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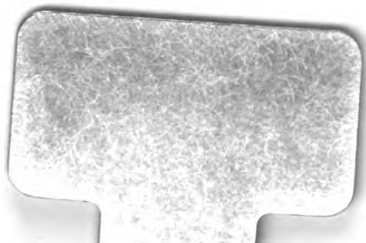
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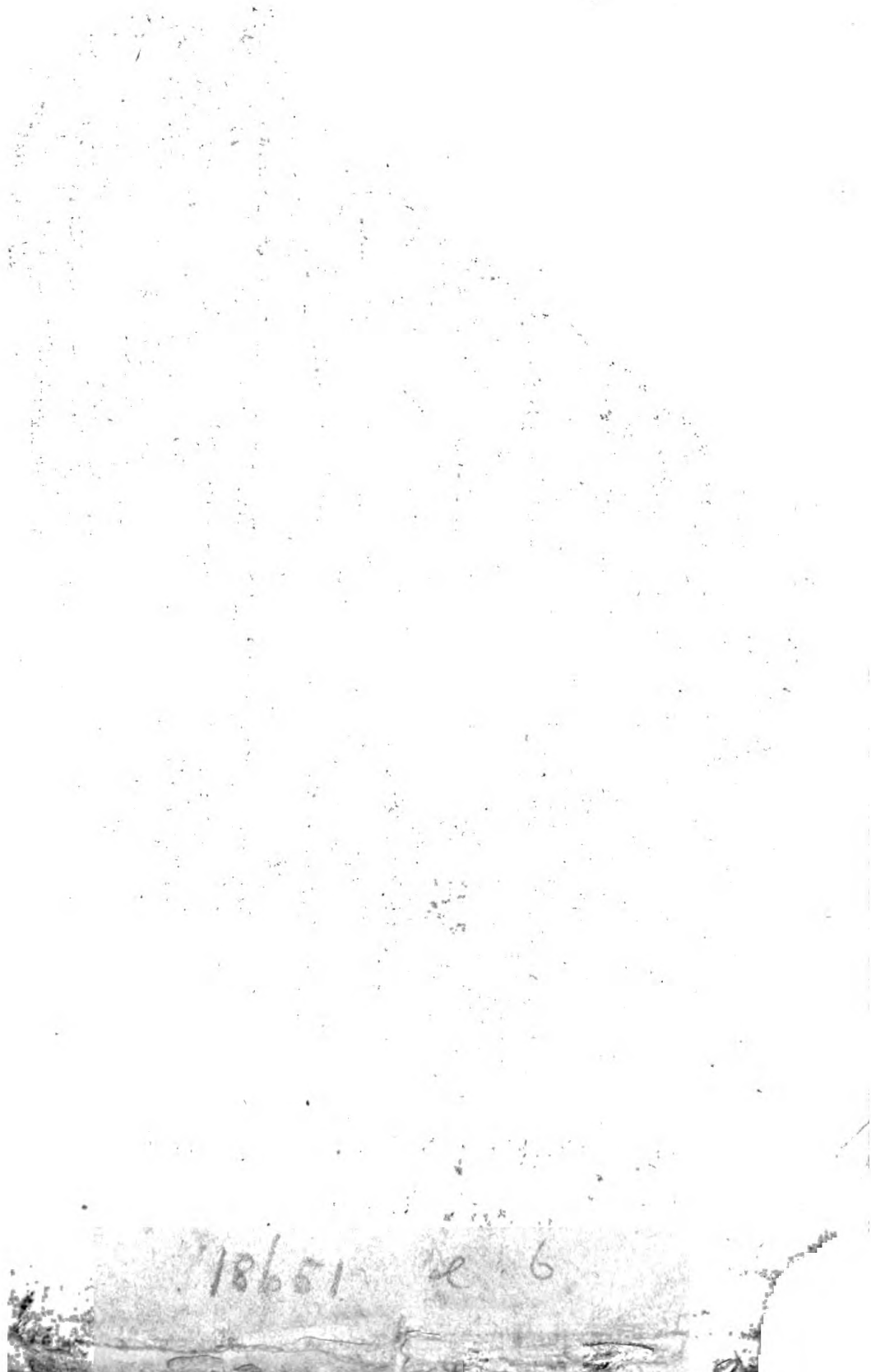
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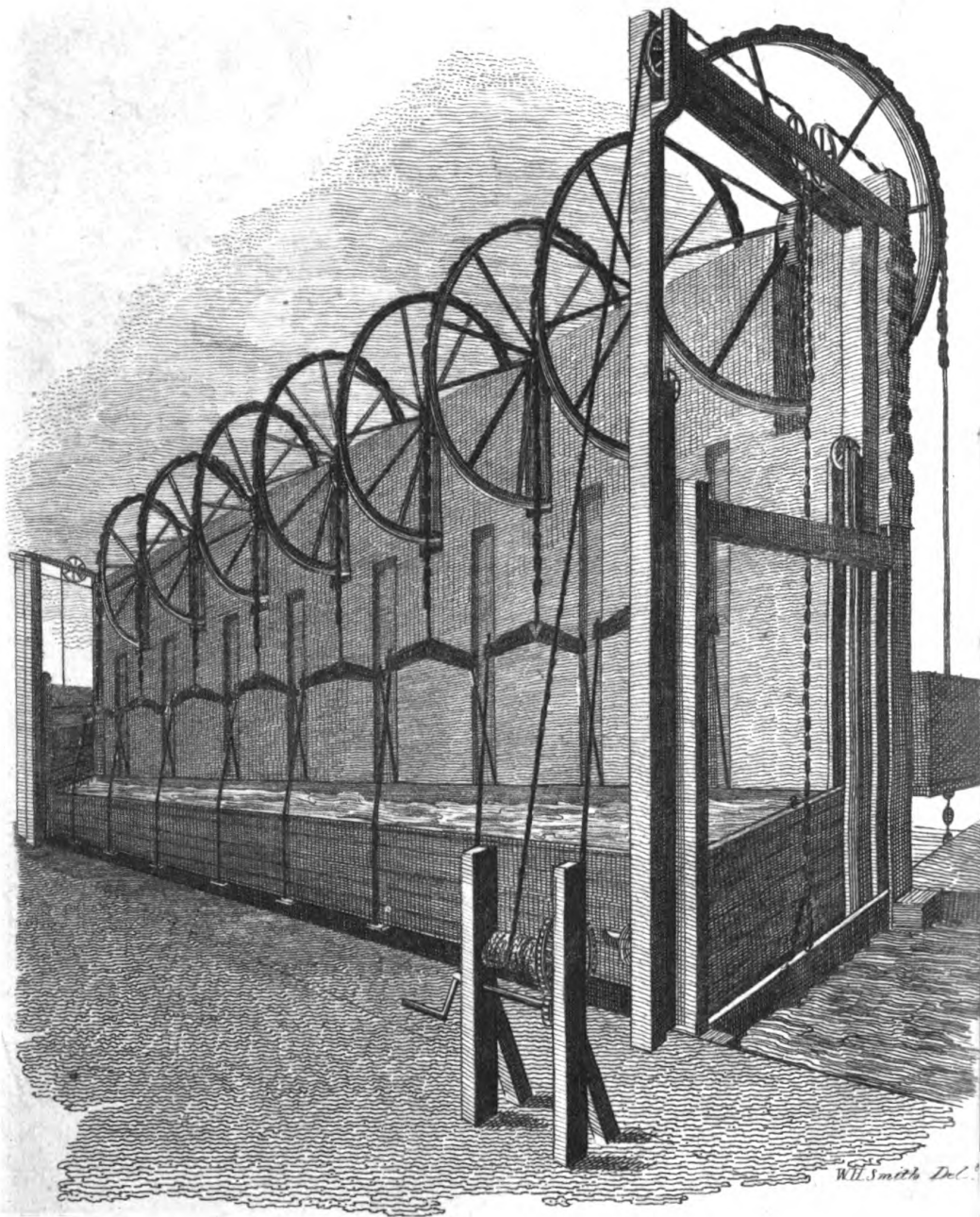








