that Motion, and being ſo much in the Air, kept him alive ſo long. The Picture * [ſee TAB. V. Fig. 1. 2.] is within Four Inches in Length and Breadth of the Bones. It is done by a very good Hand, and very exact; and every thing I have wrote to be depended on; and taken from the Bones; it is not a Copy. I was in Haſte: Mr. *Vandenhagen*, who drew it, finiſhed mine, and died ſuddenly, before he had quite done.

XIX. *A* Narrative *of a new Invention of* expanding Fluids, *by their being conveyed into certain ignified* Veſſels, *where they are immediately rarefied into an elaſtic impelling Force, ſufficient to give Motion to* Hydraulopneumatical *and other* Engines, *for raiſing Water, and other Uſes*, &c. *by* John Payne.

TO produce a great Power at a ſmall Expence, is what every body deſires in moving Machinery; and is what, by this new Invention, we have proved by Experiments and Practice to be a great Improvement, when applied to that noble Invention the *Fire-engine:* Therefore I ſhall proceed to give a ſhort Deſcription of the Veſſels and Machinery contrived for that Purpoſe; *viz.*

A Pot or Veſſel made of wrought or caſt Iron, nearly the Figure of a Cone, whoſe Diameter at the

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* Now in the *Muſeum* of Sir *Hans Sloane*.

Baſe is Four Feet, with Holes round the Edge, for Nails or Screws to faſten a globular Head of Copper of about Five Feet and half Diameter, as by the Figure annext will appear [TAB. VI. Fig. 2]. There is then placed in the Inſide a ſmall Veſſel or Machine, which I call a Diſperſer: This Baſon or Veſſel hath Spouts round the Sides fixed to it, and the Bottom thereof reſteth on a Centre-pin; and in the Middle of this Baſon or Veſſel is a Socket, with Holes near the Bottom, to let the Water or Fluids paſs from above, through an iron Pipe of about Seven Feet long, the lower End of which is placed in the Socket, ſo as the End of the Pipe will be always immerged in Water in the Baſon, to prevent the expanded Fluids from returning up the Pipe; and the other End of this Pipe goes up through the Copper-head, which is incloſed very tight, but ſo as it may eaſily be moved with a circular Motion, in order that the Water or other Fluid, which is conveyed through this iron Pipe down into the Diſperſer, may be diſperſed or ſhowered round, on the Sides of the red-hot Pan, or ignified Veſſel, in a very exact manner.

This evaporating Veſſel being thus completed, we then take One, Two, or more, of theſe Veſſels, with theſe Contingencies, and place it or them in a reverberatory Arch or Canal, for conveying the intenſe Heat of a ſtrong Fire, the Flame of which encompaſſes the metal Pot or Pots, and brings them to a red Heat; and in that Condition they are continually kept, while in Uſe, with the Water running from a Ciſtern or Veſſel (where the Water is heated) through a Gauge-cock down the iron Pipe into the Diſperſer, which conveys it to the Sides of the ignified Veſſel or Pot,

Pot, when it is immediately rarefied or expanded into an elaſtic Steam or Vapour, fit for Application to give Motion to ſundry ſorts of Machinery, *&c.*

TAB. VI. Fig. 1.

1ſt, A, *A Globe made of Copper, 12 Inches Diameter.*

B, B, *Two braſs Cocks, one oppoſite to the other, fitted very tight.*

C, *A Handle or Bale, faſtened to the Globe, by which it may be hung or held up.*

D, *A ſmall Valve or Clack, fitted to the upper Cock, of One Inch Diameter.*

The Whole, thus fitted, weighed 15 Pounds 3 Ounces *Troy*, or 12 Pounds 9 Ounces $\frac{1}{2}$ *Avoirdupois*; and, filled with Water, it weighed 45 Pounds 7 Ounces, from which deduct the Metal, the Weight of Water is 32 Pounds 13 Ounces $\frac{1}{2}$ *Avoirdupois*, which is about 4 Gallons, containing about 925 cubical Inches.

