

THE STOTHERT AND PITT STEAM FAIRBAIRN TYPE CRANE

David Jones

'A "Fairbairn" Type Crane, has a curved jib and post in one, extending to a considerable depth in the foundations, the tapered end of which has an underground gudgeon working into a foot step bearing.' This definition has been taken from a translation of the German book *Cranes*, by Anton Bottcher and A Tolhausen.

The 35 tons crane in Bristol City Docks follows this definition, and the following contemporary description is taken from pages 78-9 of the 1885 catalogue of Stothert and Pitt, the Bath engineering firm.

This type of Crane was originally introduced by the late Sir William Fairbairn (hence its title), and is considered the best form of Crane for dealing with heavy and bulky packages in and out of high-sided vessels of large beam and tonnage, giving, as it does, the greatest possible amount of clearance under the jib sheave. The Crane illustrated, had a radius of 35 feet from the centre to the plumb of the chain, and a height of 40 feet from ground line to the centre of the jib head sheave, and was constructed for lifting loads up to 35 tons. The jib was built up of wrought iron, of box sections, the cross section at ground line being 6 ft 6 in. by 4 ft 0 in., extending 15 feet. below the surface.

The Crane was fitted with two pairs of Engines, one pair being 10 ins dia. by 16 ins. stroke, devoted to the lifting gear, and the other pair 5½ ins. dia. by 9 ins. stroke for the stowing or turning gear. The lifting gear had four powers and speeds of lifting exclusive of the return chain, and was also fitted with hand gear for making an occasional lift when the Crane was not in steam. The slewing or turning motion was also fitted with gear to work by hand. Each pair of Engines were fitted with link reversing motions, which enabled the loads to be lifted or lowered by steam, and the employment of two pairs of Engines greatly facilitated the handling of the Crane, as the lifting and turning could thus be carried on simultaneously without alteration of clutches, which would frequently have been imperative if one pair of engines had been employed for the double purpose.

The Crane was fitted with a massive cast iron base-plate, bolted to a masonry foundation, and bored out to receive a live ring of rollers working between the ring and the turned cast iron centre, fated round the crane post, the upper face of the base-plate had an internal geared ring of 8 ft 11⅓ ins. diameter (This measures on site at 11 ft 9⅞ ins.) into which the stowing or turning pinion geared. The whole of the various motions were brought within easy control of the driver, and at such a position that he had an uninterrupted view of the jib head while at work.

The Boiler was of the vertical type, 10 feet high by 4 ft 4 in. diameter, fitted with all the usual steam and furnace fittings, and steam donkey feed pump, water tank, coal bunker, etc. The Boiler, Engines, and Gear of this Crane were protected by a neat wrought-iron house, giving ample room to the driver.

This Crane has given very satisfactory working results since its erection, and the total cost, exclusive of house and foundations, was £3,600, and the total weight about 120 tons:

SITE

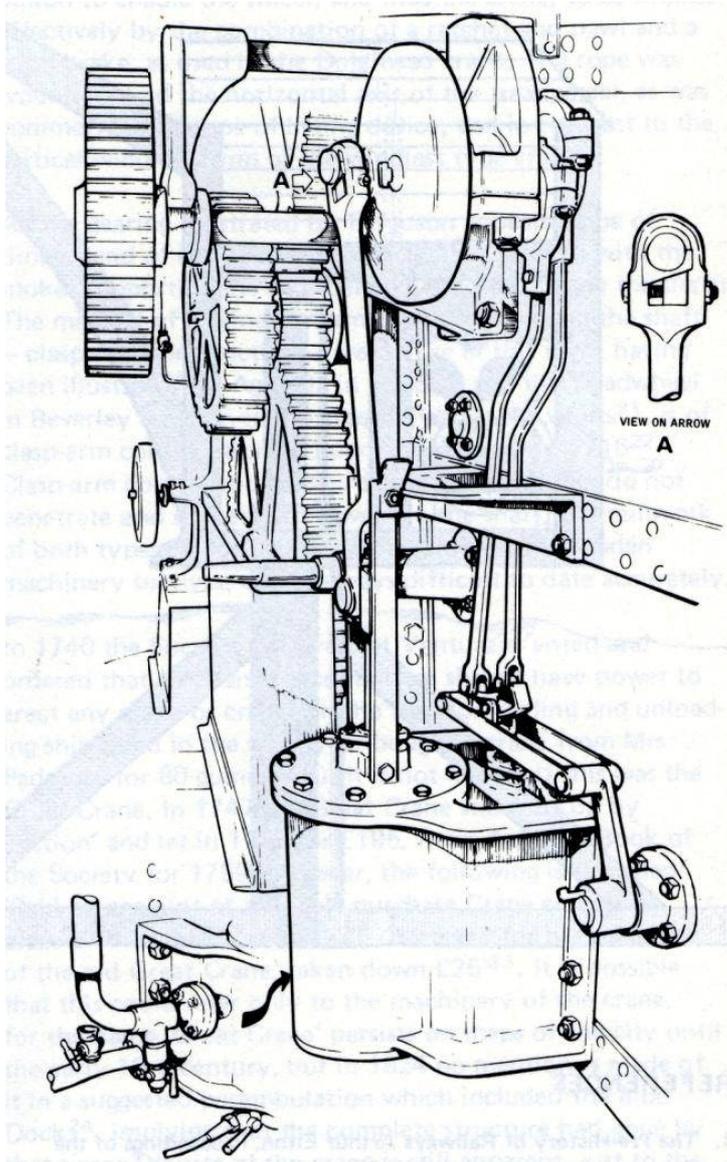
The crane is situated at the Princes Street end of Wapping Wharf in Bristol City Docks. The foundations form an extension to the wharf, being very substantial and well keyed to the original masonry. From available drawings of the period, it is understood that the extension was proposed in January 1876. The first materials, 'stones marked and ordered for fitting' and 'contract cement ordered, 206 yds 5 ft cube' appeared on 9 June and 27 December 1876 respectively. Using 12 inch square baulks of timber to form a coffer dam, work was started probably in December 1876 or January 1877.

