dem in fruſta confractum & auctionis lege venditum fuit, ita ut permulti eorum, qui adhuc in vivis ſunt, hujus rei oculati teſtes eſſe poſſint, & per conſequens nemo de hac circumſtantia, quod ſatis magna fruſta Ambræ reperiantur, dubitare debeat; hac occaſione ſemel adhuc quæro, qua ratione Americani Domini referentes cum ſua cyſtide hic convenient, ſi de tam ingentibus Ambræ gryſeæ fruſtis auditu vel lectu quicquam percipiunt?

Continuabitur hæc Diſſertatio in N° *ſeq.*

II. *An Account of a* new Engine for raiſing Water, *in which Horſes or other Animals draw without any loſs of Power (which has never yet been practiſed) and how the Strokes of the* Piſtons *may be made of any Length, to prevent the loſs of* Water, *by the too frequent opening of* Valves, *with many other Advantages altogether new; the Model of which was ſhewn to the* Royal Society *on the* 28th *of* November, *by* Walter Churchman, *the Inventor of it.*

The Deſcription *of this* Engine *is given on the Sides of the* Plate, *where the* Engine *itſelf is likewiſe delineated.* Vide TAB.

THE Animals all draw horizontally, and in a ſtreight Line, and at right Angles, whereby they exert their utmoſt Force. — By theſe Advantages

tages a far greater Power is gain'd from the Strength of Horſes, *&c.* than by their going round in a Circle; for by the Twiſt and Acuteneſs of the Angles, they draw in towards the Centre, whereby they waſte their Power, and alſo ſhorten their Levers: Beſides, their Muſcles and Tendons from their hinder Legs all along their Sides to their Necks are unequally ſtrain'd, as the Duty is hardeſt on one Side, even tho' their Walk is large. Therefore each of thoſe Inconveniencies muſt be attended with Pain to the Animals when at Work, and a great Loſs of their Strength.

2*dly*, A Crank does not riſe quite one third of its Circle, neither do the Regulators or Rods riſe or fall perpendicular, but obliquely, by which an oval Figure is made by the Piſton's Motion in every Cylinder, which occaſions great Friction and a loſs of Water, and every Arm of it is continually varying in its Power whilſt working, as its Lever is diſtant from the perpendicular Line, and two of the Arms (ſuppoſing it a quadruple one) as they croſs the Perpendicular are always drawing to, and from their own Centre, by which the Power is not only loſt, but the Time alſo; and farther yet, by the ſhortneſs of the Strokes, all the adjacent Water is frequently contrarily moved, and by the often opening and ſhutting of the Valves, there is alſo a great Waſte of the Water, beſides the many heavy Bearings, Frictions, Surges, and Repairs belonging to it; all which Inconveniencies and Impediment being thoroughly conſidered, there muſt certainly be required a much greater Power to work the ſame than by my Method. For, hereby, a

Stroke of 24 Feet will riſe, and by enlarging or diminiſhing the fix'd Wallower, you obtain a Stroke of any required Height, even to the extent of the Atmoſphere's Preſſure. By this great Advantage, the Water riſes freer, and with greater Velocity, and as the Lifters or Forcers riſe and fall exactly perpendicular, and with an equal continued Strain, and as the Bearings alſo are fewer and lighter, conſequently the Friction in all theſe will be a great deal leſs than with the Crank, *&c.* And, Laſtly, Seven Eights of that Water which is always loſt by the ſlow opening and ſhutting of the Valves will be ſaved.

From the above Conſiderations, and by the many Experiments I have made on this Occaſion, in order to know the real Difference between theſe different ways of Working, I find, that near twice the Quantity of Water will be raiſed to the ſame Height, in the ſame Time, with the ſame Power, by my Method, more than with the beſt Crank-work that has ever been yet erected.

III. *An*

A Perspective View

a.a.a.a. Is the great Frame, the ends of which under the Pine-Apples are to be contracted to the place of the little Frame, so that the Cross piece at III may support ye 3 bearings now shewn in the little one, for a better view only.

b.b. The little frame on wch the Cap Brasses are, wch receive the turnid Gudgeons in the 3 Horizontal Shafts.

cc. The Strong Supporters by the loose Wallowers.

dd. The loose Wallowers, whose turnid rounds geer truly with ye Coggs in ye great Wheel.

eee. The Regulator, wch has a Circular, direct, and retrograde Motion: see this in the Margins at Fig. 2 & 3.