This Veſſel or Globe I then hung over the large Veſſel F, in which Water was rarefied or converted into Steam; and by the Pipe E, at the large Cock G, which being open, as alſo the other Cocks B B, the Steam had a free Paſſage through the Globe A, by which the Steam excluded or forced out the Air that was in the Globe, and by its elaſtic Quality ſupplied its Place; when both Cocks B B were ſuddenly ſhut, and the Globe A taken down and hung over a Veſſel of cold Water, with the lower Cock B, immerged in Water, and then opened under Water; on which the Water ruſhed into the Globe very furiouſly, until

it

it had ſupplied the *Vacuum*, when the Cock was again ſhut, and the Globe, with the Water, put in the Scales, and then found to weigh 44 Pounds 9 Ounces; which take from 45 Pounds 7 Ounces, the whole Weight, as before, there remains but 14 Ounces, the Difference, which ſheweth that all the Air was nearly excluded out of the Globe by the Steam: In Ounces it ſtands thus $\frac{727}{713}$, which is very near a perfect *Vacuum*.

2*dly*, I again excluded the Air out of the Globe with Steam as before, and both Cocks B B being cloſed with the Globe full of Steam, we put the Globe in the Scales, and it weighed 12 Pounds 10 Ounces $\frac{1}{2}$. I then opened one of the Cocks, and let in the Air, on which the Scale deſcended; and, by adding Weight in the other Scale, it was found to weigh 12 Pounds 11 Ounces; which ſhewed that the Weight (not the Preſſure) of the Air the Globe contained, was $\frac{1}{2}$ an Ounce *Avoirdupois*.

3*dly*, The Globe being filled with Steam, as before, and condenſed with cold Water on the Outſide of the Globe, and the Metal again made very dry, and the Air let into the Globe, the Water from the condenſed Steam was found to weigh 4 Penny-weight.

4*thly*, The Globe filled with Steam, as before; only now I continued the Globe longer with the Steam paſſing through it, by which it acquired a greater Degree of Heat; for I found by thoſe Experiments, that the leaſt Degree of Cold leſs than the Steam, a Part would be condenſed again into Water, by which the Quantity could not be certainly attained to, that would exclude the Air out of a certain Space, which is the chief End of this Experiment. But in this Experiment I ſucceeded better; for, on weighing the

the Globe, when the Steam was condenſed, the Air let in, and all cold, it was as followeth; *viz.* 15 Pounds 3 Ounces 2 Penny-weights *Troy*, the Weight without the Steam being 15 Pounds 3 Ounces; ſo that the Weight of the Water condenſed from the Steam, or the Water converted into a ſtrong elaſtic Steam to fill the Space of this little Globe, is but 2 Penny-weights, or $\frac{1}{10}$ of an Ounce *Troy* of Water, by which $\frac{1}{10}$ of an Ounce *Troy* of Water fills, when converted into Steam, 925 cubical Inches of Space in a Veſſel, ſo as to exclude nearly all the Air. I repeated this Experiment ſeveral times, and found it nearly the ſame; and by immerging the Cock in Water, and opening it again, as in the firſt Experiment, I found the Weight of Water to be nearly as above, and to make about $\frac{1}{16}$ Void or *Vacuum*; ſo that 1 Ounce *Troy* of Water makes 9250 cube Inches of Steam, of equal Force with the like Number of Inches of Air; and with this Remark, that the Weight of the Steam is much leſs than the Weight of common Air; for in this Globe I found the Air to weigh $\frac{1}{2}$ Ounce *Avoirdupois* or 9 Penny-weight *Troy*; and the Steam, which filled the ſame Space, to weigh but 2 Penny-weight *Troy*, which is but little more than $\frac{1}{5}$th Part, and ſhews how very ſmall the Particles of Water are when ſo divided by the Force of Fire, and of what Force. From which I ſhall conclude, that 1 cubic Inch of Water will diſcharge or force out 4000 Inches of Air from a Veſſel of that Content, which I have likewiſe proved by other Experiments in working the Fire-engine: Therefore I ſhall make it my Standard in ſome future Calculations for Practice, about that noble Machine.