STRUCTURES

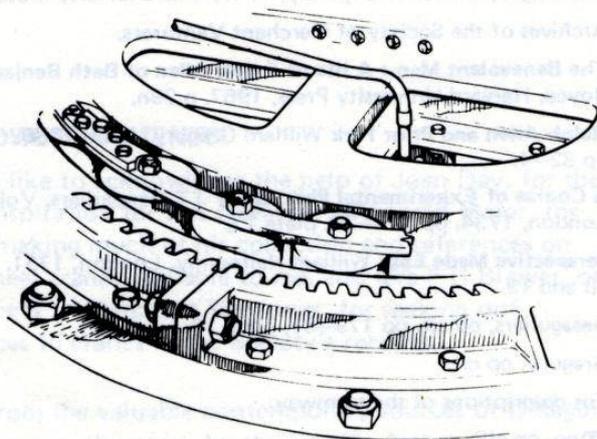
The post of the crane, running in a roller bearing at the top and a gudgeon bearing at the foot, is mounted in a metal well of four sections. This well is restrained at its top by three tie rods of 3 inch diameter, forming three U-shapes on plan, and one tie rod at the base. Large cast plates are bolted at 90° to the ends of the rods. Across the extension, running parallel with the original wharf face, are four bracing rods and plates helping to bind the masonry around the metal well. The whole assembly, encased in stone and cement, blends well with the original wharf.

Since its installation there have been some additions and alterations made to the crane, which, when first erected does not appear to have had ladders or handrails. A single ladder to the roof and first roller, then double side-by-side ladders for the remainder of the jib have been fitted and handrails now extend the length of the jib and around the base of the cab. The smaller roof, covering the boiler and winding drums, is an addition, and this has necessitated the extension of the steam exhaust pipes from the main cylinders. The boiler also appears to have been altered during the crane's existence, the original having been flat topped with insulation of asbestos and wood laths. The chimney has a fine top and a safety valve mounted at the front of the boiler.

The present boiler, by Marshall and Sons Co Ltd, from Gainsborough, No. 92766, has a domed top, and a 'Ramsbottom' type safety valve at the back. On the front, each side of a central manhole, is a sighting glass, or water gauge, and to the left is a steam pressure gauge, reading to 200 lbs per sq in., but the indicated working pressure is 100 lbs per sq in. Above the furnace door are three cross-water tubes, with inspection covers at their ends. The ash from the fire falls through the base of the boiler to an -ash box which is supported between the two longitudinal chassis members.



lifting cylinder and valve gear



turning ring and rollers

The jib and post are essentially the backbone of the crane, and the two small cylinders, stowing gear, main lifting cylinders, gear train, winding drums and brackets, together with the chassis, are hung from it. The chassis consists of two longitudinal flanged members 4 ft apart, and six cross members. Substantial though the chassis is to support the boiler at its extremity, it only carries the water tank, donkey engine, coal bunker, floor and wrought iron cab.

All castings and gear wheels carry Stothert and Pitt's initials, an exception being the three steps into the cab which bear the name of St Pancras Ironworks, London. The only form of decoration to be found appears at the intersections of the iron window bars, a small inconspicuous rose.

