FUSSELL'S TRIAL BALANCE LOCK
A BOAT LIFT NEAR MELLS, SOMERSET

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Strung out along a secluded valley at the extreme eastern end of the Mendips in Somerset are a number of strange structures which appear to have served no purpose. At Edford there is a canal bridge in a field and in Coleford there is the "Huckyduck", a spectacular aqueduct, high above the village, apparently connected to nothing whatsoever. Not far from Frome is the remains of what appear to be a staircase of deep, strangely misshapen, lock chambers excavated into a hillside.

These are some of the surviving remains of the Nettlebridge branch of the Dorset and Somerset Canal, or "The Canal that Never Was", as Robin Atthill called it in his book "Old Mendip". [See *Fig. 1* for a map of the main line and *Fig. 2* for the branch line]

Started in 1796, the canal was never completed and many of its engineering features have been shrouded in mystery and were believed lost forever. With the formation of the Dorset and Somerset Canal Study Group in 1995, the scattered pieces of information have been gradually brought together and a clearer picture is emerging of how the canal was intended to have been built. This research has been made more difficult by the fact that the Company Records have disappeared without trace.

Of particular interest was the involvement of James Fussell (1748 - 1832), a shareholder in the canal and an ironmaster who had established an edge-tool works at Mells, near Frome, not far from the line of the canal. He had a number of patents to his name and one, No.2284 of 1798, [See *Fig. 3*] was worthy of special attention: it was for a *"Balance Lock for Raising and Lowering Boats, &c.; applicable to other Purposes"*.

Fussell's Balance Lock was a two-tank boat lift which pre-dated the better-known Anderton Boat Lift, in Cheshire, by seventy-five years and was amongst the first of that kind in the world. Fussell had taken out patents on several specialised chains of his own design and he hit upon the idea of using his newly invented sprocketed chain to synchronise the movement of the two ends of the long tanks of water. Without this invention to hold them level, the tanks would have been unstable and the water would have run to one end and capsised them.

The large masonry structure containing the tanks was divided into two chambers and let into a hillside where the canal changed level. The feature which appeared to be lock chambers at Barrow Hill near Buckland Dinham was in fact a flight of boat lifts based on Fussell's principle. It had evidently fallen victim to the canal's premature demise because it had never been completed. The remains of five pairs of lock chambers have survived to this day [See *Figs. 4 & 5*].

There was tantalisingly brief contemporary newspaper report [Bath Chronicle 16 Oct 1800] that an earlier "trial" balance lock had been built somewhere else on the canal to test out the principle — and that one had actually worked.

The search homed-in on a section of canal on the Mells Estate where a change of level occured inside a densely-wooded valley. This was the site which had earlier been identified by Robin Atthill as the most likely position for the trial lock; fortunately, he had shown the location to Gerald Quartley, who passed this information on to the authors.

A visit was arranged to the site in 2002 [See *Fig. 6*], but the only clue that anything might possibly lie beneath the surface was a couple of dressed stones which appeared to have been laid as a course of masonry. By 2004, with the landowner's permission, the area had been cleared [See *Fig. 7*] by work parties from the D&SC Group, Bradford on Avon Scouts and the Somersetshire Coal Canal Society (who have a particular interest in boat lifts of all types). Further work with a pickaxe [See *Fig. 8*] revealed that this indeed had been the site of a structure. One 8ft. wide masonry wall, with returns at each end, was uncovered. Evidence for another similar wall was also found about 8ft. 6in. to one side of it. The total size of the structure was not clear at this stage, but it gradually became apparent that a major work of excavation, beyond the capabilities of hand digging, would be needed to uncover it all.

With archæologists on hand, a large excavator was brought in to see what else might be found. In particular, the length and depth of the structure was unknown at this stage, so we could not be certain that what we had found was a boat lift. This doubt was soon dispelled as the massive extent of the structure was revealed [See *Fig. 9*]. The result was vastly beyond anyone's expectations - the excavation opened up a masonry chamber 30 ft. long, 8 ft. wide, with other evidence suggesting that the structure had probably been over 30 ft. high [See *Figs. 10a & 10b*]. An archway at 'basement' level appeared to lead to a second parallel chamber, filled with rubble, making the entire structure 24 ft. wide.