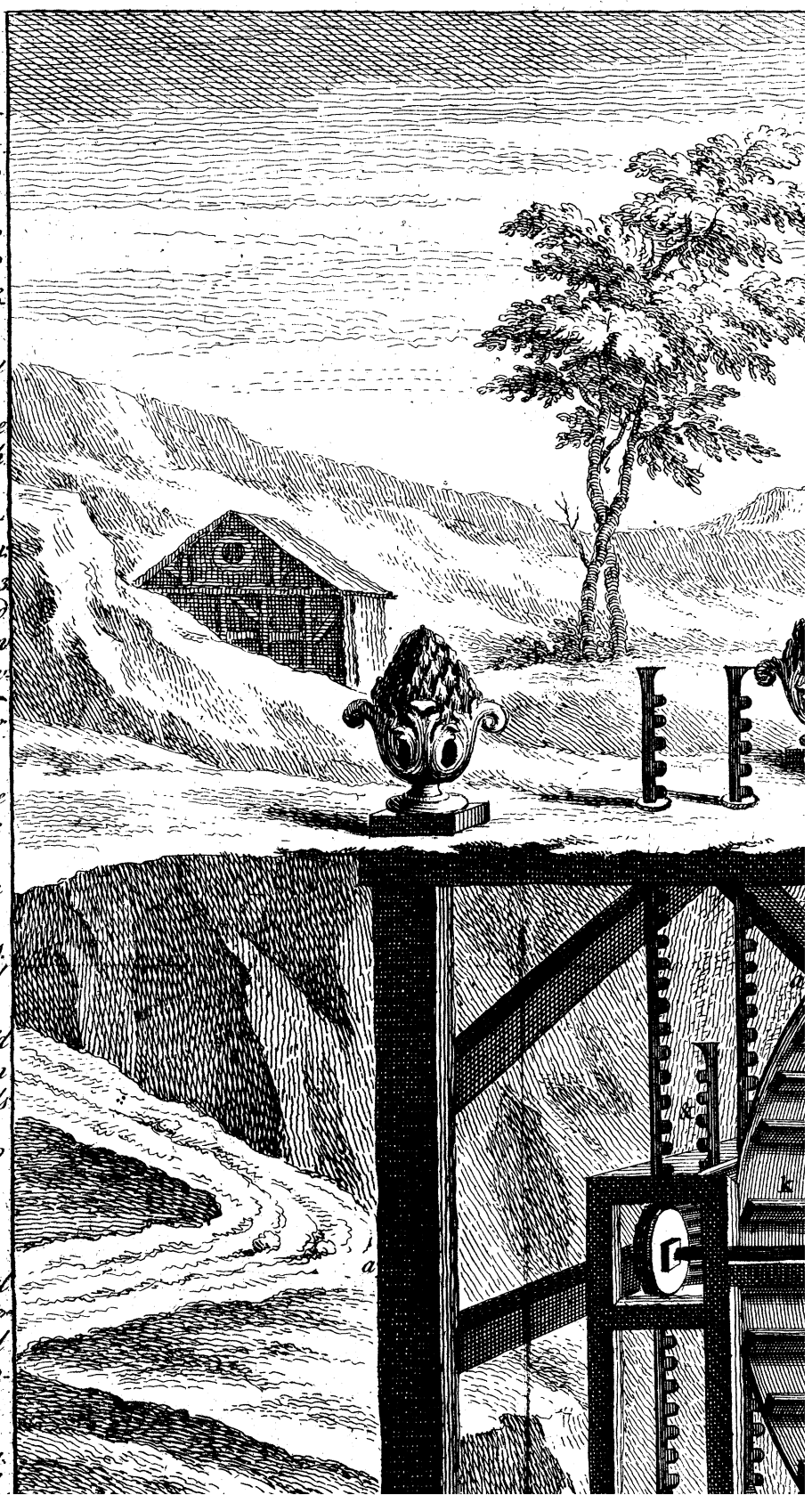
ff. The Strong Shoulder or Stud fixid to the Shaft close by ye Wallower, which Stops this loose Wallower, when ye end of ye regulater comes against it, thereby confining it for 2 Revolutions; after which it quits this Stud, & does the same on the opposite side of the Wheel, & so on Alternately, to reverse ye Motion of the Stems in the different Cylinders.

gg. The Wheels, with their Coggs, which Alternately work ye fixid Wallower lying between them.