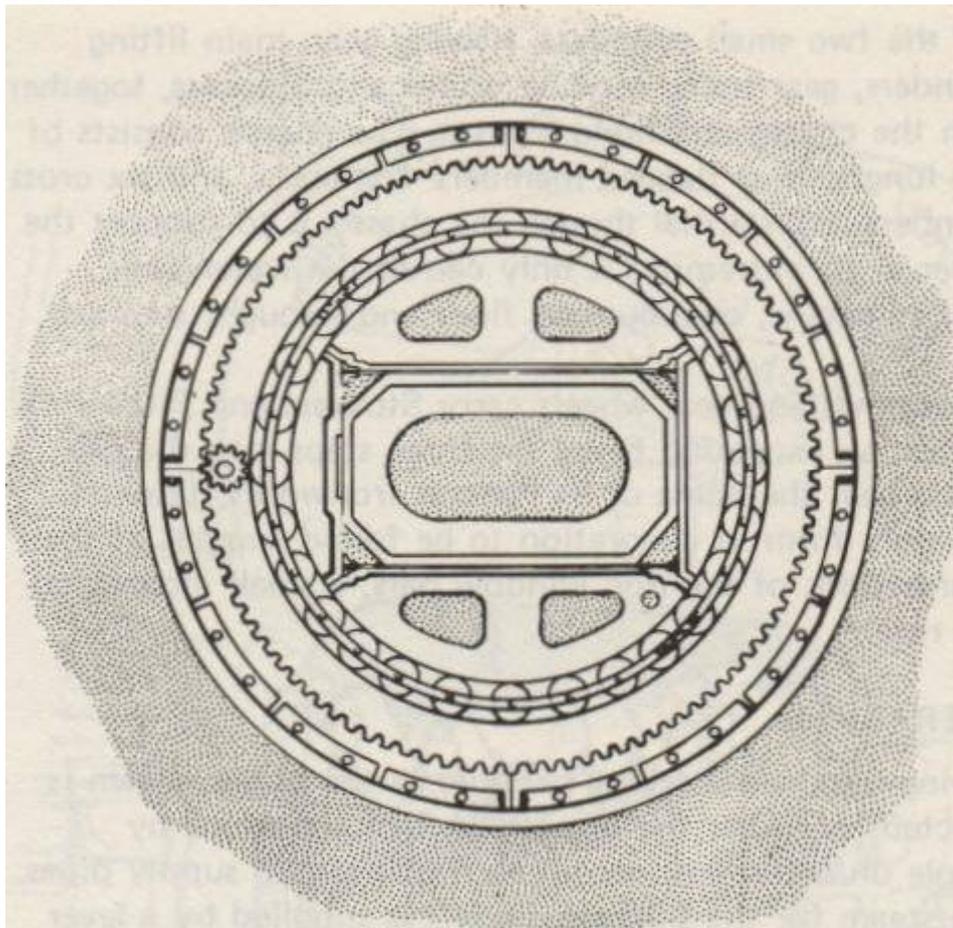
OPERATION

Having obtained working pressure in the boiler, steam is selected for either the turning or lifting motions by simple on/off valves, one in each of the two supply pipes. The steam for the lifting cylinders is supplied by a lever at roof level dropping to a convenient hand height; its operation is push-pull. The steam from the main cylinders is exhausted through the roof to atmosphere. Steam for the stowing cylinders is supplied from a smaller supply tube through a screw-type on/off valve. The common exhaust is then piped to the water tank on the right hand side of the crane, probably a simple condenser, and the tank itself is vented to atmosphere through a very long vertical pipe. Both sets of engines use Stephenson's link motion, operating through quadrants with two notches either side of neutral, forward and reverse, giving five positions.

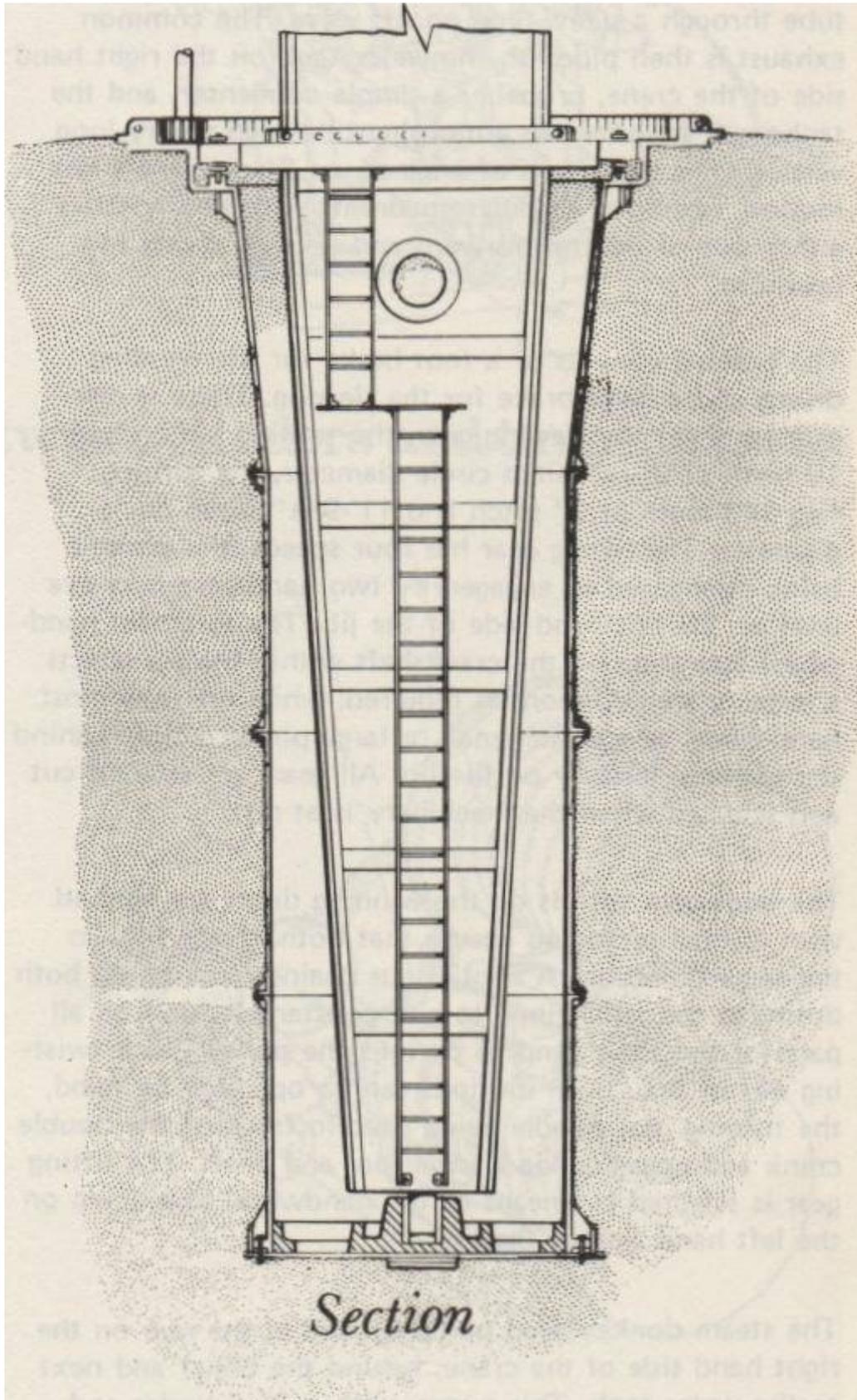
The braking consists of a foot brake for the winding drums and a hand brake for the stowing. There is one gear ratio for the stowing gear, the turning pinion has 10 teeth at 99/16" pitch circle diameter, the turning ring 148 teeth at 3" pitch and 11'-9 3/8" pitch circle diameter. The lifting gear has four speeds, the pinions being disengaged or engaged by two hand-wheels at eye level on the left hand side of the jib. The foremost handwheel operating on the crankshaft within the jib selects a large or small pinion, as required, while the innermost hand-wheel selects the small or large pinion visible behind the crank externally on the jib. All gears are straight cut and selected when the machinery is at rest.