At this stage it was decided to analyse the results and sort through the evidence which had been found, before contemplating

further excavation. The excavation of the second chamber was undertaken the following year and revealed a similar structure [See *Fig. 11*] and an even greater quantity of artefacts [See *Figs. 12, 13 & 14*]. Since then, a further smaller investigation has discovered and unblocked the drainage system in one chamber, which supports the theory that the chambers were intended to be operated dry, so that the tanks did not float. During this investigation, a casting was discovered which appears to be a link of chain [See *Fig. 15*] and which connects accurately with the wrought-iron link shown in *Fig. 14*. Fussell's chain patent [*Fig. 16*] shows a chain made up of alternate cast and wrought iron links almost identical to the ones we discovered in the excavations and a photographic reconstruction [*Fig. 17*] gives an impression of what this chain would have looked like.

With what we already knew from Fussell's patent description and the discoveries we had just made, we were now in a good position to describe the operation of the mechanism which occupied the two chambers. [See *Figs. 18 & 19*]

CONSTRUCTION

The Balance Lock comprised two tanks full of water, each long enough to contain a boat. At the place where the canal stepped from one level to another, they were arranged in a pit, side-by-side with one end towards the upper canal and one end towards the lower. Running the whole length of the space between the tanks was a wall, on top of which were iron wheels. These were larger in diameter than the thickness of the wall so that chains draped over them hung down slightly clear of the wall on each side.

BALANCE

The tanks were suspended from the chains by a pulley arrangement and the lengths of the chains were such that when one tank was level with the bottom canal, the other was level with the top. The tank weights were adjusted to be equal, so that they were in balance and easy to move up and down with little effort. They could be moved with a hand crank geared to one of the wheels or by adding or removing a little water from one of the tanks.

MOVING THE BOATS

The ends of the tanks could be clamped against the ends of the top and bottom canals to make a water-tight seal. Doors or sliding panels were then removed to allow a boat to be floated from the canal into the tank. As the boat entered the tank a certain amount of water would have to flow out to make room for it - the weight of this water would be exactly the same as the weight of each boat with its cargo, so the balance of the tanks would not be upset. With the boats in the tanks, the doors or panels were replaced to seal the ends of the canals and the tanks. The tanks could then move up on one side and down on the other so as to deliver the boats to their new levels.

CONCLUSIONS

1) The Trial Balance Lock described in the Bath Chronicle was built at the site identified by Robin Atthill, half a mile from the main Barrow Hill flight.

2) The dimensions of the construction have been measured [*Figs. 10a & 10b*] and the maximum size of the boats estimated at 30ft long by 7ft wide.

3) The mechanical construction of the Lock was substantially as described in Fussell's patent 2284.

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"The Dorset & Somerset Canal" Kenneth R. Clew ISBN: 0 7153 5228 8