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THE PERPENDICULAR LIFT  
from the lower level.

*Third Edition,*

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A  
DESCRIPTION  
OF THE  
*PATENT PERPENDICULAR*  
**LIFT,**  
ERECTED ON THE  
*Worcester and Birmingham Canal,*  
AT  
**TARDEBIG, NEAR BROMSGROVE.**

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IN A LETTER TO A FRIEND,  
BY EDWARD SMITH,  
*Notary Public, Canal Agent, &c.*

—  
THIRD EDITION,  
WITH A POSTSCRIPT, AND AN ACCOUNT OF THE  
TRIAL OF THE LIFT.

—  
*Illustrated by Engravings, from Drawings taken on the Spot*  
BY W. HAWKES SMITH.

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## ADVERTISEMENT

TO THE

*THIRD EDITION.*

THE recent discussions on the subject of the **PERPENDICULAR LIFT**, and the consequent increased demand for the "Description," have called for a re-publication of the following Letter.—In preparing for the Press, due attention has been paid in the Postscript, to the late Improvements and present state of the Machine.



A DESCRIPTION  
OF THE  
PERPENDICULAR LIFT, &c.

— — — — —  
*To W—. B—. Esq. Salop.*  
— — — — —

*DEAR SIR,*

**AS** you are very desirous of obtaining some information respecting the **PERPENDICULAR LIFT**, which has lately been erected on the **Worcester and Birmingham Canal**, at **Tardebig**, and having had, besides, frequent inquiries from other correspondents, I determined, before I answered your queries, to go to the spot, and examine for myself, a **MACHINE**, which has attracted the attention of the public, and particularly of those who are interested in the prosperity of the Canal.