The large gear wheels on the winding drum are meshed with a small pinion to ensure that both drums turn in the same direction. A continuous chain is wound on both drums at the same time, to give constant tension on all parts of the chain, and to prevent the pulley block twisting out of line. Both motions can be operated by hand, the turning gear handle being sited in front of the double crank and engaging via a large gear and bevel. The lifting gear is selected by means of the handwheel low down on the left hand side of the jib.

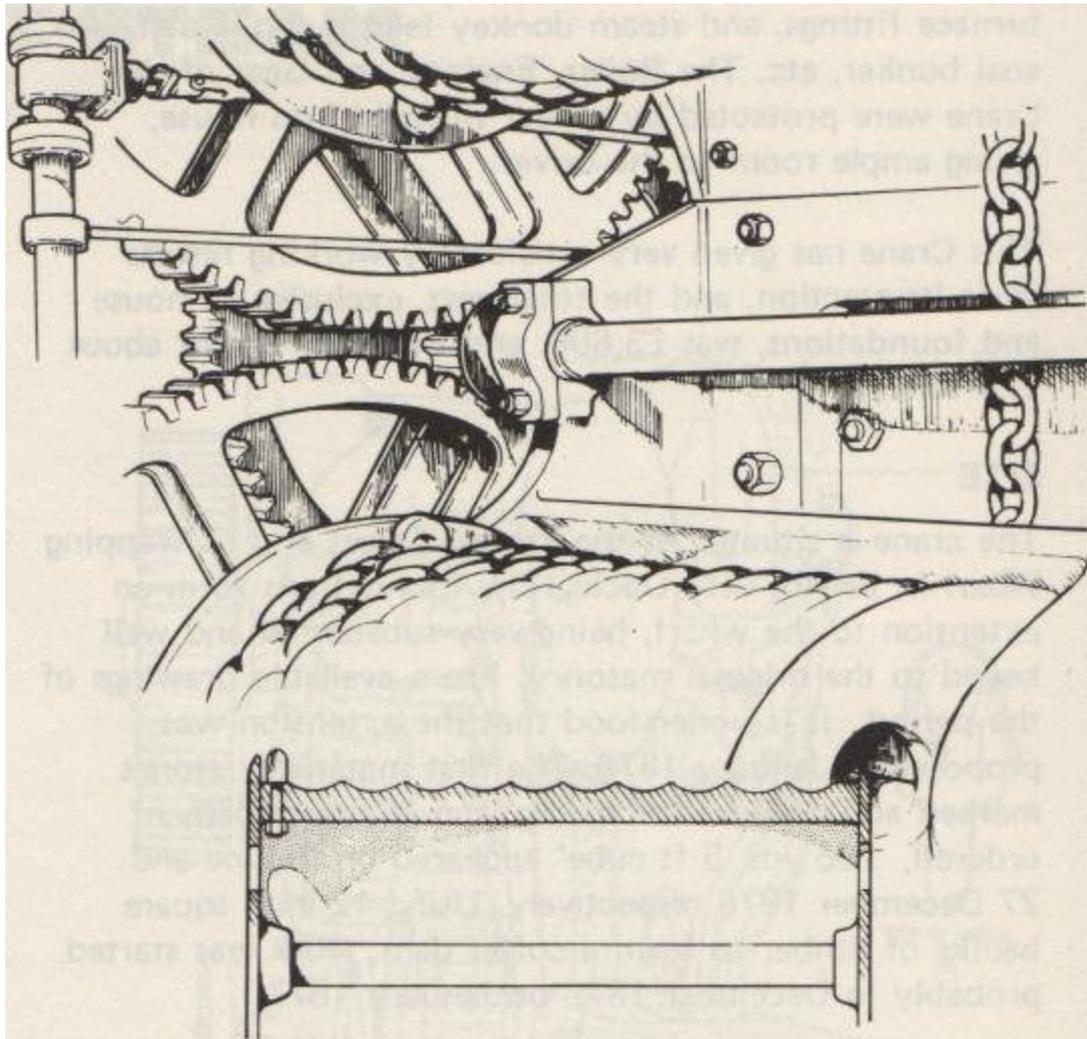
The steam donkey feed pump is, sited at the rear on the right hand side of the crane, behind the boiler and next to the water tank. This pump, with a 3" cylinder and 1'-6" flywheel, is used to lift water from the foundation pit and maintain the level of the water in the boiler from the water tank.



