The Nineteenth Century Substage Machinery – The Theatre Royal, Drury Lane

David Wilmore

Augustus Harris, who was lessee of the *Theatre Royal* in the 1890s, had a very clear strategy for attracting the theatre-going public. He decided to enhance the scenic capabilities of the theatre, replacing the traditional English Wood Stage, a system common throughout the British Isles, with a more modern and efficient installation which would enable him to present "Sensation Drama".

Sir Augustus Harris (1852-1896)[From: Tyneside, Christmas Number, 1894, p.12.]

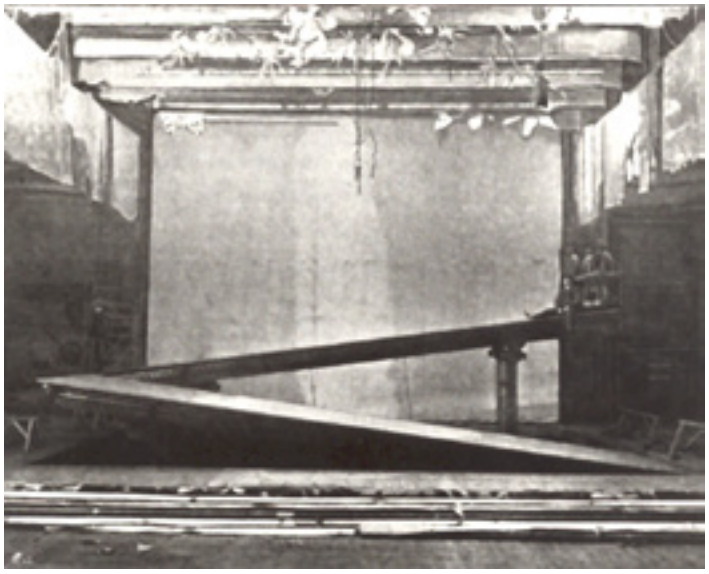
Edwin O. Sachs (1870-1919) [From: **theatre***search archive]*

The new *Theatre Royal* machinery was commissioned from Carl Dengg a Viennese manufacturer using the principles outlined by the Asphaleia Syndicate, a group formed after the terrible Vienna Ring Theatre Fire to make theatre-going much safer. It comprised two hydraulic platforms or bridges, each possessing two direct 18½ ins. x 21ft. 6ins. hydraulic rams, one at each end of the bridges. They were positioned 6" off centre to the right of centre stage and measured 39ft. 3ins x 7ft. 6ins. The direct rams were originally designed to allow the bridges to be raised 11 feet above the stage and lowered 8 feet below it, though these distances of travel were modified in later years for specific productions.

The Hydraulic Rams [From: The Stage Year Book 1910.]

The hydraulic power required to operate the machinery was supplied by the *London Hydraulic Power Company*. However, before the supply could be connected several modifications had to be made. The machinery had originally been designed to operate at a low hydraulic pressure, but the standard operating pressure in London was much higher, at 700lbs per square inch. It was therefore necessary to fit reducing valves to compensate for this pressure variation, and this work, along with the overall installation was carried out by Messrs. Archibald Smith and Stevens, a well established London firm of lift engineers.

It seems very strange that Harris should have decided to import machinery from Austria, when comparable if not better equipment could have been supplied in Britain. *Clark and*

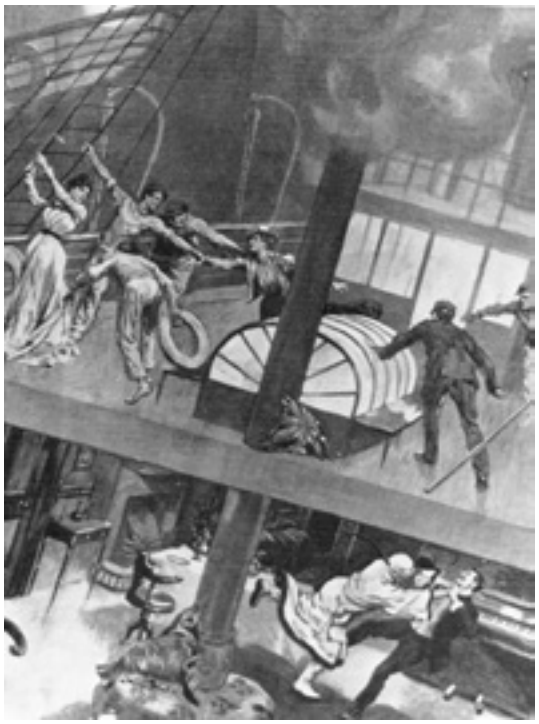


Tilting Hydraulic Bridges – The White Heather fit-up [From: Engineering, June 17th, 1898, p.754.]