Accordingly, a few days since, a party of us set off on a very fine morning; and, to be on a certainty, we went to the residence of **MR. WOODHOUSE**, the Patentee and Engineer, at **Barns**

Green, and procured a note to his foreman to shew and explain to us the whole apparatus. By the time we arrived at Tardebig, we were much gratified by the arrival of MR. WOODHOUSE, who had followed us, and with great politeness attended us to the place, and gave us every information that we wished.

On entering the building (for every part is under cover) at the lower level of the Canal, the appearance of a number of large wheels, rods, and chains, seen in perspective, had a very striking and pleasing effect; we walked by the side of an oblong trough or vessel, filled with water, large enough for a canal boat to float in. This reservoir of water with the canal boat, weighs 64 tons, and is suspended by eight rods and chains over as many large cast-iron wheels or pulleys, which are balanced on the other side of the wall by an equal number of square frames loaded with brick-work, or other heavy materials. After examining the lower structure of the building and machine, we got into an empty boat, which floated in the reservoir, and were slowly raised to the upper level of the canal, without any noise or jarring in the machinery, by means of wheels and pinions on the other side, which were worked by two men with great ease; it took about three minutes to ascend twelve feet, the difference between the two

levels. When the trough is thus raised to the necessary height, the paddles at the end, which are very ingeniously contrived for the purpose, being drawn up, a communication is made between the water in the trough and that in the canal, and the boat passes from the trough into the upper level of the canal, to pursue its course. In case a boat be ready in the upper level, it is in turn floated into the trough; the communication is stopped by letting down the paddles into their places, and the machine is made to descend by the same means to the lower level of the canal, where, by similar paddles, the boat is released to proceed on its journey. Whether the boat be loaded or empty it makes no difference in the weight, for as the machine is kept filled to a certain height with water, the boat, on its entrance, displaces just as much of this fluid as is equal to its own weight.

I had previously formed a very erroneous idea of the machine, and fancied it was complex and might be easily injured, and thus rendered useless; but so far from being complex, nothing can be more simple; the wheels, rods, and chains, are strong enough to bear a far greater weight, and if one half of the number were removed, or could be supposed by any accident or design, to be out of order, the remainder would do the work; and if the

pinions, &c. should by any means be deranged, the machine, with little trouble, would act without them, the reservoir being balanced by the weights suspended; and as to the friction of the wheels, chains, &c. it is next to nothing, and, as Mr. WOODHOUSE observes, will scarcely be perceptible after a great length of time. He assured us, that the greatest attention had been paid throughout; the iron was of the best quality, and every part tried to the utmost; the great wheels were cast at three separate intervals, so as to allow for the contraction in cooling, to which all metals are subject, and every thing done to the greatest truth and mathematical exactness. Some persons have thought the woodwork of the reservoir, particularly the paddles at each end, too slight, and liable to be damaged by the boatmen, which is a very natural idea to occur to those who have been accustomed to the management of the ordinary canal locks, where the boatmen will run the boats against the locks, with as much violence as if they were forcing the gate of a fortress, or draw the paddles before the gates are closed; thus occasioning great concussion and damage to the whole fabric, and rendering them leaky. But, in the present case, means no doubt will be found to prevent this, and to introduce the boats into the reservoir without any unnatural force;

and if the paddles be found too slight, or the troughs should receive any injury, they may be speedily removed or repaired.

With respect to your other queries, I feel myself on rather tender ground ; and though it would be presumptuous in me to suppose my opinion of any consequence, yet, as you desire it, I will venture, in some degree, to comply with your request.

The great desideratum, you know, is the procuring of water sufficient to answer the purpose of navigating down to the Severn. In case the six feet locks are adopted, the water must be raised, by fire engines, from the Severn, and thrown back for sixteen miles, to the summit at Tardebig; thus there must be an immense expence incurred in the construction of such a number of fire engines as will be requisite for this purpose, and also in the consequent charges for the supply of fuel, repairs, and the regular working the engine. This, I presume, may easily be calculated by persons expert in such matters, from the allowed data. Now in case the LIFTS are adopted, there will be very little waste of water, perhaps not so much as is constantly forcing its way through, or under a canal lock gate, when the lock is worn, or shaken by accident or mismanagement.

The expence of erecting and fitting up these **PERPENDICULAR LIFTS**, must certainly be great, besides the constant expence of one or two men stationed at each to work it. The present **LIFT** is only 12 feet, and by way of experiment ; for the Committee, in the first instance, did not chuse to run too great risk ; but the machines may be adapted to raise twenty, thirty, or any number of feet, by greater length of chains, and adequate building to suit the levels, at a much less proportionate expence than in shorter **LIFTS**. To what extent this may be carried, prudence and experience must dictate ; and, therefore, whether the expence of the **PERPENDICULAR LIFTS**, or the old system of Lockage, with the expences of procuring water, be greater, it would be improper for me to give an opinion.