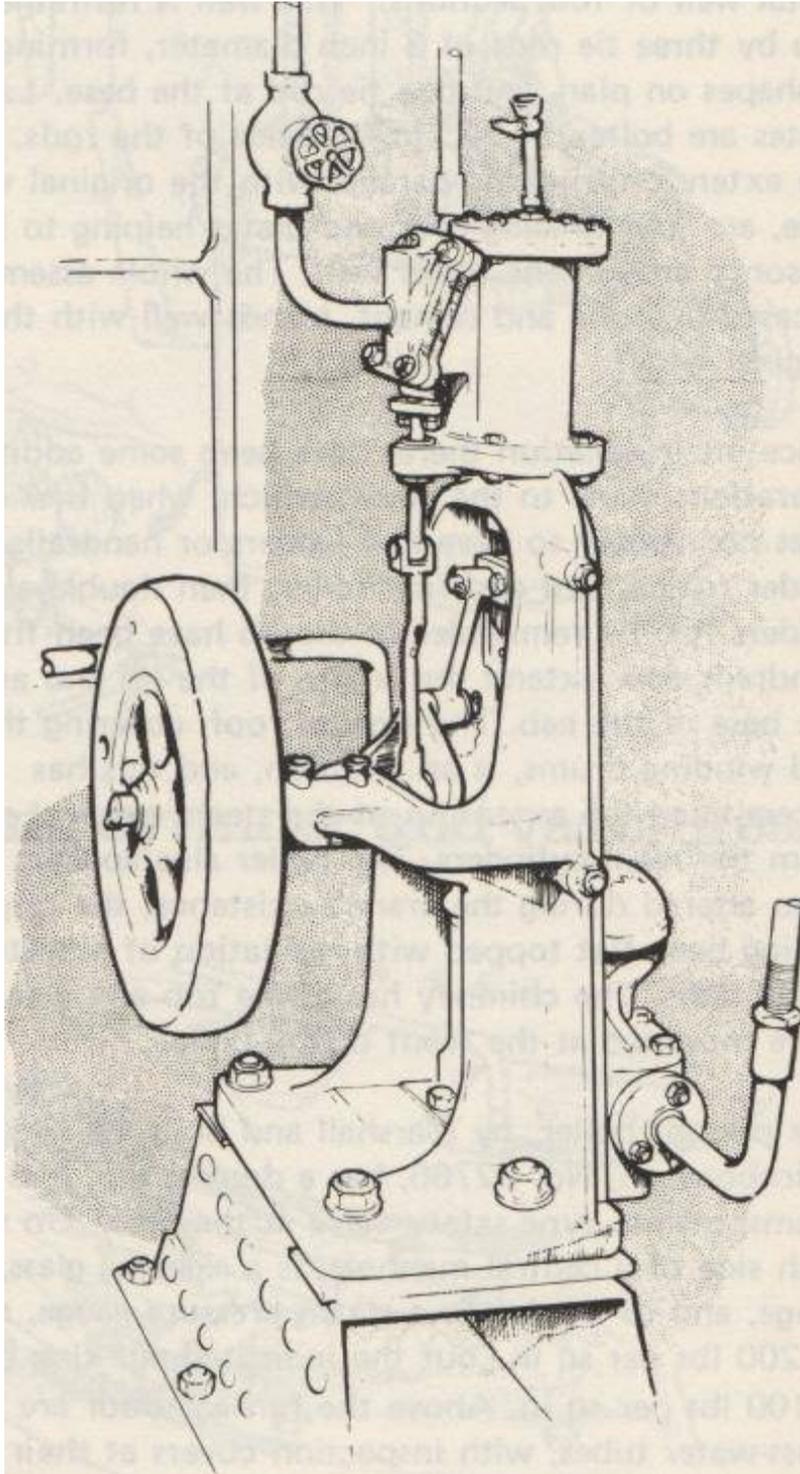
Plan



centre post in foundation well
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lifting drums and pinion



donkey engine and pump
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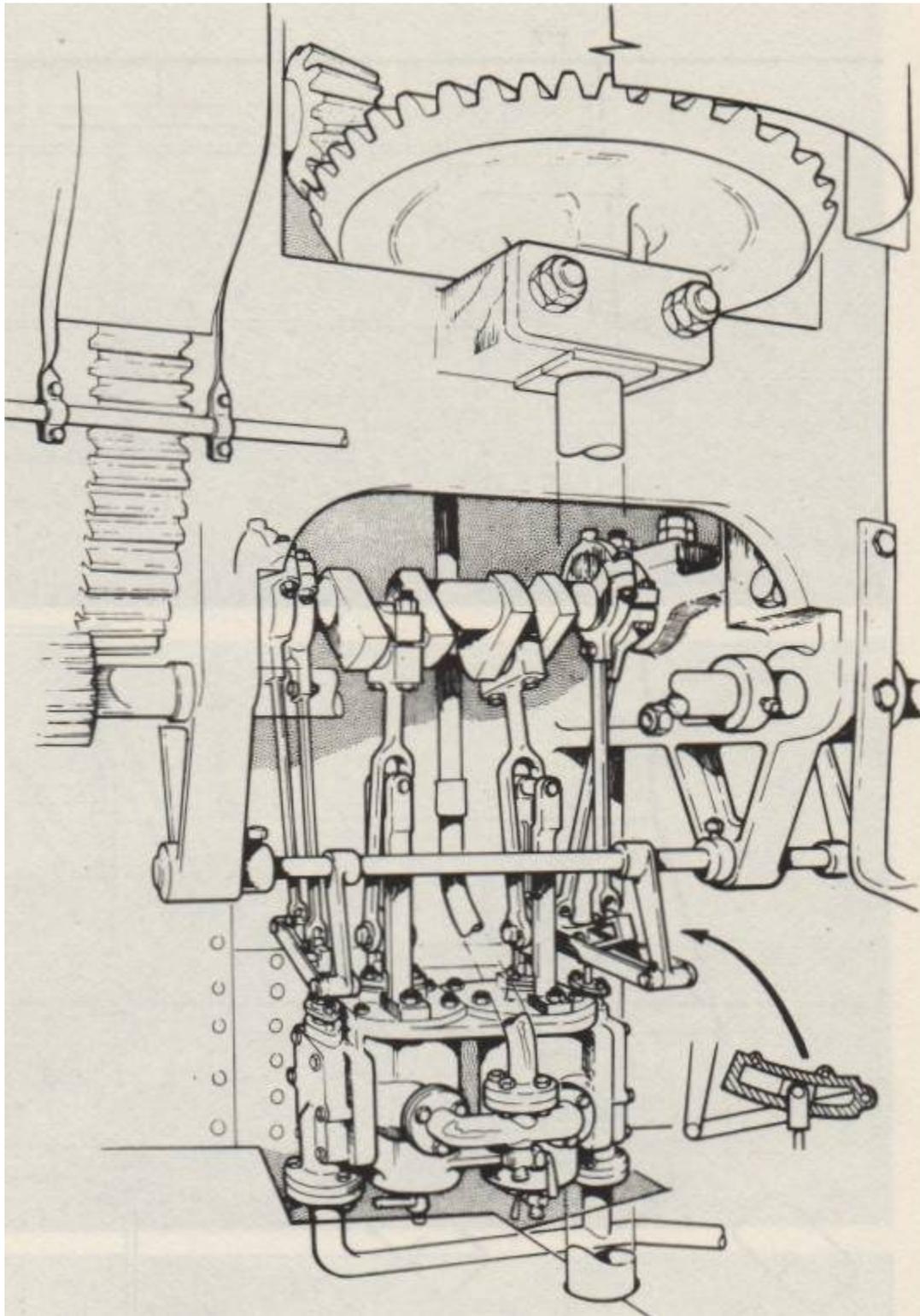
On behalf of the Technology Department of Bristol City Museum Paul Elkin writes on the present state and the future of the steam crane:-