ſtly,

5thly, I proceeded, as before, with Steam in the Globe A; and condenſed it, as in the third Experiment; and then tried the Preſſure of the Atmoſphere on the Clack or Valve D, and found it required about 10 lb *Troy*, to lift the Clack from its Tube of 1 Inch Diameter; but in this I was not exact with ſmall Weights.

6thly, I excluded the Air with the Steam, and in Place of the Clack I ſcrewed on very tight a Plate, on which I placed a glaſs Receiver, as uſual, with the Air-pump; and then, turning the Cock, the Air under the glaſs Receiver expanded itſelf into the Globe, by which I had equally a Share of the *Vacuum* partly made in the Globe, and could thereby make many Experiments that are made with the Air-pump, *&c.* which I mention only, that ſome curious Gentlemen may hereafter make ſome further Obſervations by the like Experiments.

Obſervations from Experiments made by J. Payne.

1. THAT a Pot or Veſſel, of the Size and Shape here mentioned, will (being kept to a dark-red Heat, and the Water regularly diſperſed) rarefy or expand 50 Gallons of Water, Wine Meaſure, *per* Hour.

2. That a cube Inch of Water will make in Practice 4000 Inches of Steam; or that the elaſtic Steam of one cube Inch of Water is ſufficient to exclude the Air out of a Veſſel that is in Content 4000 Inches.

3. That the above 50 Gallons will produce 46,000,000 cube Inches of elaſtic Steam *per* Hour, which is *per* Minute 770,000.

4. That

4. That the ſecond Pot or Veſſel, as in the Draught TAB. VI. Fig. 2. will rarefy or expand 40 Gallons of Water, Wine Meaſure, *per* Hour, and will produce 36,960,000 cube Inches of elaſtic Steam *per* Hour, which is *per* Minute 616,000 Inches.

5. That both being united together make 1,386,000 cube Inches of Steam every Minute, from 346 Inches of Water.

6. That, by an Experiment made at a Fire-engine, 40 Gallons of Water *per* Hour, made into elaſtic Steam in this Method, will effectually give Motion to a 24 Inch Cylinder *Fire-engine.*

7. That, by true Experiments made at *Wedgbury* and *Newcaſtle on Tyne*, One hundred Weight, containing 112 ℔ of Pit-coals, will, and is ſufficient in this Method to expand or rarefy 90 Gallons of Water *per* Hour into an elaſtic Steam or Vapour.

8. That, by the beſt Accounts and Obſervations I could get and make, they conſume under their Boilers to make the ſame Quantity of Steam, Three hundred Weight of Pit-coal, at 112 ℔ to the Hundred, in working a Fire-engine one Hour.

9. That 95 Gallons of Water *per* Hour, expanded or rarefied into Steam, will work a 36 Inch Cylinder Engine.

10. From theſe Obſervations I conclude, that this new Invention will ſave at leaſt 60 *per Cent.* in Pit-coals, to work a Fire-engine.

TAB. VI. Fig 1.