In the course of conversation, many circumstances highly favourable to his plan were mentioned by Mr. **WOODHOUSE**, which, though they should be received *cum grano salis*, appeared to me to have great weight. By the old plan, each of the locks must have the same fall, and in each range they must be built near to each other, so as to be under the eye of the lock-keeper ; of course, instead of adapting them to the nature of the country, a great expence must unavoidably take place in the forming the land to the locks. This will not be the case with the



LIFTS; being quite distinct from each other, it will not signify whether they be close, or one or six miles asunder, nor whether they lift 12, 20, or 30 feet. They may be accommodated to the nature of the country through which the canal passes, will require much less land, and may be placed, probably, in situations where the land is of least value; the canal, for the same reason, may vary its course according to circumstances, which cannot be the case in the old system; and when we consider the great price of land in some situations more than others, the saving to the canal company, in this respect, will be very great.

As soon as one LIFT is finished, the canal may be used, a great saving thereby in water carriage to the remaining works, and perhaps the tonnage constantly increasing, which is not the case in the Lock system, which cannot be used to much effect till the fire engines are completed, and the water brought to the highest level. At all events, the LIFTS will not be thrown up, but, if found too expensive, they may be used as far as they go, and the remainder finished by Lockage. The present LIFT will not be used for some months, because a tunnel near it is not yet completed; in the mean time, every thing will have time to settle, and any alteration or improvement in the approaches to the LIFT, and the management of it, may be made.



Many persons have supposed this machine to be somewhat similar to Mr. WELDON'S Caisson, which was erected at Coombhay, near Bath, on the Somersetshire Coal Canal, which did not succeed, and was abandoned, after a great expence incurred, and are therefore apprehensive the LIFT may share the same fate; but I look upon it there is little or no resemblance between the two machines, except the intention, viz. that of lifting boats through a much greater perpendicular space than could be done by Lockage.

When we had seen and examined every part, Mr. WOODHOUSE shewed us a bed of stone very near the canal, which he had discovered since the experiment was undertaken; this stone is of an excellent quality; like the Bath or Portland stone, soft when it comes out of ground, but becoming hard by exposure to the air; and he calculated that it might be used for the canal at one half the expence of common brickwork. This must prove a very valuable discovery to the Company.---Of a similar stone to this, Tardebig Church was built, about thirty years since, and the spire, with its open, airy base, has a fine effect.

I cannot conclude without expressing to you some of the ideas that have occurred to me since I saw this machine, and under what obligation

I consider the public to be to the Worcester and Birmingham Committee, for patronizing Mr. WOODHOUSE's plan. In the possibility of its not being adopted in the future progress of this canal, still it will remain as a model for all other canals, who of course may profit thereby, and rectify any error they may have fallen into. The great utility of the plan is not, perhaps, so striking on the line of the Worcester and Birmingham Canal, where there must be a continued succession of LIFTS, as it would be in some insulated situations.

At the time I am writing, I have before my eyes, 150 yards from my house at Bordesley, a large fire engine, which till of late was an insufferable nuisance to the neighbourhood, by the immense volumes of thick black smoke it was throwing out, night and day, without intermission. This inconvenience of the smoke has been lessened, in a great degree, by some simple contrivance in the management of the fire place, which ought to be adopted in all such cases. When I observe this engine employed solely in throwing back water to the upper level of the Warwick Canal, for the floating of the boats, up and down through half a dozen locks, within the space of half a mile, I cannot help considering, that had the LIFT been known and applied, the canal might, at a little expence, have been

continued on a level to the place where the fire engine is constructed, the expence of working the engine and all the lockage saved, and the boat, by one LIFT, removed from one level to the other; the first cost of the LIFT, no doubt, would be great, and then you have said nearly the whole; no fear of dry seasons, the reservoirs and feeders being sufficient to supply the loss of water from exhalation by the summer sun.

Again, to look at the Birmingham Canal at Smethwick, with its fire engine, reservoirs, and double range of locks---to what advantage might this machine be applied in such a situation!

In order to preserve a clear idea of the machine, my Son, who accompanied me, made some Drawings of it, as annexed, seen in perspective, &c. They, with his explanations, will give you a tolerable conception of it. In short, I went over with no great expectation of any thing more than the mere amusement of a country excursion; but I have been so much pleased with the structure, that I must advise every person interested, to examine it for himself.

I remain, with respect,

DEAR SIR,

Your obedient Servant,

EDWARD SMITH.

BIRMINGHAM, MARCH 6, 1810.