Authority for maintaining the warehouses, and installations in the City Docks in Bristol has been transferred over a period of several years from one section of the Corporation, The Port of Bristol Authority, to the City Engineer and Planning Department. The steam crane had already been identified as of historic importance and it was therefore decided in 1974 that the crane should become part of the museum's technology collection. The museum has organised the restoration of the crane, and applied for a grant from the Science Museum's Grant-in-Aid Fund to offset the cost of acquiring and maintaining this important feature of the Docks.

A number of people, including several BIAS members, have already contacted me at the museum, and offered to help renovate the crane. However, in order to make best use of funds available for the project, it was decided in mid 1975 to employ a professional firm of restoration engineers to service the boiler and make the crane weather and vandal proof as quickly as possible before the end of this year. Staff from the City Engineers Department will also remove the old paint from the jib and apply two coats of micaceous iron oxide paint. Advice on painting the crane was provided by the firm of Leigh's Paints Ltd, who carry out similar work on modern harbour installations built by Stothert and Pitt

Dorothea Restoration Engineers Ltd began stripping the boiler in October 1975, and by the end of November most of the work of re-building the wrought iron cab will have been completed. The windows, which are one of the many attractive features of this otherwise very practical piece of machinery will be reglazed and detachable metal shutters are being fitted to prevent the windows being damaged when the crane is not in use. When this initial programme of restoration work is completed early in 1976, the crane will be structurally and mechanically sound and in working order. However, a good deal of work will still need to be done to improve the appearance of the machinery and it is hoped that this is where the main effort of volunteers can be concentrated into really bringing the crane into first class condition and keeping it that way. However, an important contribution has already been made by BIAS members; David Jones, of course, has produced an extremely useful set of detailed drawings of the crane and Tom Fisher of South Bristol Technical College has undertaken the rebuilding of the boiler feed pump. I would be pleased to hear from anyone who would like to work on the crane in the future and help on any occasion when the crane is to be steamed.

At the moment, no definite programme of "steam days" for the crane has been drawn up, but discussions are in progress with the newly formed company City Docks Ventures Ltd about ways in which the museum's steam crane and the electric cranes on Prince's Wharf which the company owns can be used for practical work such as lifting boats out of the Floating Harbour for repairs or restoration. One date has already been booked however; the steam crane will be working during the weekend of the the next Bristol Regatta on the 3rd and 4th of July 1976.