Bunnett, a London firm of stage engineers, had in fact installed sophisticated hydraulic equipment into the *Lyric Theatre*, Shaftesbury Avenue in 1888. This belief was aired at the time by the *Engineering* correspondent who commented: "There is no doubt that if English engineers were to undertake similar work they would be able to make something lighter and more suitable for the purpose."[1]

The Viennese hydraulic machinery did, however, have several advantages over the bridges of the English wood stage, one of which Sachs identified in his remark that, "these appliances [the bridges] were primarily intended to facilitate the presentation of a large shipwreck scene,"[2] a feature attributable to their ability to tilt from one end to the other. This motion was effected by independently controlling the hydraulic rams at either end of the bridge, and by the inclusion of a pivoting joint between the top of the ram and the bridge table top. The process is illustrated by two photographs which were taken during the 'fit-up' for a production of *The White Heather*.

Sachs, writing his serialisation for *Engineering* on 'Modern Theatre Stages'[3] noted that the bridges "had been adapted for the so-called 'see-saw' movement under the direction of Mr. Brown, who is in charge of this appliance at Drury Lane". This comment, which was omitted from *Modern Opera Houses and Theatres,* suggests that the machinery may not have had a tilting mechanism when it was originally manufactured in Vienna. *The Price of Peace* was produced by Arthur Collins in 1900, and here we can see how he utilised the tilting action to simulate the rocking ship in very stormy seas!



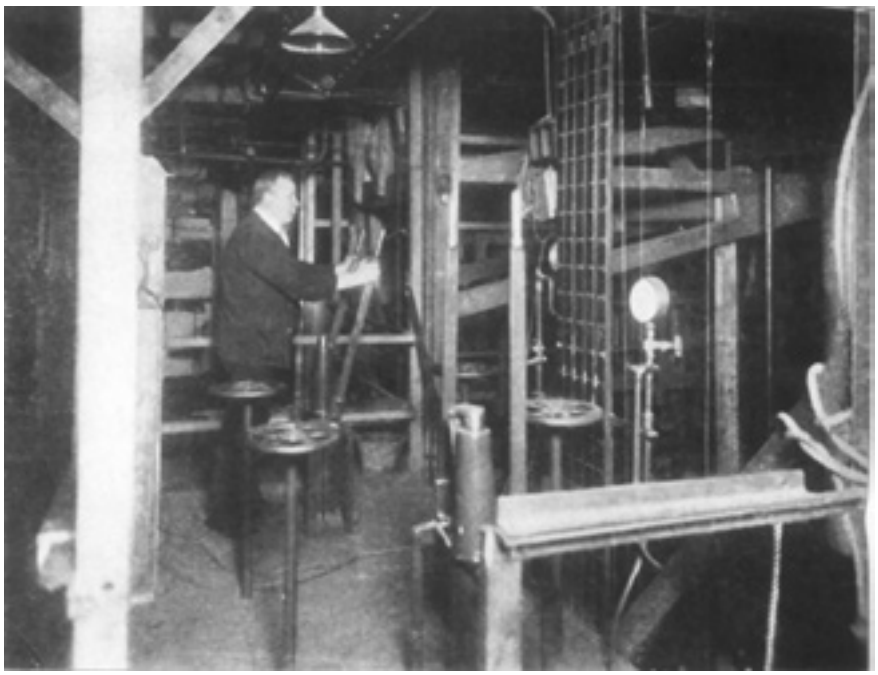
The Price of Peace, Theatre Royal, Drury Lane, 1900. [From: The Graphic, September 29th, 1900, p.472]

The hydraulic bridges were at all times controlled from a platform located on the stage left side of the mezzanine floor. This was a departure from the location advocated by the Asphaleia Syndicate, for they recommended that all the machinery should be controlled by

1 *Anon., "Hydraulic 'Bridges' at Drury Lane", Engineering, 17th June, (1898), p.754.*

2 *Sachs, Edwin O., Modern Opera Houses & Theatres, vol.III, supplement 1, p.77.*