"Canal Inclines & Lifts" David Tew ISBN: 0-86299-344-X

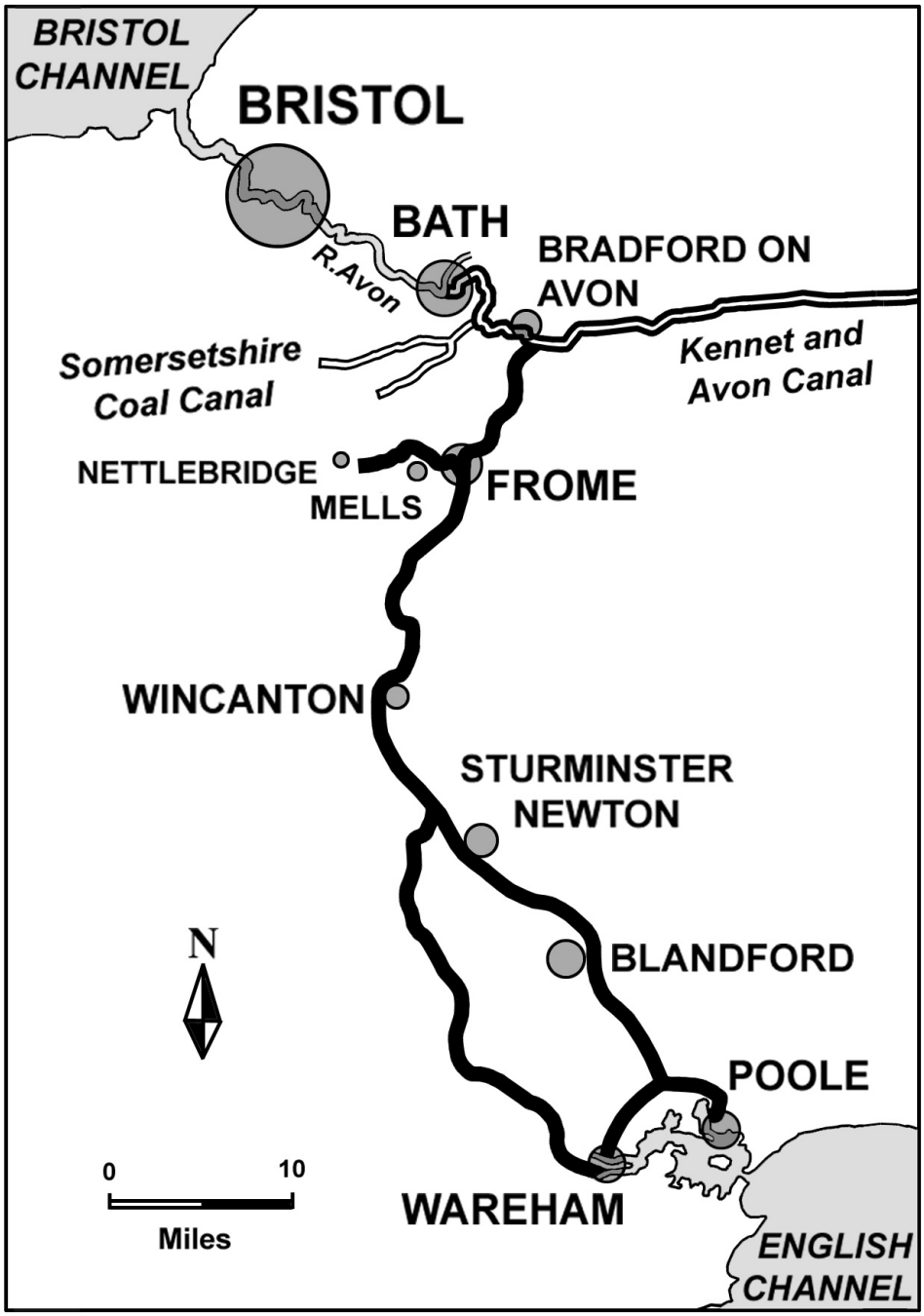


Fig 1 **- Dorset & Somerset Canal main line**

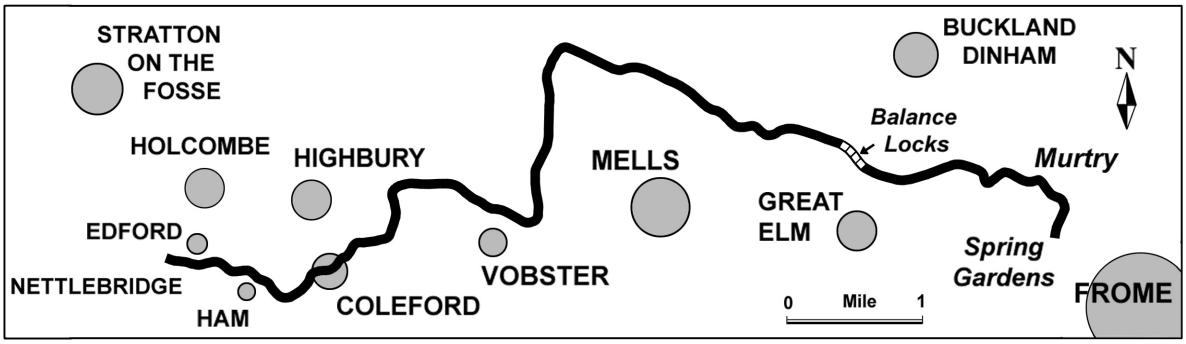


Fig 2 **- Dorset & Somerset Canal branch line**

A.D. 1798 . . . . . N° 2284.

Balance Lock for Raising or Lowering Boats, &c.; applicable to other Purposes.

FUSSELL'S SPECIFICATION.

TO ALL TO WHOM THESE PRESENTS SHALL COME, I, JAMES FUSSELL, of Wells, in the County of Somerset, Iron Manufactor, send greeting.