twin cylinders and turning gear

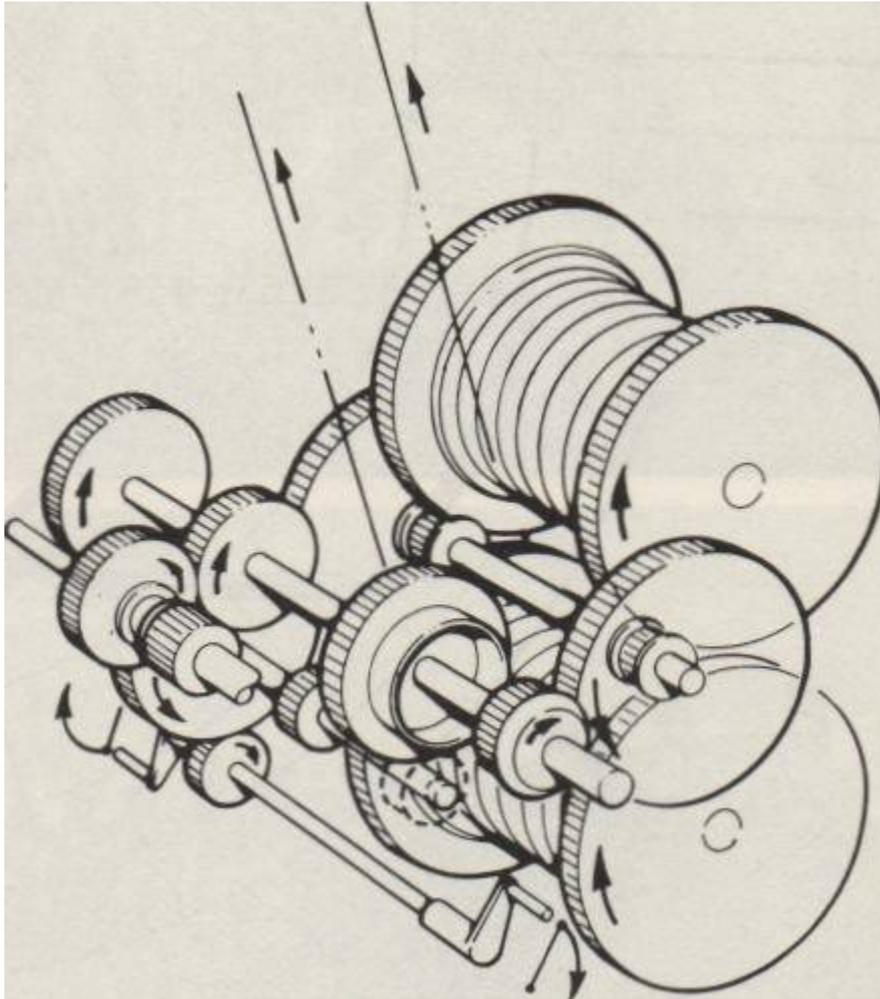
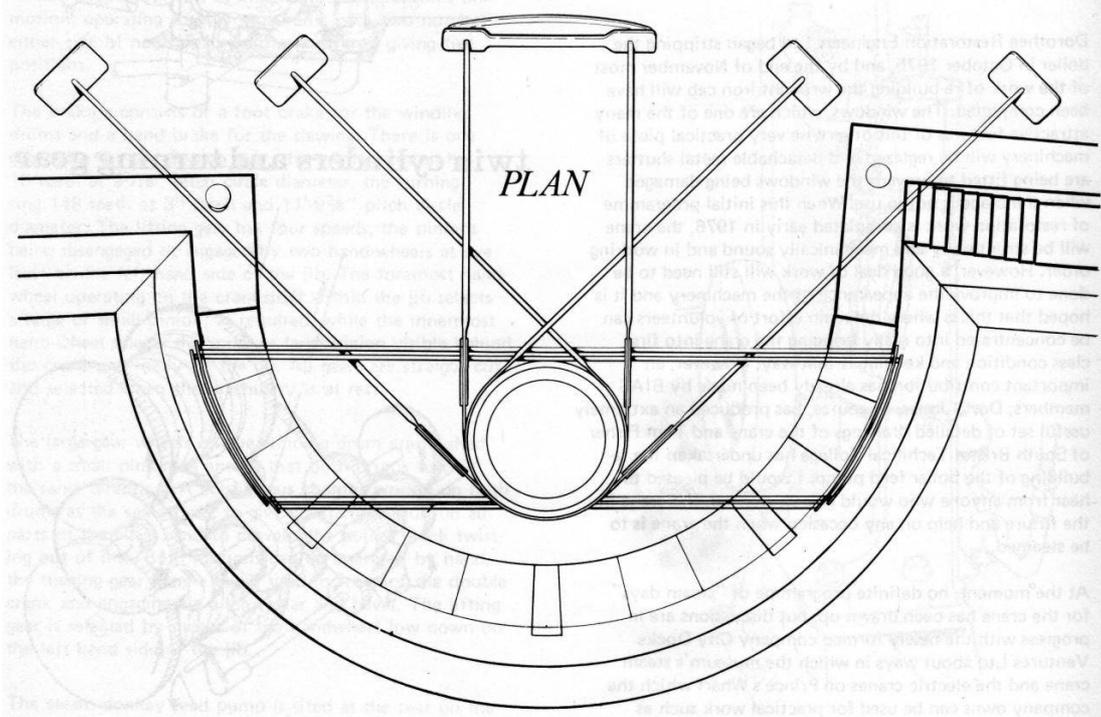
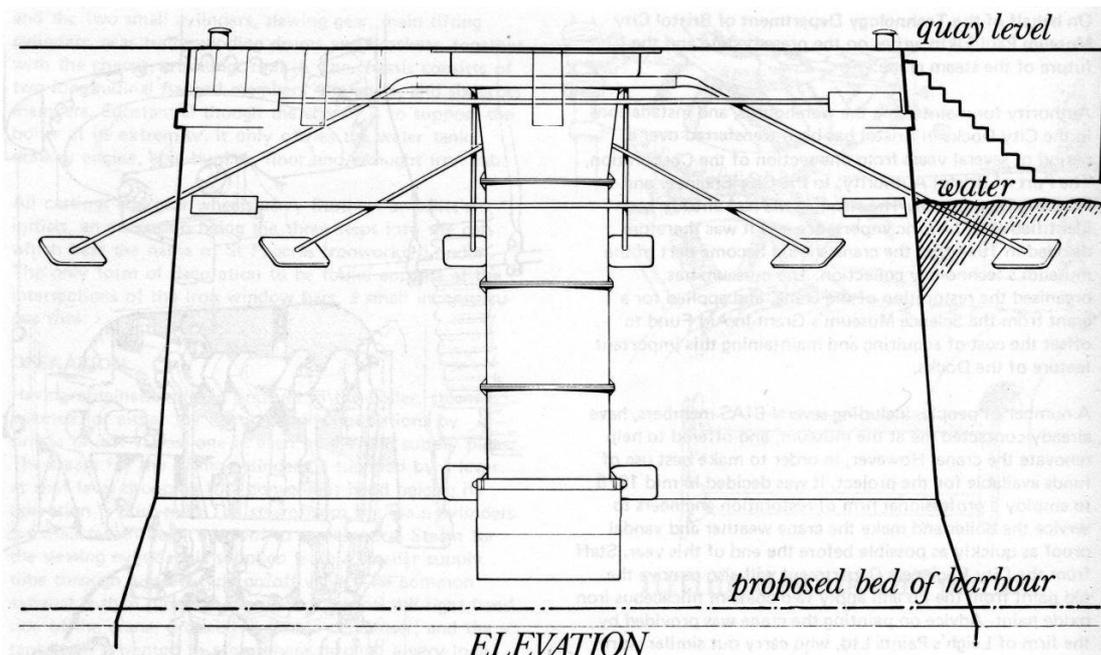
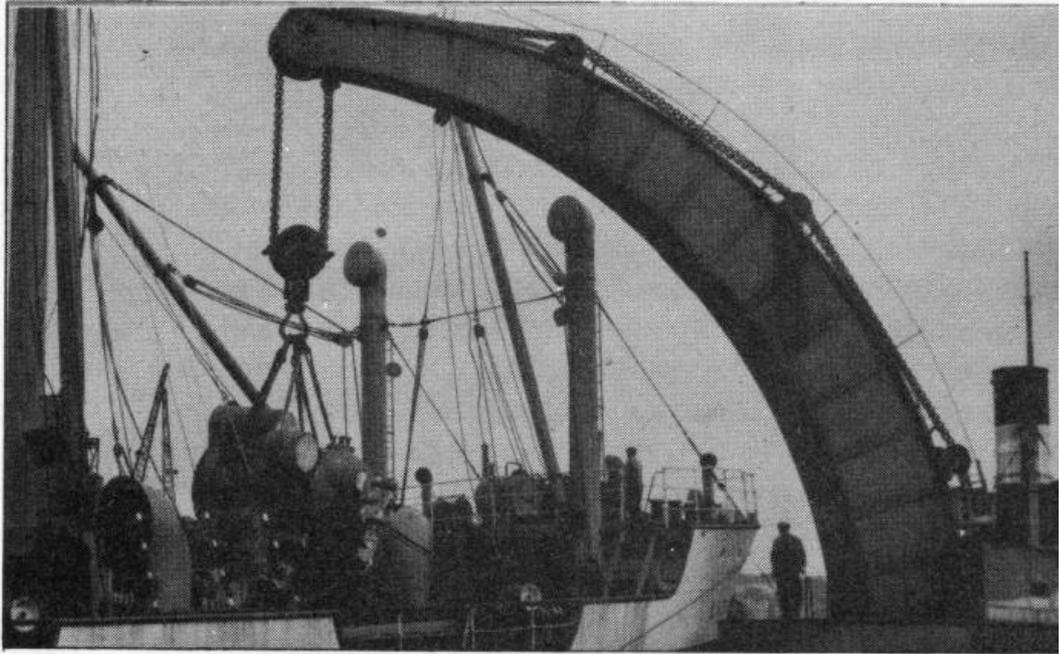
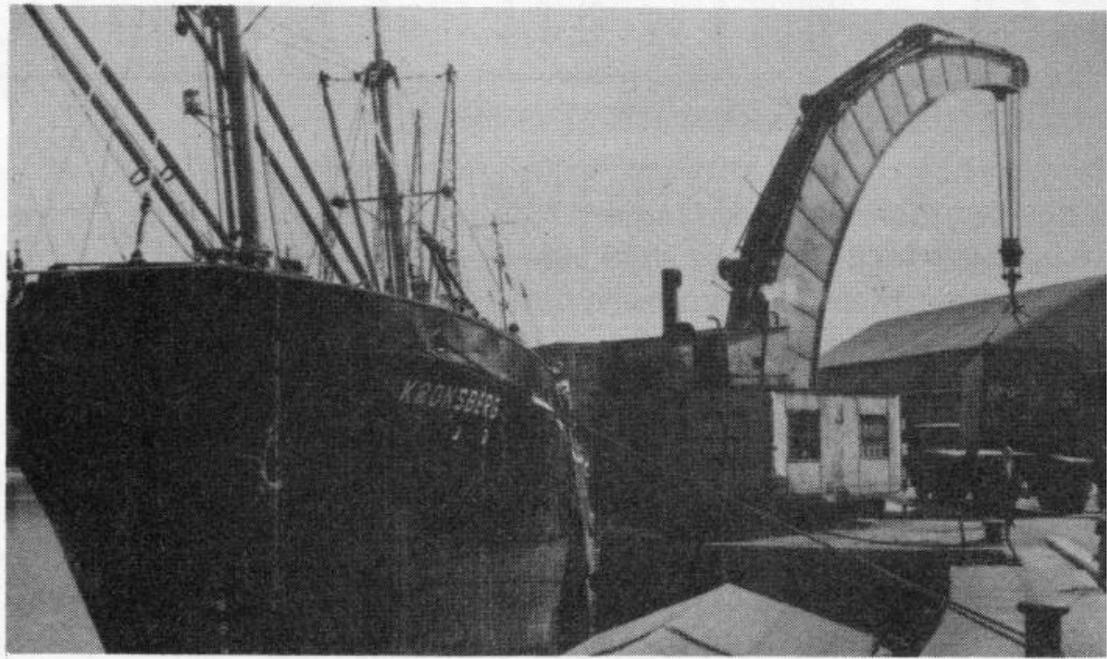


diagram of gear train
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Extension to Wapping Wharf, Bristol Docks
 Masonry foundations of crane. Based on Stothert and Pitt drawings of February 1876



Pictures from the PBA collection

The Stothert and Pitt steam crane working in Bristol City Docks May 1955, June 1970