# EXPLANATION

OF THE

## PLATES.

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### PLATE I.

**I**S a perspective view of the internal part of the machine, when viewed from the lower level of the canal. The surrounding walls are taken away to avoid confusion: the centre wall is also broken off, at the nearest end, in order to shew the manner in which the balancing weights, at the back, are suspended. The better to display the construction of the trough, it is raised five feet above the lower level; the dimensions of it are as follows; length 72 feet---breadth 8 feet ---depth 4 feet 6 inches, all outside measures. It is composed of planks, 3 inches thick; its weight, when filled to the proper height with water, is 64 tons. The paddles, and their appurtenances, are marked as clearly as the nature of the case would admit; a further explanation of them, will be found in the references to figures 2, 3 and 4, Plate II.

From the corners of the trough, rise four strong posts, 12 feet high, in each of which is a groove, which receives the respective paddles. Parallel to these, are similar posts, in which slide the paddles of the canal. When a boat is to be introduced at the lower level, the narrow space between the paddle of the trough and that of the canal, is first filled with water, by opening a valve, the situation of which is pointed

out by the letter *H*, in fig. 2 and 4, Plate II.; the lateral pressure of the water against the paddles, is thus removed: The small chain, which hangs down between the upright posts (the lower part of which is double) is then linked to the hooks of both paddles, and by means of the crane near the end, they are drawn up together, and the boat floats into the trough; the paddles are then dropped, and the trough raised to the upper level, when the boat is liberated by opening the paddles at the contrary end. A similar operation takes place, when a boat is required to descend from the upper to the lower level.

◆

PLATE II.

FIGURE 1, a section of the end of the machine; this clearly shews the principle by which the weight is raised, viz. that of the simple pulley, where, the weight suspended on each side being equal, a force sufficient to overcome the unavoidable friction, being applied, puts the whole in motion either way. *AA* represents the section of the trough, suspended from the iron beam *CD C*, by rods, the lower ends of which are fastened by screws and nuts at *BB*, and the upper ends are fixed in the same manner at *CC*.

From the centre *D* of the beam *CD C*, proceeds a very strong double chain *DD d E*, passing over the wheel *HH*. From the end *E* hangs an iron rod *EFG*, which passes through a thick square platform of oak at *G*, loaded with brick-work to the weight of eight tons; this is the case with each of the others; the weight, therefore, of the whole, is 64 tons, being equal to that of the trough, which they hold in equipoise.

*HH*, a cast-iron wheel, 12 feet in diameter, one of the eight which are seen in Plate I. *IK*, the centre wall, 30 feet high.

From *L*, under the centre of the trough, is suspended a chain, which is loaded at equal distances with blocks of iron, 1, 2, 3, 4, 5; the weight of them is equal to as much of the chain and rod *D d E F G*, as hang in a perpendicular direction. The weights *F G*, are provided with similar chains, so that, as in the present instance, when they are at the lower level, the opposite blocks are called into action, and counterbalance the force of that portion of chain and rod, extending from *d* to *G*, while the blocks suspended from *G* lie inactive, in the cavity *M N*: the contrary is the case when the trough is sunk.

Figure 2, is a section of the paddles, &c. of the upper level. *A a*, *B b*, the two perpendicular posts, containing the grooves, in which the paddles *C D* slide. *E F*, small wheels at the extremities of the posts; these, by rolling against other surfaces, contribute to regulate the ascending and descending motion of the trough. This is more distinctly seen in Figure 3, which is a profile of this part.

*G G*, is the bottom of the canal, which projects a little beyond its paddle, in order to fill up the space between the bottoms of the two paddles, through which the water would otherwise escape. The side spaces are filled up by square pieces of wood, which slide against strips of thick felt; thus rendering the whole completely water-tight. *H*, the small valve, by withdrawing which the space between the paddles is filled with water.

Figure 4. A plan of the situations of the paddles in the grooves; which is sufficiently explained by comparative reference to the other plates.

### PLATE III.

AN elevation of the back of the machine, shewing the eight wheels *H 1*, *H 2*, &c. the chains and rods *D E F*, and the poise weights *F G*. Here also the external building is

removed, the centre wall alone remaining, in the interstices of which the wheels revolve.

The wheels No. 2 and 7, are toothed through twelve feet of their circumference, and by means of these teeth, they are acted upon by the wheelwork, which this plate also exhibits. *II* are the two winches by which the pinions and wheels *KK*, *LL*, *MM*, *NN*, *OO*, are turned, and sufficient power is thus acquired to move the wheels *HH*; this is effected by the teeth of the pinions *OO*, meeting those of *H 2* and *H 7*; these two being connected by the common axis *PP*, their motions necessarily correspond. On the sides of the weights *FG*, are small projections, which slide into grooves, constructed in the upright posts *QR*. By means of these grooves, and the regulating wheels *EF*, in figures 2 and 3, Plate II. the perpendicular motion is rendered so perfectly true, that it was judged unnecessary to give the wheels *HH*, any hollow; the chains consequently move on flat surfaces, depending only on the mathematical truth of the work.