A, A, *The Two Pots.*
B, B, *The Two Copper Heads or Globes.*

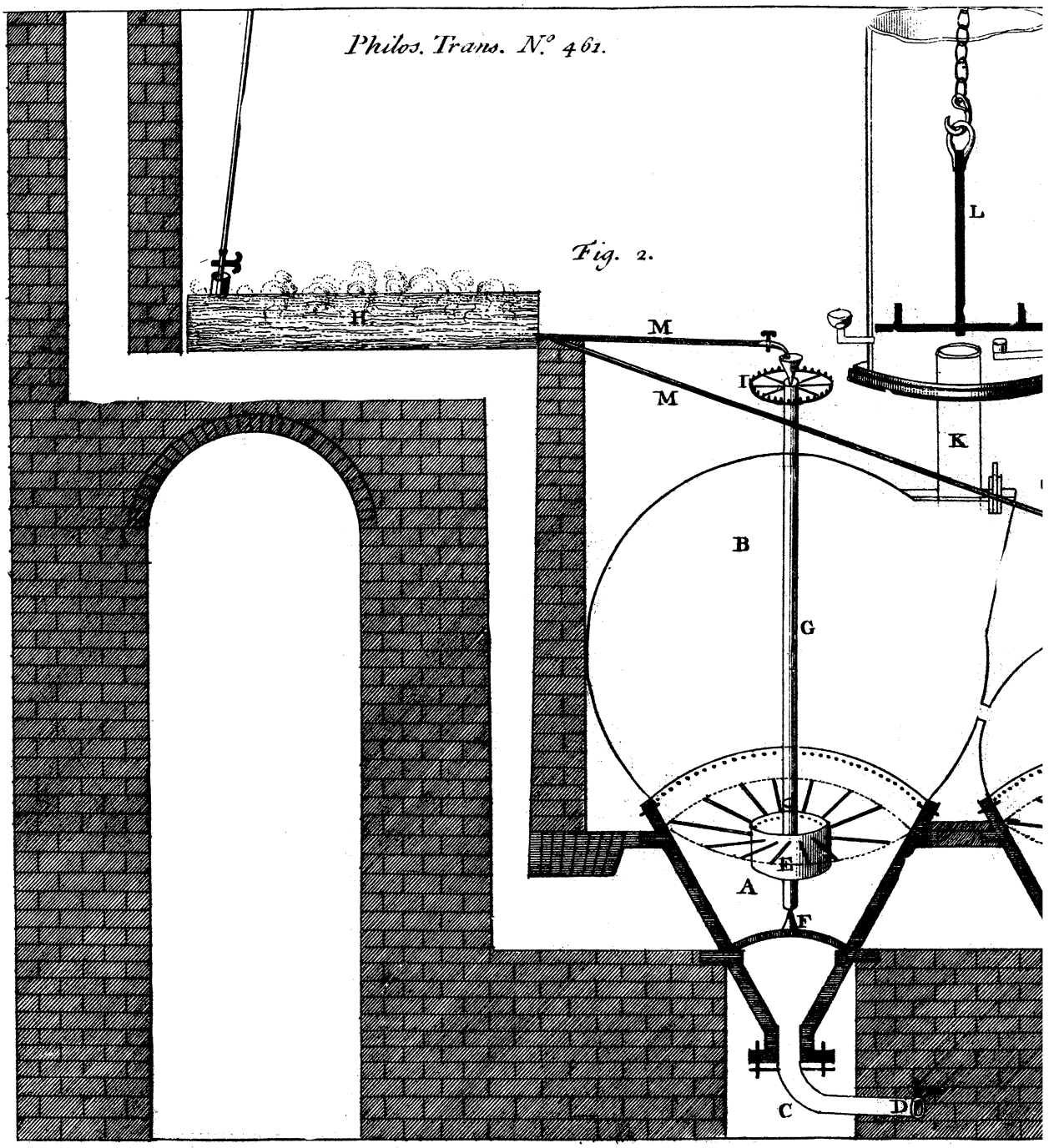
C, C, *The Two ſinking Pipes, for waſte Water, that is not evaporated.*
D, D, *Clacks or Valves, to keep out the Air.*
E, E, *The Two Diſperſers and Spouts.*
F, F, *The Stools with a Centre-pin, on which the Diſperſer reſteth.*
G, G, *The Two iron Pipes, in which the Water is conveyed to the Ciſtern.*
H, *A Ciſtern of hot Water.*
I, I, *Two Cog-wheels, to turn the Diſperſer.*
K, *A Steam-pipe, in which is conveyed the Steam to the Cylinder.*
L, *The Cylinder of the Fire-engine.*
M, M, *Leaden Pipes, that convey hot Water from the Ciſtern to the Diſperſer.*

XX. *An Examination of* Weſtaſhton *Well-waters, belonging to* Tho. Beach, *Eſq; a Well about Four Miles from that of* Holt; *by* Ambroſe Godfrey Hankewitz.

Obſ. 1. I Took four Ounces of the *Weſtaſhton* Water, with as much Milk, and ſet them on the Fire; as ſoon as they boiled, the Milk began to curdle, which denotes a brackiſh Salt of a neuter Nature. The Water changes Syrup of Violets green.