WHEREAS His present Majesty King George the Third, by His Letters Patent under the Great Seal of Great Britain, bearing date the Twenty-fourth day of December, One thousand seven hundred and ninety-eight, did give and grant unto me, the said James Fussell, my executors, administrators, and assigns, His Royal will and pleasure that I lawfully might make, use, and exercise and vend, during the term of years therein expressed, within that part of Great Britain called England, the Dominion of Wales, and Town of Berwick-upon-Tweed, my Invention of "A MACHINE OR BALANCE LOCK FOR RAISING BOATS FROM A LOWER LEVEL OF A CANAL TO AN UPPER, OR LOWERING THE SAME FROM AN UPPER TO A LOWER LEVEL OF A CANAL;" in which Letters Patent a proviso is contained that if I, the said James Fussell, should not particularly describe and ascertain the nature of my said Invention, and in what manner the same is to be performed, by an instrument in writing under my hand and seal, to be inrolled in His Majesty's High Court of Chancery within one calendar month next after the date of the said Letters Patent, then such Letters Patent were to be void, as in and by the same, reference being thereto had, will more fully appear.

NOW KNOW YE, that in compliance with the said proviso, I, the said James Fussell, do hereby declare that my said Invention is describeb in manner following that is to say:—

Fig 3 — **Fussell's Patent 2284 Title page**

***Fig 4* — The Staircase of Lock Chambers at Barrow Hill**

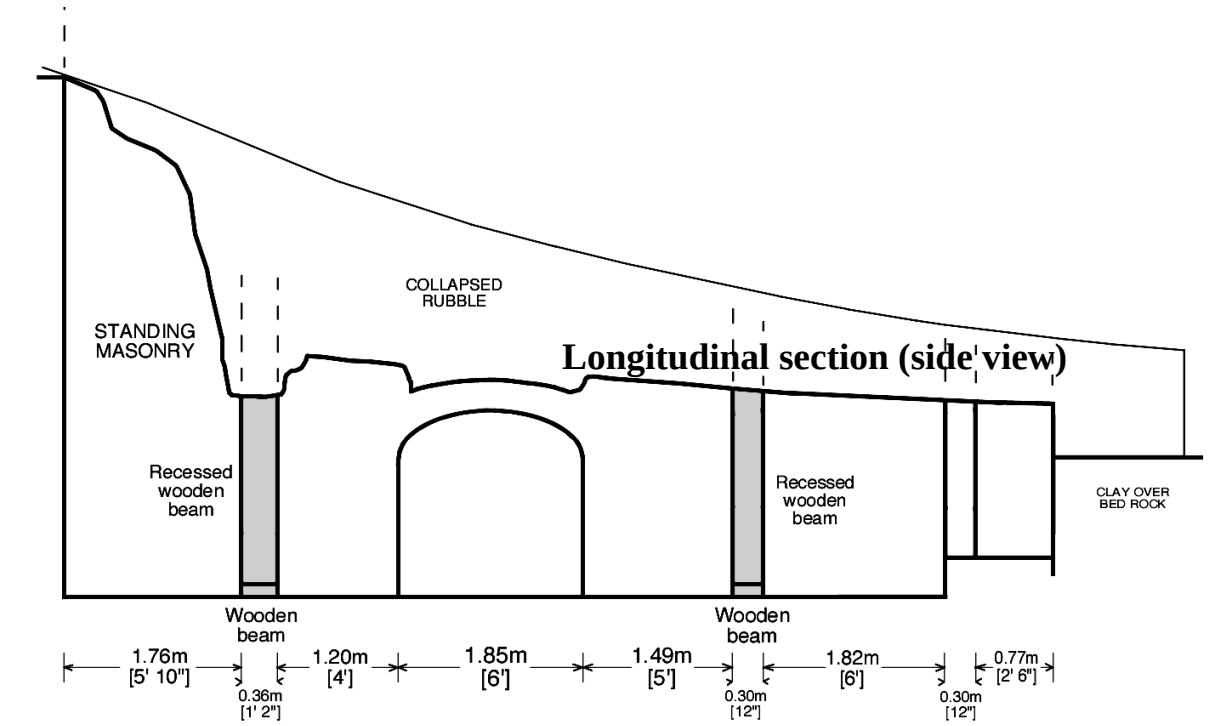
***Fig 5* — One of the Lock Chambers**

***Fig 6* — Investigation of the site**

***Fig 7* — Clearance of the site viewed from the upper level**

***Fig 8* — Uncovering the masonry of the chamber**

***Fig 9* — Uncovering the extent of the first chamber**



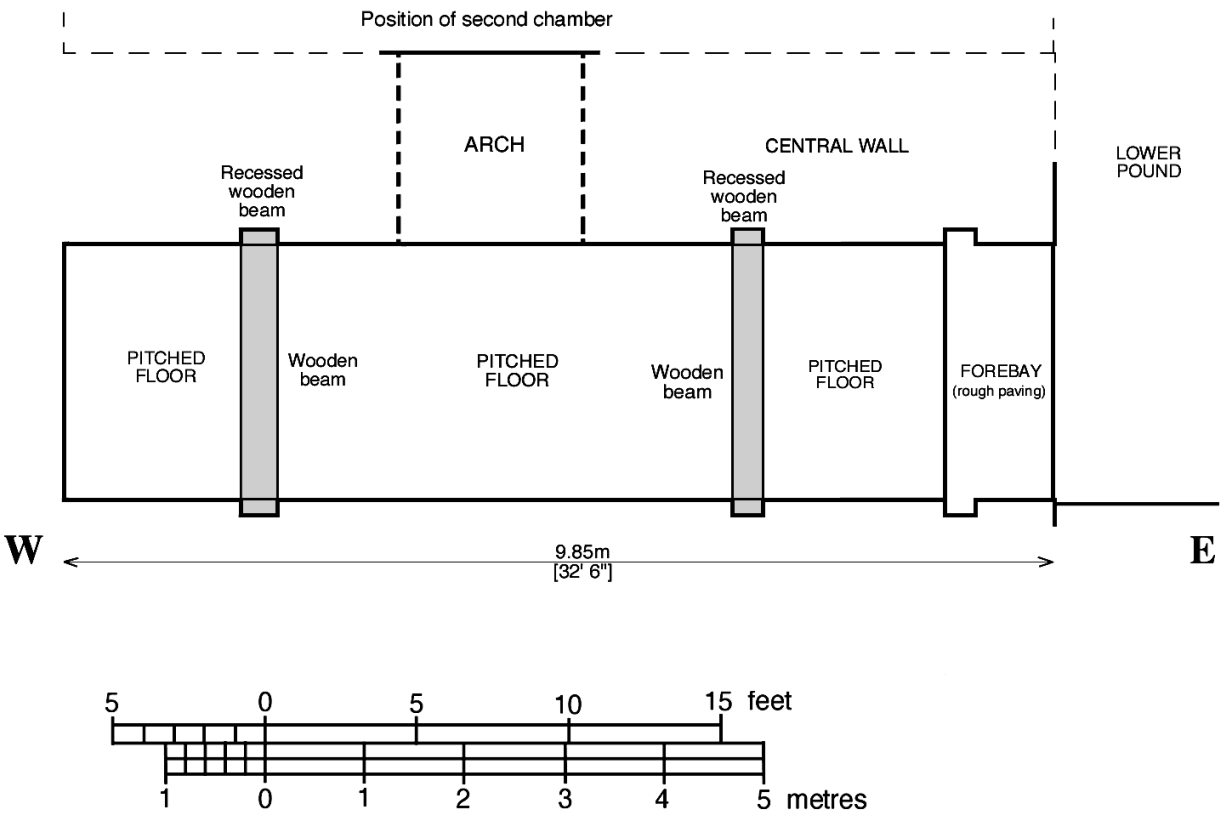


***Fig 10a* — Dimensions of the Balance Lock**

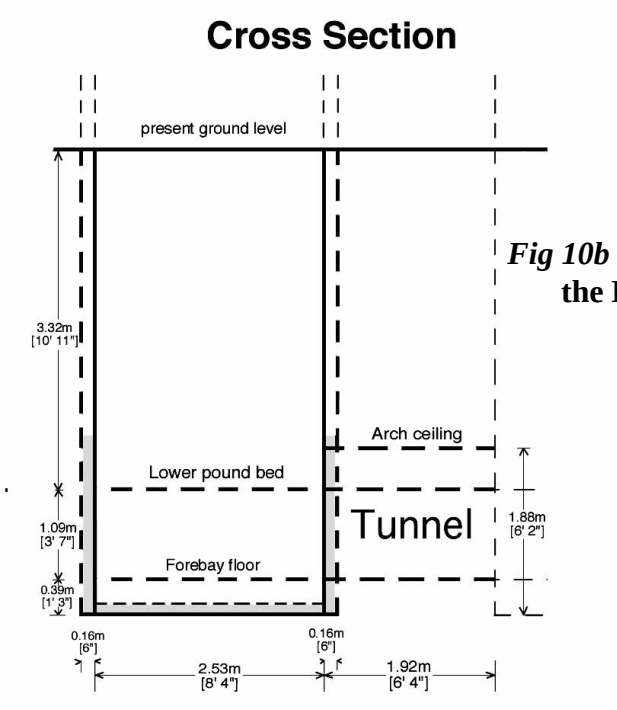


***Fig 10b* — Dimensions of the Balance Lock**

***Fig 11* — Both chambers excavated**

***Fig 12* — Larger artefacts**
Two curved cast iron segments, a bolt & nut,
unidentified casting (probably scrap used as a weight).