The lines *S*, *T*, point out the situations of the lower and upper levels of the canal, between which, as was before observed, the fall is 12 feet.

W. H. SMITH.



## POSTSCRIPT.

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SINCE the two former Editions of my Letters were before the Public, a number of Improvements have been made in the PERPENDICULAR LIFT by the ingenious Projector, to prevent the chance of accidents to which new schemes are exposed, and also to obviate several objections that have been industriously circulated against the Machine. An Apparatus has been added, which will effectually prevent the sudden motion of the Machine, in case any accident should happen while the Conductor is at the lower level, and which renders it impossible for the weights to descend, till the paddles of the conductor are adjusted.

Two Pumps have also been introduced, which regulate the speed of the Machine, and by which the conductor will pass from one level to the other, without any manual labour, in perfect safety; and the conductor and paddles are now so guarded, that they cannot receive injury from the violent entrance of the boats.

Owing to the numerous delays, the Tunnel at Tardebig was not completed so soon as stated, and the consequent trial of the LIFT, as expected by the Proprietors, could not be effectually made previous to the General Meeting of January 1, 1811. This, and other circumstances, induced the General Meeting to pass Resolutions, by which it was determined, (though so much expence had been incurred) to abandon the scheme *in toto*, and finish the Canal by means of Locks; chiefly, however, on the ground, that it was impossible (as alledged) for the LIFT to pass nearly the number of



boats requisite, when the Canal should be completed. Several respectable Proprietors, not satisfied with this determination, and concerned that a plan, in their opinion, replete with advantage to the Canal and the public at large, should be abandoned almost without trial, have come forward at their own expence, to make a complete trial of the Machine, and its capability to do what might be requisite.

This trial has continued under the patronage of these Gentlemen for nearly a month, by means of three boats constantly working upward and downward, for a given period in each day, one of 20 tons, one of 15 tons, and the other empty, being the usual proportion in the common traffic on Canals. The result of this will surprize many persons who had formed a very different idea of the power of the LIFT, and must be very gratifying to the Inventor, who, whether the scheme be adopted or abandoned by the Proprietors, will be able to refer to the solid test of experiments thus laid before the public. The result of the experiments to the day of publication I subjoin.