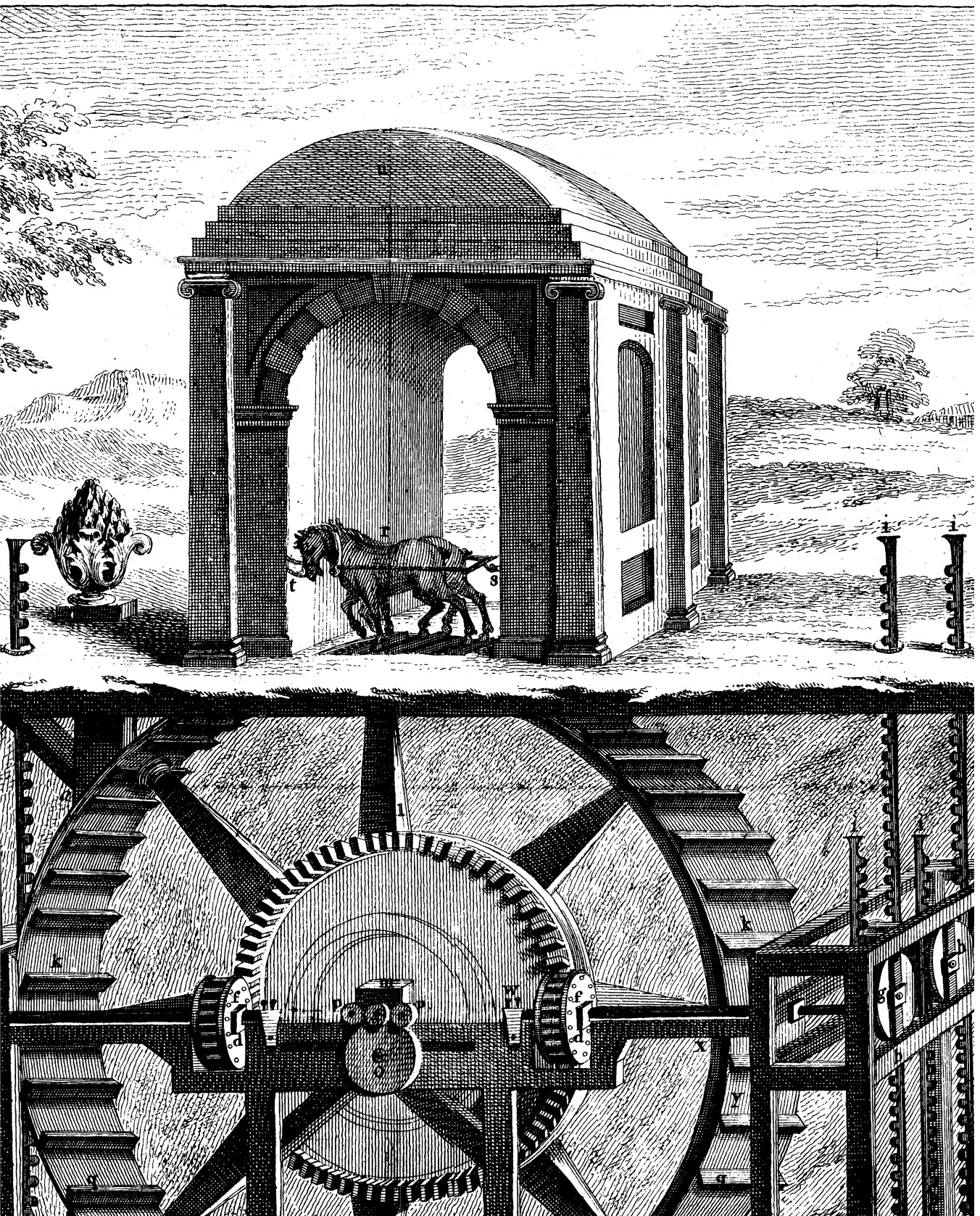
h. The fixid Wallower supposid to be of four Feet in Diameter (on a very short Shaft) whose rounds must be of Cast Soft Iron, & truly turnid, to elevate & depress the Racks to ye Height of 24 Feet by its 2 Revolutions.

iiii. The 4 Lifters or forcers, behind each of wch must be a small Leverage back Wheel, truly fitted to direct the same to rise and fall easily & exactly perpendicular, to avoid friction & Loss of Water in ye Cylinders.

kk. The large vertical Wheel;



ew of Mr. Churchman's Engi



NGINE for raising Water.