***Fig 13* — Some of the smaller artefacts**
A leather seal, a caulking iron, nails, hook.

***Fig 14* — Some further artefacts**
A brass bearing block, a wrought iron chain link

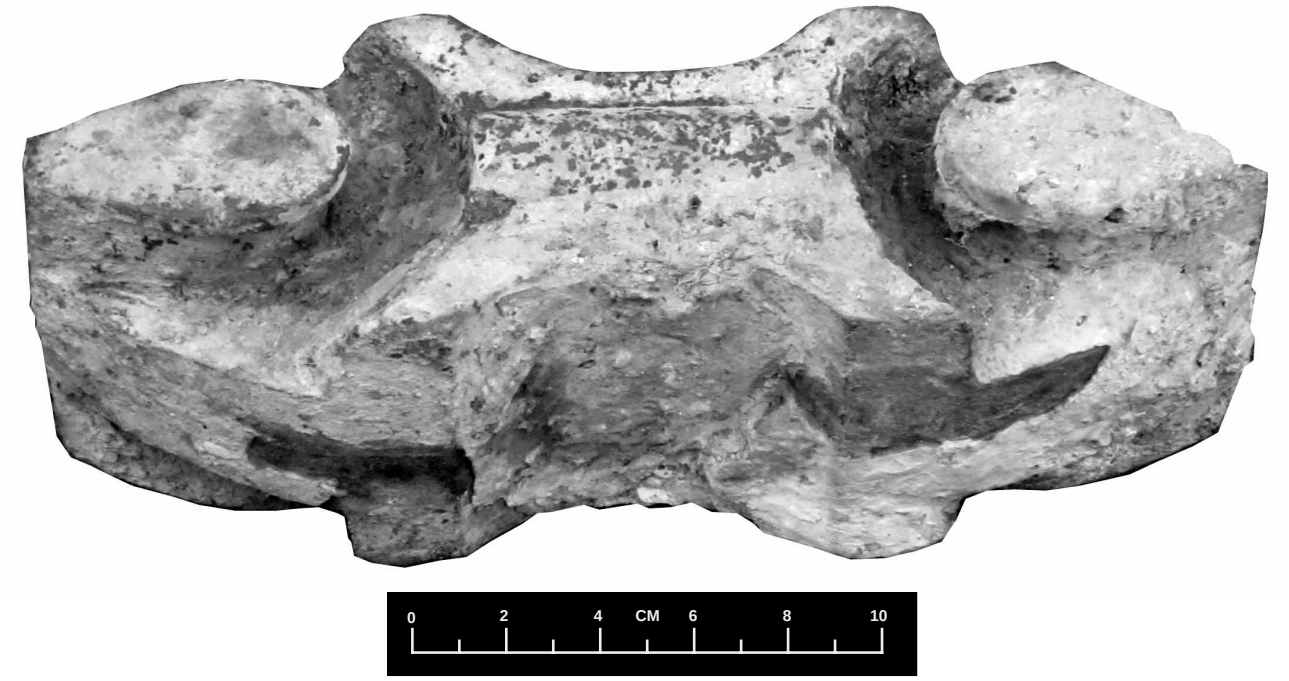