Obſ. 2. Some Powder of Galls infuſed in this Water, gives it a Tinge of a brown Purple; by which it appears, that this Water is Chalybeat: For all Martial Waters will, with Galls, turn blackiſh or inky.

Obſ. 3.


Philos. Trans. N.° 461.
Fig. 2.
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M
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L
K
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G
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C
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TAB. VI.

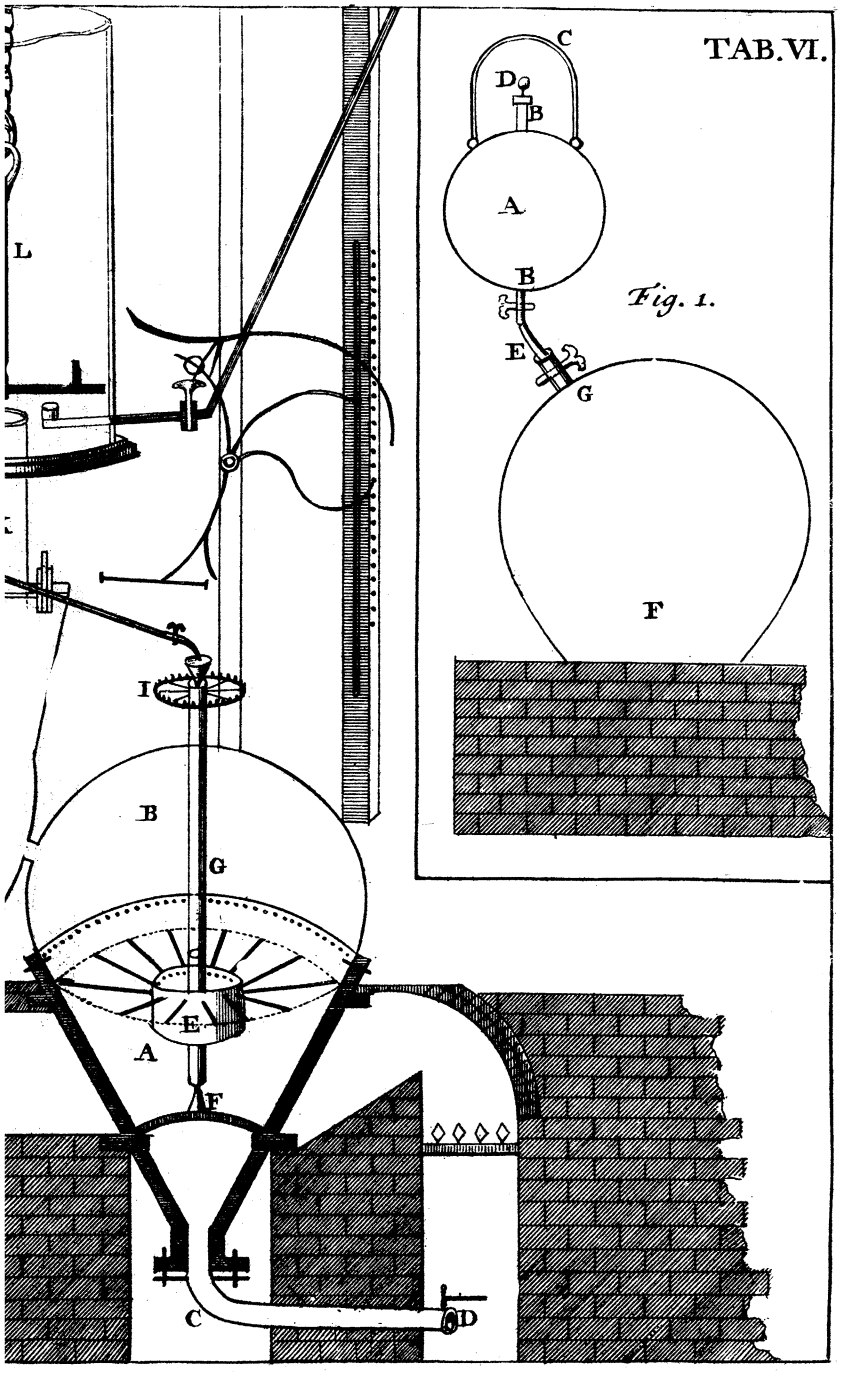
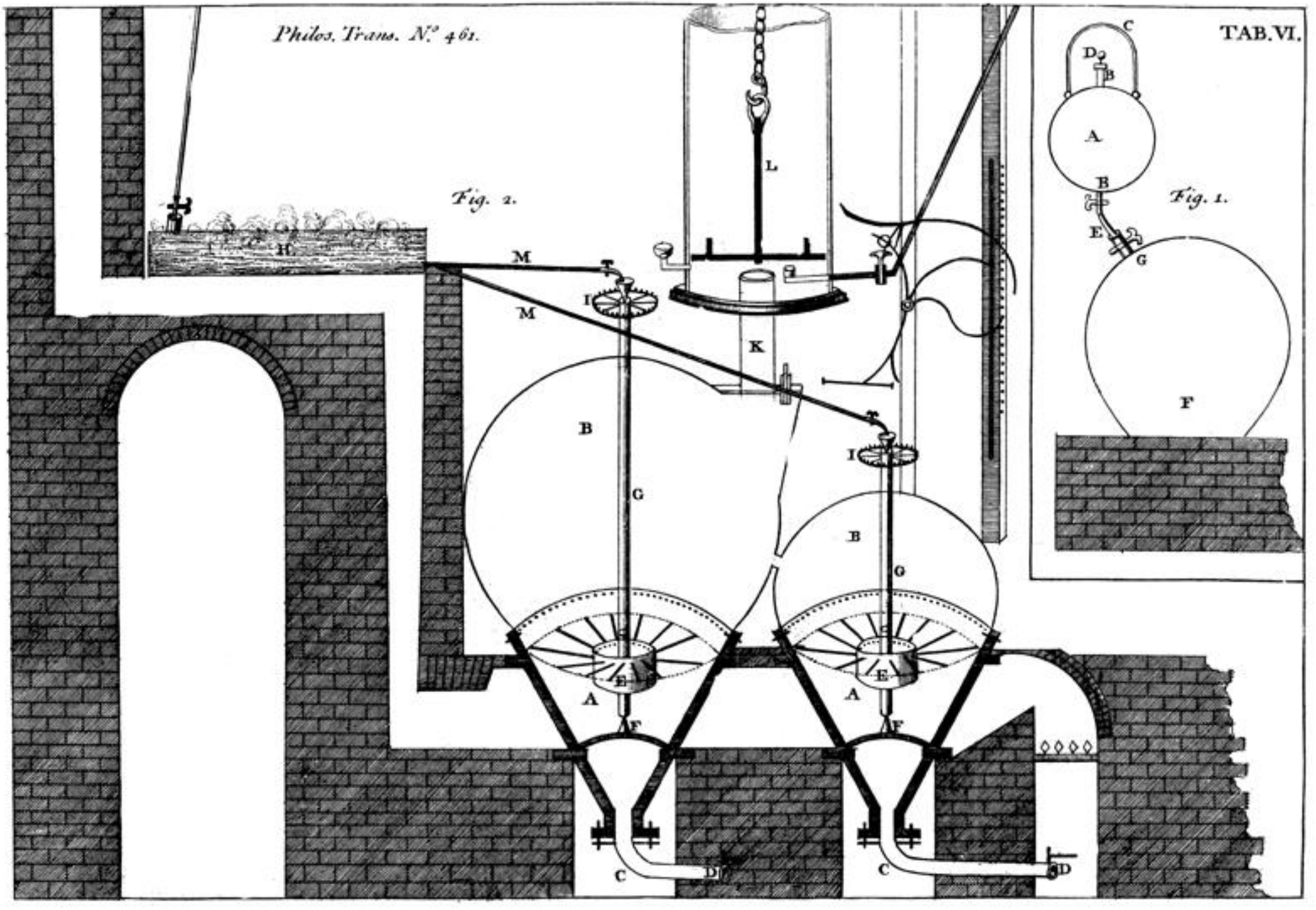


Fig. 1.


Philos. Trans. N.° 461.
TAB. VI.
Fig. 2.
Fig. 1.
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