p.p. Two small side Leverage
Wheels exactly fitted to ẏ turn'd pa
of ẏ great Gudgeon, between ẏ Colla
& Shoulder: they are to be so place
& key'd, that their friction from ẏ
Gudgeon may be alike when at W

q.q. The Steps which the Horses tre
press, about 8 or 9 Inches broad, 2
Inches thick behind, & declining
an edge, being design'd to make
level ground & good footing for the
hinder Leggs when they Draw.

r.r. 4 Horses only in view to avo
Confusion, all drawing Horizon
tally in a Streight line, & at righ
Angles, whereby these useful A
mals will soon be taught a new
pleasant way of working to the
selves, a more advantagious on
to their Masters, & of greater Uti
to ẏ Publick. See my observations
ẏ advantages of this Engine abo
others in ẏ Philos. Transac. N.° 4

s. The fastening places behind ẏ
Horses, Supposed to be strong arm
below in ẏ Supporter, & a Cross ba
above, at both of w.ch you may pla
small Sheeves or Rollers, ẏ uppe
part of them to be level with eac
Horses breast when drawing, & th
Rope or Strap to come over ẏ sam
in order to keep a weight suspende
of £300 more or less one or two In
es from a Plank. By this Metho
you will be exactly inform'd of ẏ
Strength of each Horse, how long
it continues, & when to relieve hi
as Also when justly to correct ẏ
sloth full one, whose weight res
ing on ẏ Plank will always dis
cover his Laziness.

t. The fastening places before
ing design'd to direct their head

u. The Dome merely for Ornam
in ẏ place of w.ch erect a Work-hou
over ẏ a horizontal Wind mill;
ẏ lower end of its upright Shaf
fix a Spur Wheel to work with
Cogs of ẏ great Wheel therein

..rage —
..rnd part
..n ye Collar
..so plac'd
.. from ye
..en at Work.
..orses feet
..broad, 2
..ining to
..o make
..g for their
.. Draw.
..n to avoid
..Horizon-
..at right
..seful Ani
..ta new &
..g to them-
..ious one
..ater Utility
..ations on
..ine above
..ac. N.° 434
..behind ye
..ong arms
..Cross bar
..nay place
..ye upper
..ith each
..ing) & the
..r ye same,
..uspended
.. two Inch-
..Method
..m'd of ye
..on long
..lieve him,
..rrect ye
..ght rest-
..ays dis-

..before be-
..ir heads.
..r Ornam.t
..orkloft.
..dmill; on
..ht Shaft.
.. with the

air; without friction & loss of
Water in y^e Cylinders.

k.k. The large vertical Wheel, a small Segment of which comes through y^e Floor in y^e Dome for y^e 4 Horses to stand & Draw on.

l.m. The arms, & y^e main Shaft of the Same.

n. The turn'd T Gudgeon, with its Collar & Shoulder, both of w^ch must Clasp y^e rim of the under Leverage Wheel, to keep all firm & Steady when in working. —