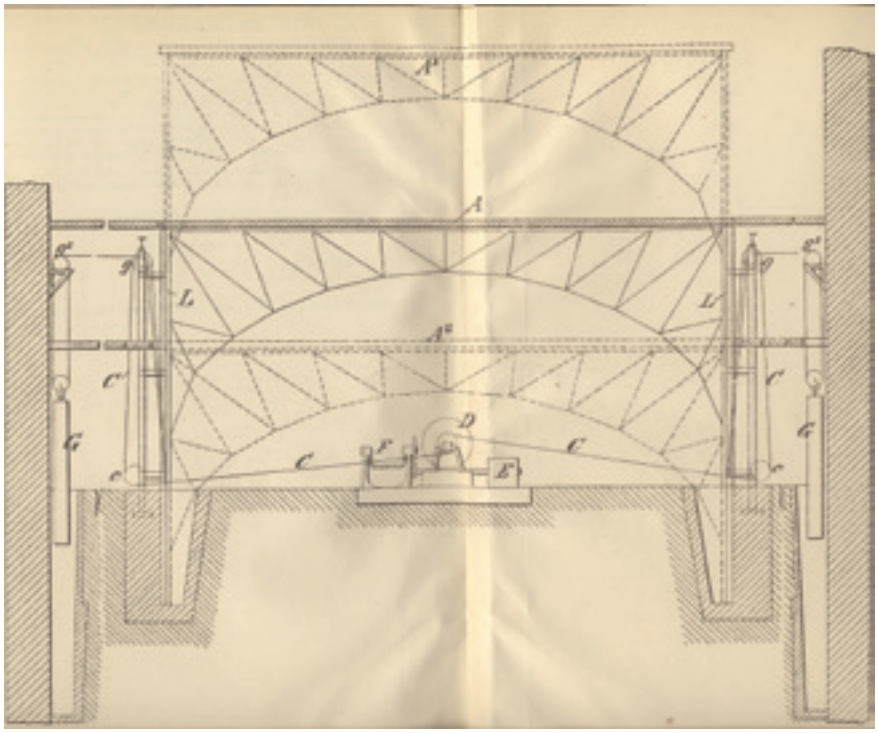
3 *Sachs, Edwin O., "Modern Theatre Stages Number XXIX", Engineering, 9th April, (1897), p.464.*



Control Gear, Stage Left Mezzanine Floor [From: The Stage Year Book, 1910.]

the stage manager at stage level, a principle known as 'centralisation'. This has one great disadvantage – the operator cannot see the machinery when it is moving in the substage, at a time when it is potentially at its most dangerous, since actors could become trapped between the structural framework and the bridge platforms.

The stagehand in charge of operating the bridge was assisted by an indicator which showed the exact position of each end of the hydraulic table. The handles which operated the control valves regulating the amount of water admitted into the hydraulic rams can be seen in operation on the photograph above. It is also interesting to note that when these photographs were taken in 1910 there still appears to have been a wooden bridge in the background on the downstage side of the hydraulic bridges.



*Edwin O. Sachs' Stage Machinery Patent No.27,000 of 1898 [From:***theatre***search archive]*

When Edwin Sachs published his treatise, *Modern Opera Houses and Theatres*, between 1896 and 1899, he became the undisputed authority on stage mechanics in Great Britain. It was therefore only natural that Arthur Collins (Harris' successor) should approach him to design some additional machinery in order to supplement the two hydraulic bridges. This new equipment was based upon Sachs' own patent, entitled *An Improvement in Stage Floors.*

The complete specification reads as follows:

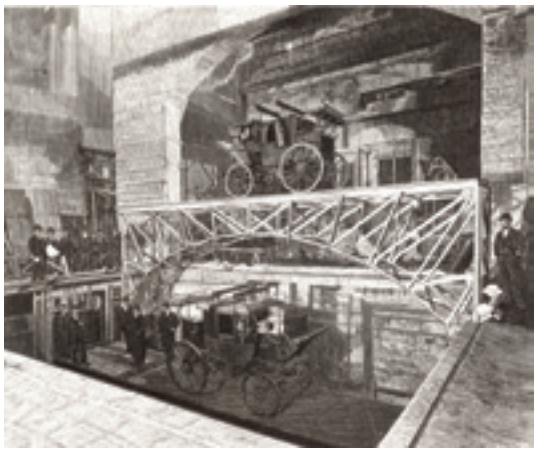
> "My invention relates to the construction of a stage floor in compartments which can be raised above or sunk below the general level, as I shall describe referring to the drawing accompanying my Provisional Specification, which is a section of a compartment of a stage floor according to my invention.
>
> The floor A is supported by a trussed arch terminating at each side in vertical legs L which run in guides, and have wire ropes attached to their lower ends. Some of the ropes run over guide pulleys gg[1] and carry counterbalance weights G. Others of the ropes C pass over pulleys g and under pulleys c to the barrel of a winch D which can be worked by an electric motor E or by hand gear F. Pits are provided for the legs L and the counterweights G.
>
> As shewn [sic] in the drawing the floor compartment can be raised above the general stage level as indicated at A or lowered as indicated at A[2]. The floor compartments are secured in any position into which they are moved by means of any suitable locking gear such as draw bolts and the motion of the compartments may be controlled by the safety brake mechanism of any known kind."[4]

