts.

The pressure parts are 100 per cent. welded with full penetration. There are no tubes rolled in place. The main steam drum is completely external to the furnace. Only the tubes are exposed to the hot gasses. They are small enough so that if they did become overheated and ruptured, no external damage would result other than steam passing out through the stack and possibly the explosion door. This would automatically extinguish the fire and relieve the pressure.

All construction and inspection pressure connections are welded ; the drum is welded and X-rayed. The boiler is inspected at regular intervals during its construction by the State of California, Division of Industrial Safety, Pressure Vessel Section. The engineering, construction and inspection is all done in complete compliance with the A.S.M.E. Boiler Code, Section 1.

In spite of the highly developed state of the art in feedwater treatment, humidity control and maintenance, not all installations receive the proper care. In these few cases a tube can fail. If this happens, a new header, complete with tubes, water walls and partition walls can be ordered from the factory and installed in the field.

All pieces are built to jigs or fixtures so that they are interchangeable with the original parts, whether it's for a boiler, a piece of auxiliary equipment or an engine.

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