

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 Expen-
 ce, 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

* 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 annex will appear [TAB. VI. Fig. 2]. There is then placed in the Inside a small Vessel or Machine, which I call a Disperser: This Basen 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 Basen 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 immersed in Water in the Basen, 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 BB, 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 BB were suddenly shut, and the Globe A taken down and hung over a Vessel of cold Water, with the lower Cock B, immersed in Water, and then opened under Water; on which the Water rushed into the Globe very furiously, until
 it

it had^o 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*.

2dly, I again excluded the Air out of the Globe with Steam as before, and both Cocks BB 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*.

3dly, 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.

4thly, 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 immersing 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 $\frac{15}{16}$ 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 *Avoir-du-pois* 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 $\frac{1}{7}$ 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.

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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. **T**HAT 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 lb 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 lb 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.*

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C, C,

- 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.*
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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.

Fig. 2.