***Fig 15* — A cast iron chain link**

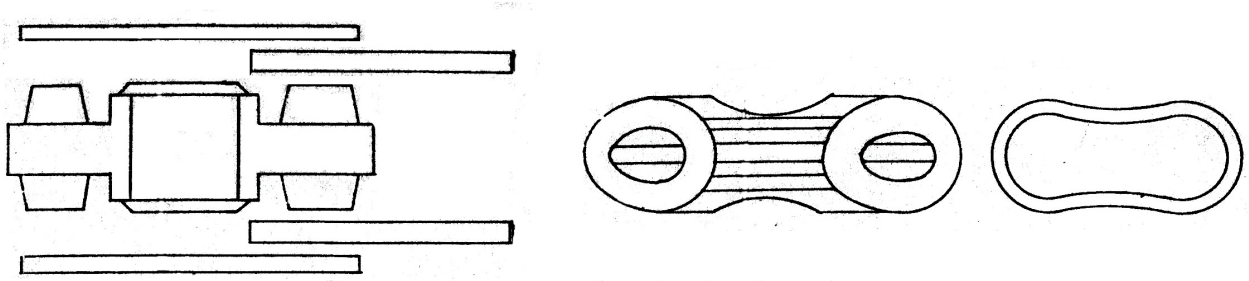


***Fig 16* — Fussell's patent drawing of a chain**

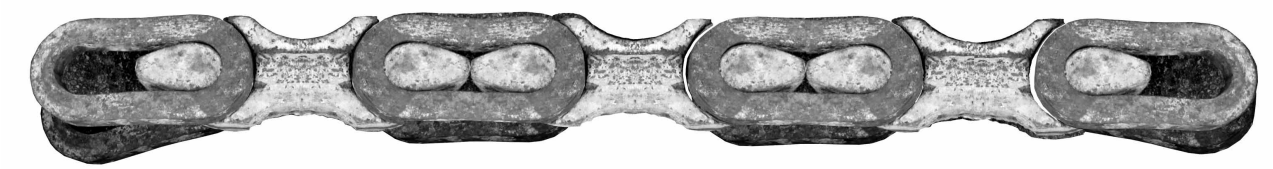


***Fig 17* — Photographic reconstruction of