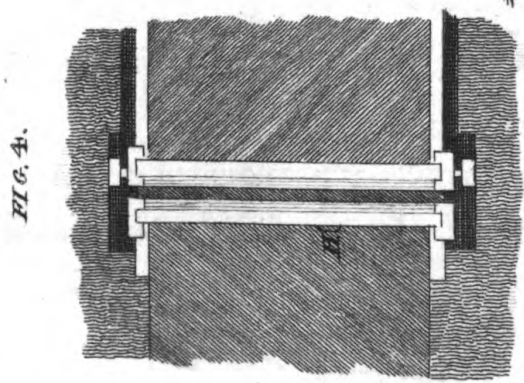
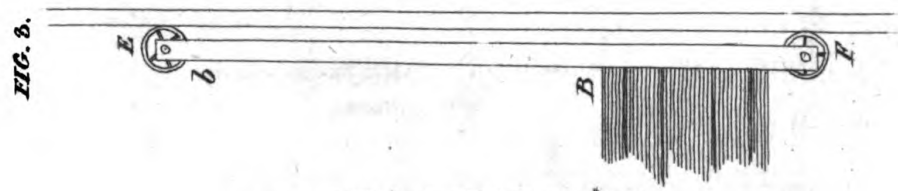
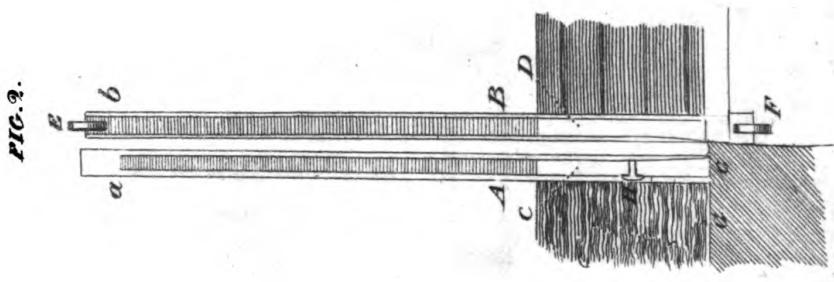
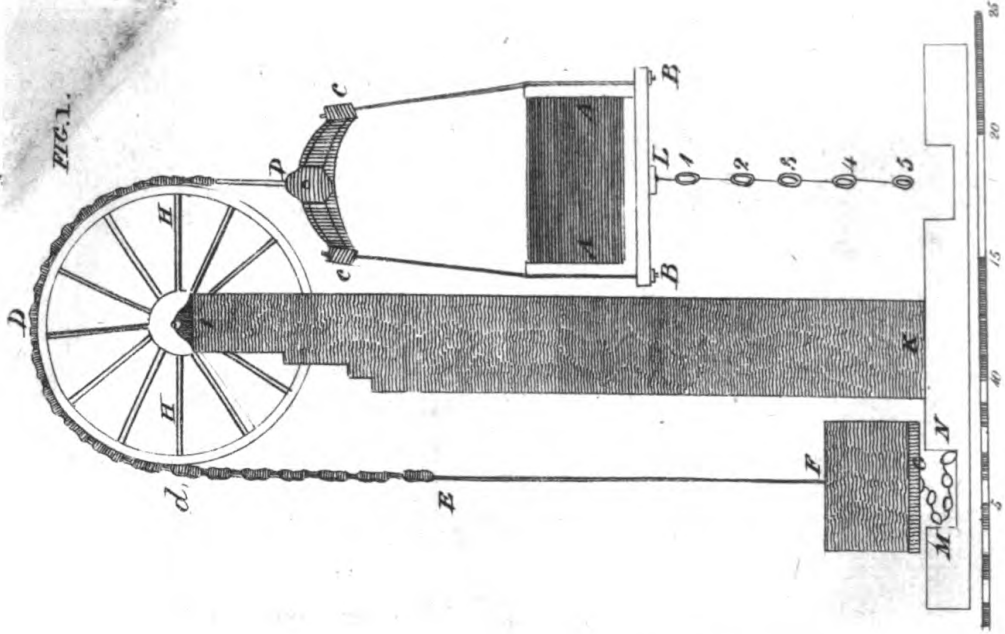
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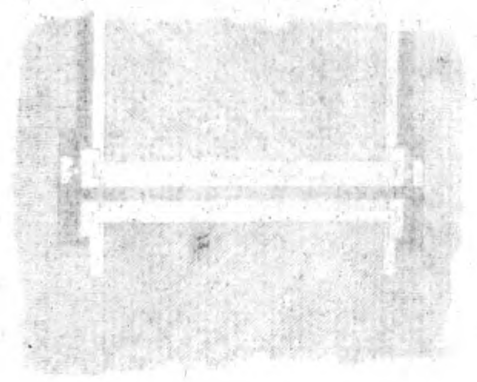
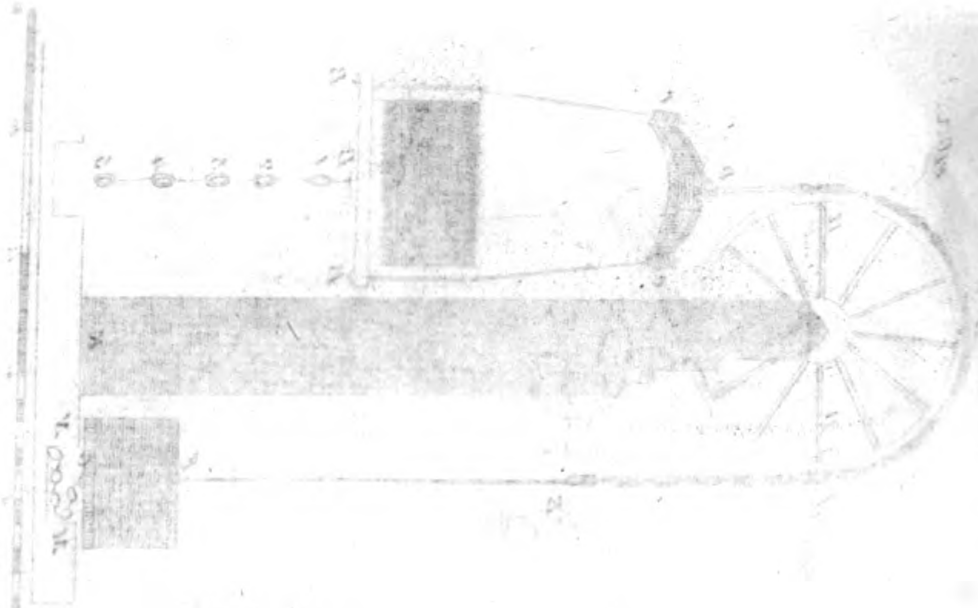
E. SMITH.