Although Sachs produced a practical patent for a stage mechanism powered by electricity, there were those who thought it

4 Sachs, Edwin O., An Improvement in Stage Floors, UK Patent No.27,000, (London: HMSO, 1898).

would not work. “It was declared”, he said, “that electricity was a force that could not be made adaptable to the slow raising of the stage required during certain scenes, say, in the so-called ‘transformations’, and that, were electricity employed, the stage would shoot up suddenly and so on.”[5] Nevertheless in the early months of 1898 Collins commissioned Sachs to construct initially two bridges, as laid down in his patent, with the option of another two at a later date.

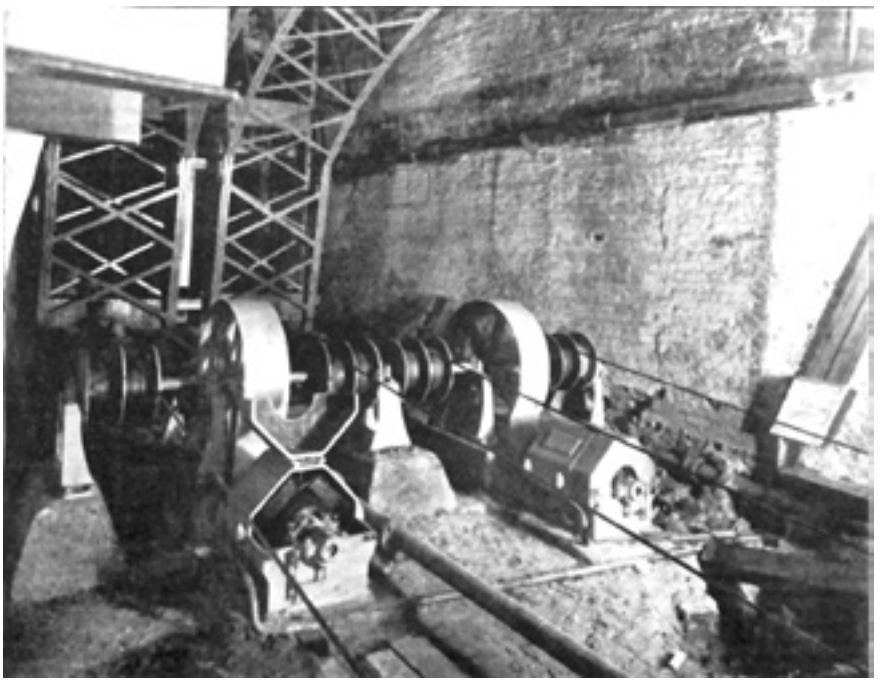
Sachs’s scheme to improve the *Theatre Royal* stage involved dividing it into six moveable sections. The hydraulic lifts were retained as sections III and IV, sections I and II were to be constructed according to the patent at a later date, and the work was to begin by installing two electric bridges in sections V and VI on the upstage side of the hydraulic lifts. The whole reconstruction scheme was carefully scheduled by Collins and Sachs to ensure that the theatre did not have to close its doors to the public. During the installation period performances of *The Great Ruby* were given nightly at the *Theatre Royal*, while a shift system was operated by the workmen 24 hours a day. Indeed, on occasions the four-in-hand coaches [see illustration] and cavalry in the production had to pass over a stage which was only supported by temporary trestles!



Carriages for “The Great Ruby” after installation of the Electric Bridges [From: Scientific American, 7th October, 1899, p.232.]