a length of Fussell's chain**

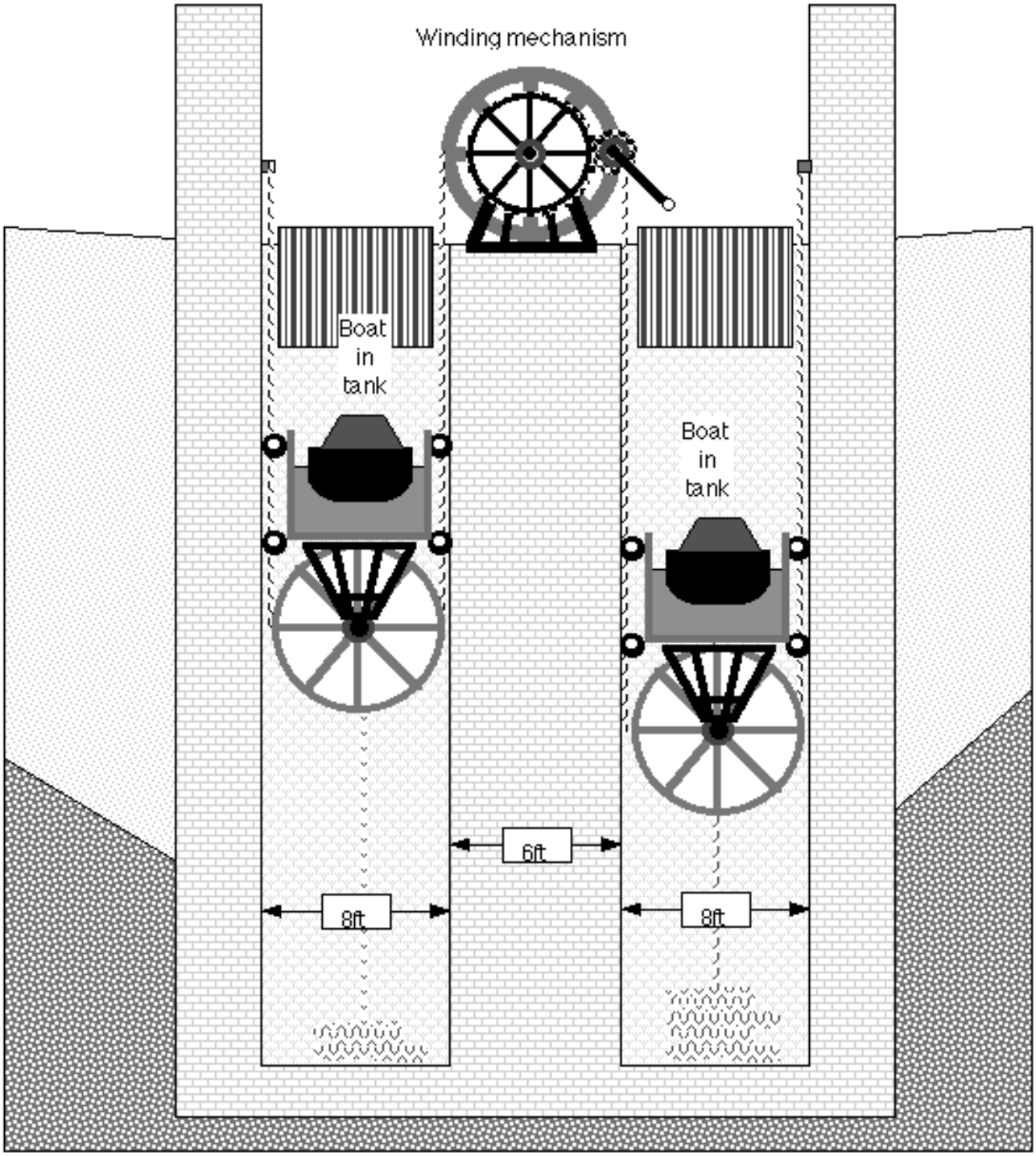


Fig 18 — Fussell's Balance Lock, transverse section

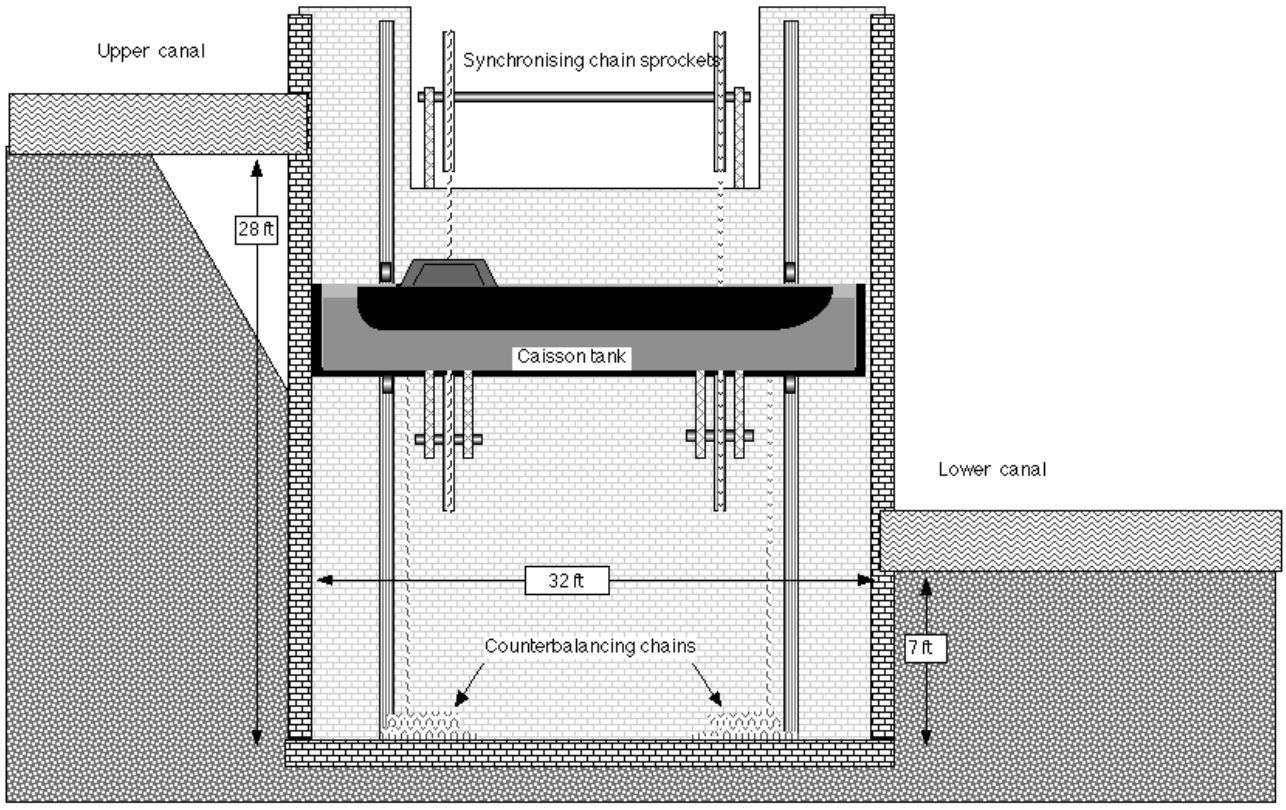


Fig 19 — Fussell's Balance Lock, longitudinal section