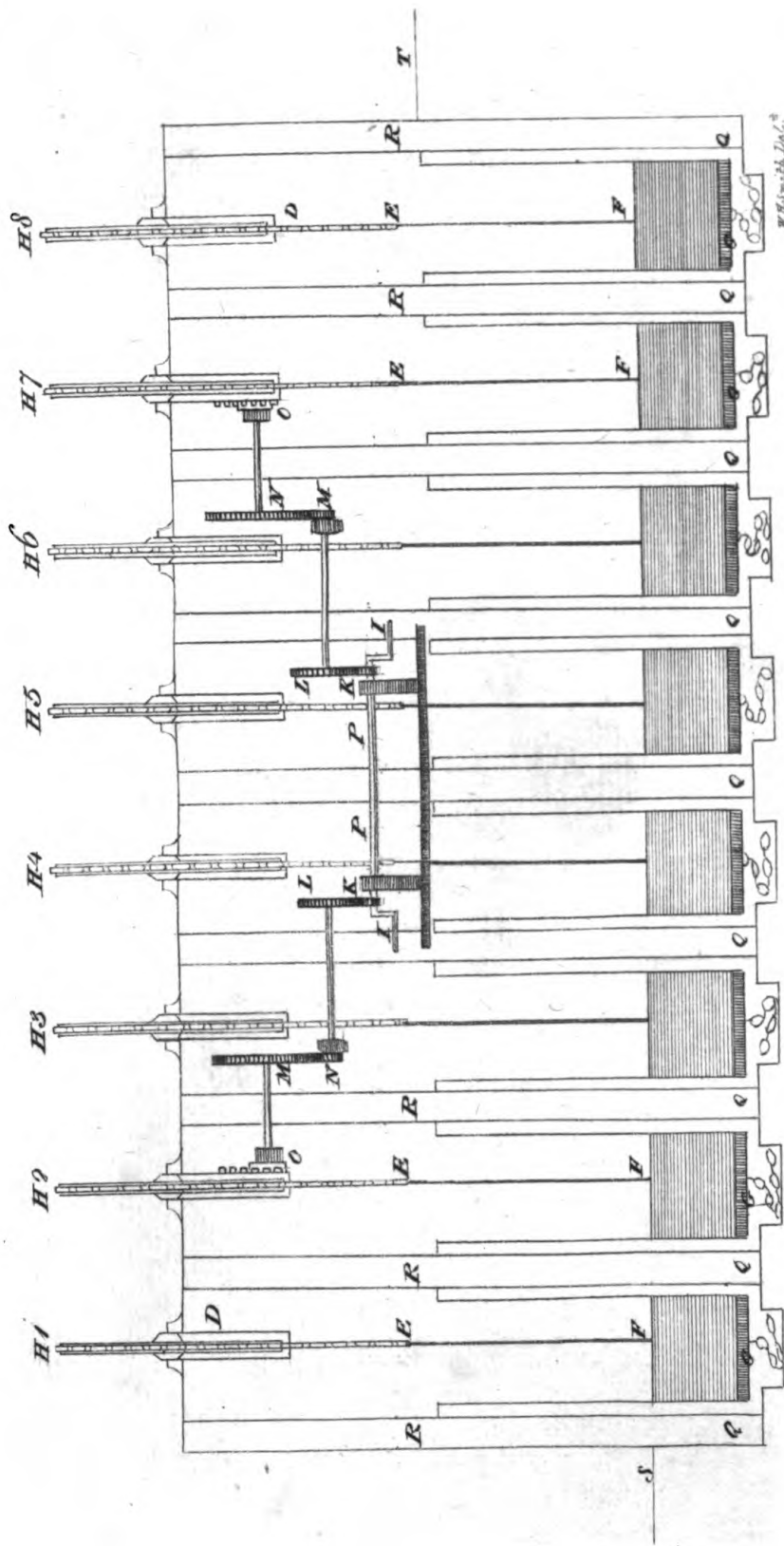
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— 26, 2nd	60	ditto	in 8 Hours 10 Min.
— 27, 3d	70	ditto	in 9 Hours 8 Min.
— 28, 4th	37	ditto	in 5 Hours 1 Min.
Mar. 1, 5th	50	ditto	in 6 Hours 40 Min.
— 2, 6th	50	ditto	in 6 Hours 48 Min.
— 4, 7th	50	ditto	in 6 Hours 52 Min.
— 5, 8th	40	ditto	in 5 Hours 16 Min.
— 6, 9th	51	ditto	in 6 Hours 21 Min.
— 7, 10th	48	ditto	in 6 Hours 22 Min.
— 9, 11th	41	ditto	in 5 Hours 20 Min.
— 11, 12th	40	ditto	in 5 Hours 25 Min.
— 12, 13th	100	ditto	in 11 Hours 46 Min.
— 13, 14th	58	ditto	in 7 Hours 20 Min.
— 14, 15th	50	ditto	in 5 Hours 41 Min.
— 15, 16th	110	ditto	in 12 Hours.
— 16, 17th	50	ditto	in 5 Hours 37 Min.

(Signed)

WILLIAM JOHNSON.







W. B. Smith, D. C.

Scale of Feet