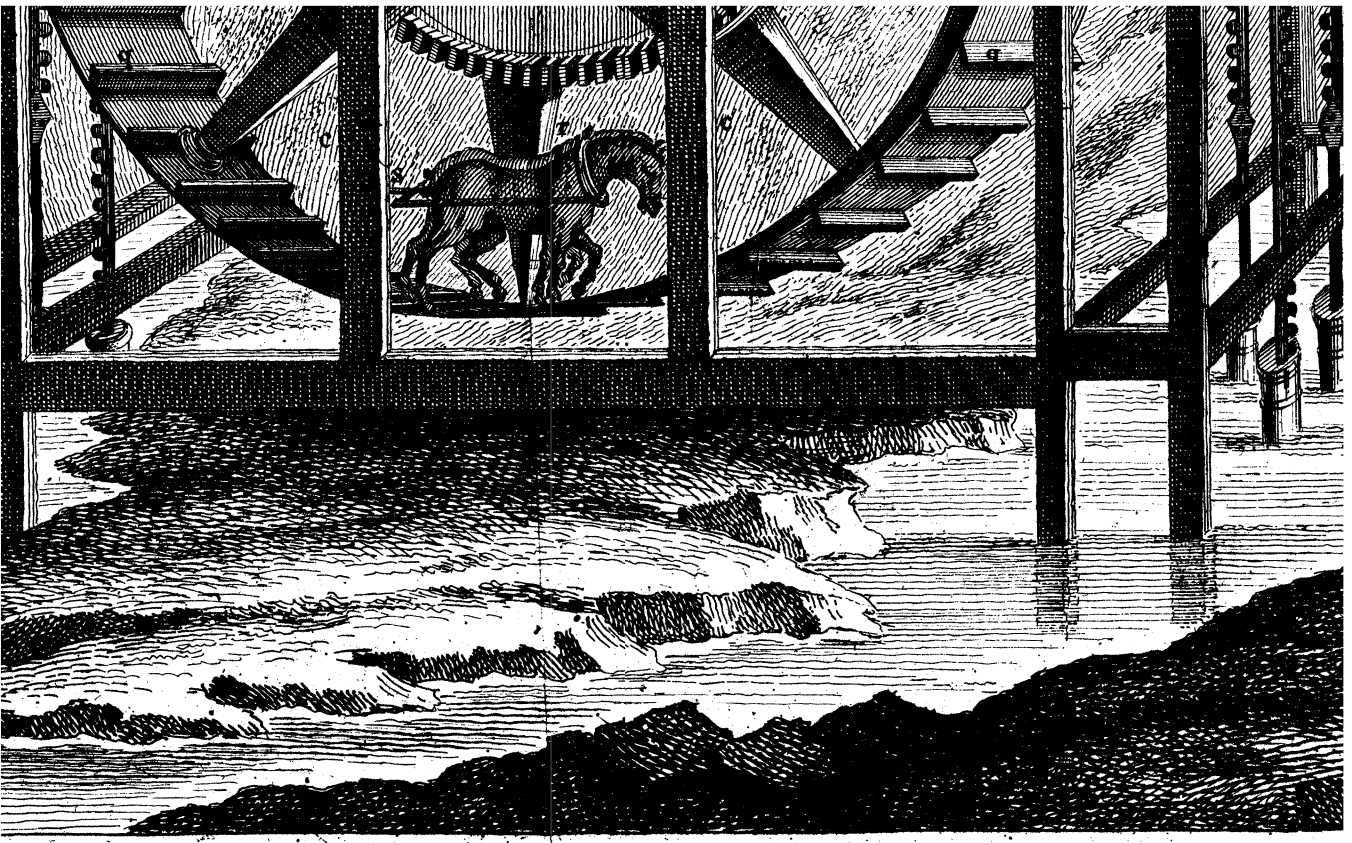
o. The leverage wheel of about 4 feet in Diameter, with a Brass or Iron rim suppos'd to be truly turn'd, and to have a Strong short Iron Spindle through its Center, & at each end a turn'd Steel Collar & Shoulder bearing on 2 Cast Cap Brasses exactly level, & sunk into a Strong Arch'd piece of Timber well braced and Supported for this purpose. *

Fig. 3.

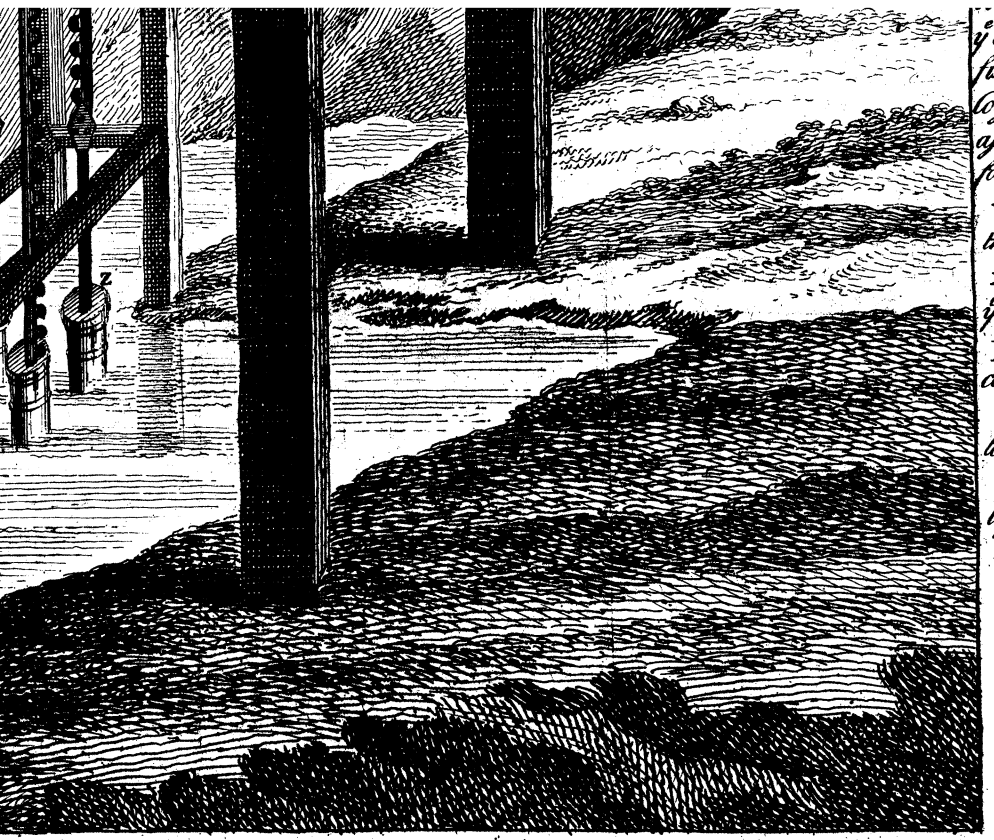
The Arms lie horizontal, and the oval part is perpendicular. —