The steelwork of each of the two sections weighed a little in excess of 4.75 tons and the joists and staging which were mounted on the top provided an additional 1.5 tons, giving an overall total weight of 6.25 tons. The bridges were of course counterweighted up to a maximum of 4.5 tons. They were originally designed to travel 8ft. 6ins. below the stage and 10ft. 6ins. above, but subsequent modifications reduced these figures. The smooth travel of the platforms was assisted by the long legs which slid in right angle guides. To accommodate the legs of the bridge when it was lowered into the substage, special pits were excavated as shown on the patent cross-section.

Each bridge was equipped with an electric-four-pole enclosed shunt-wood motor, which developed 7.5 HP at 520 revolutions per minute, although they were capable of working at a higher rate in emergencies. The actual speed of the motor was reduced by the ration of 104 to 1 by means of a large worm gear, the worm-wheel being geared to the shaft which carried the two requisite winding drums each capable of five revolutions per minute. Around the drums were wound steel ropes, which in turn passed over deflection pulleys to be attached to the legs at four individual points near each corner.



The Electric Motors in the Cellar [From: Engineering, December 23rd, 1898, p.835.]

Sachs died in 1919 at the early age of 49, leaving the installation of stage bridges I&II unfinished. It was not until C.B. Cochran produced Noel Coward’s *Cavalcade* at the Theatre Royal in 1931 that the missing sections were finally installed. The Directors minute books tell the story of the age old theatre argument – was the equipment a production cost or an infrastructure cost, and more importantly who would pay for it! Whilst retaining the basic principles of Sachs’s original designs the equipment was manufactured by the London Lift and Engineering Company Ltd.

5 *THL, op.cit., p.426.*

The final performance – the hydraulic bridges tilt for one last time!

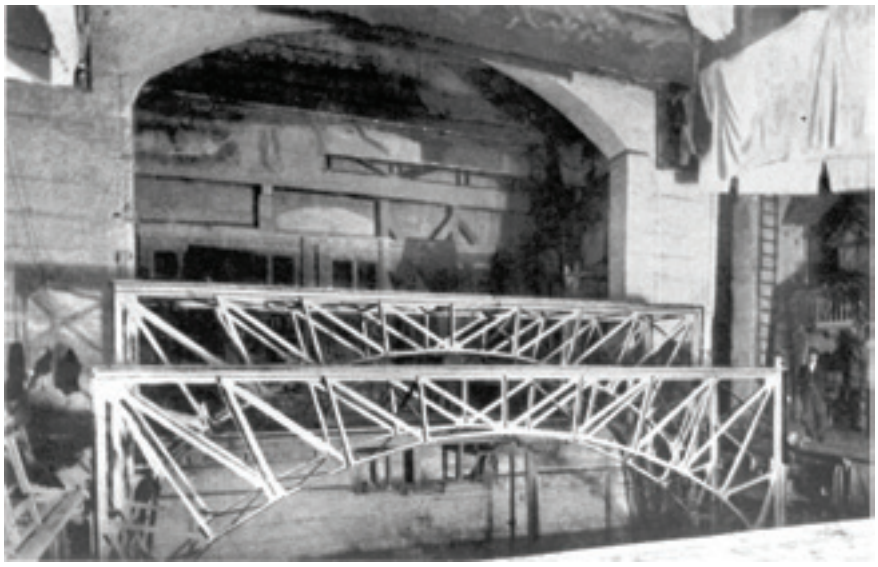
and not the Thames Ironworks with new and improved electric motors.

The substage installation as largely conceived by Sachs remained in situ until the closure of *42nd Street*. The theatre then closed for a £60M restoration which included the removal of the whole installation with the listed building consent proviso that one hydraulic and one electric bridge would be carefully dismantled and stored for possible future use elsewhere. Digital scans, meticulous photography and CGIs were all commissioned to record the machinery in situ, and prior to decommissioning the hydraulic bridges were fired up for one final hurrah! This took place on a memorable day infront of an invited audience (which included Mr. Richard Sachs, Edwin's grandson) on the 26th January 2019.

Immediately after this event the careful dismantling process began, a collaborative task that involved Unusual Rigging, Dorothea Restorations and Theatresearch. The two retained bridges were carefully dismantled, craned out of the theatre and packed up into six forty-foot containers which are now in storage.

However the story is not over – it simply continues … we are now looking for a new home for the machinery, and if you're interested don't hesitate to get in touch via office@**theatre***search*.co.uk

Further reading see: Edwin O. Sachs – Architect Stagehand Engineer and Fireman, available at: www.**theatre***search*.co.uk



The Electric Bridges Elevated Above Stage [from: **theatre***search archive]*