N.B. A single Shaft with the loose and fix'd Wallowers, w
lifting or forceing, at either of its ends, or at both together: but
purposes Vid. Fig. 2 in the Margin. —— The Pins 4.4

* In large Engines & Machines where the motion is regular every heavy bearing should have one of these Wheels

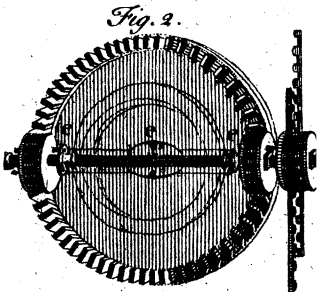


vers, will be of great simplicity and advantage to the Publick, as being erected for less expence
er: but chiefly, as it is easily adapted to the different sorts of Windmills, Waterwheels, &c. of a
Pins 4.4, & the arms 55, which clasp the brasses 6.6. with the oval figure 7 & its 2 teeth make this Regulator,
e Wheels for, they save Power by greatly abating Friction. Upon the Principle of these Leverage-Wheels Captain Rowe ha



ỹ lower end of its upright Shaft
fix a Spur Wheel to work with th
Coggs of ỹ great Wheel, thereby to
assist ỹ Horses, or wn. there's a suffic
force of Wind to do their whole Duty
w. The Coupling Staples with
their Brasses.
x. The Strong Catch wch. confin
ỹ great Wheel to the Frame.
y. The Screw or Key-band to
confine all close & tight.
z. The Cylinders wch. are screw
together at their ends out of sig
&. All ỹ same sort of Work ch
ly for Uniformity in ỹ Draug

Fig. 2.

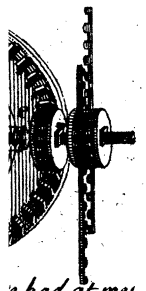


expence, and as it will work pleasantly any number of Racks for
&c. of all denominations already in use. It also serves for small
pulator, which is work'd by the Stud in the main Shaft.

These Prints may be had at
Chocolate-Warehouses
in St. Paul's-Church Y.d I
and in Broad-Mead Bri

Rowe has publish'd what he calls his Friction Wheels tho subsequent to my Specification thereof.

ht Shaft.
with the
ereby to
is a sufficien
hole Duty.
es with
ch
v. confines
frame.
hand to
ht.
ire screw'd
out of sight
Work chief
Draught.



e had at my
houses
h Y.t London
Head Bright

A Perspective View of Mr. CHURCHMAN's ENGINE for raising Water.

a.a.a.a. To the great Frame, the ends of which under the Pine-Apples are to be contracted to the place of the little Frame, so that the Cross piece at III. may support ye 3 bearings now shewn in the little one, for a better view only.

b.b. The little frame on wch the Cap Brasses are, wch receive the turnd T Gudgeons in the 3 Horizontal Shafts.

c.c. The Strong Supporters by the loose Wallowers.

d.d. The loose Wallowers, wch have turnd rounds geer truly with ye Coggs in ye great Wheel.

e.e.e. The Regulator, wch has a Circular, direct and retrograde Motion: see this in the Margins at Fig. 2 & 3.

f.f. The Strong Shoulder or Stud fixd to the Shaft close by ye Wallower, which Stops this loose Wallower when ye end of ye regulater comes against it: thereby confining it for 2 Revolutions: after which it quits this Stud & does the same on the opposite side of the Wheel, & so on Alternately, to reverse ye Motion of the Stems in the different Cylinders.

g.g. The Wheels, with their Coggs, which Alternately work ye fixd Wallower lying between them.

h. The fixd Wallower supposd to be of four Feet in Diameter for a very short Shaft, whose rounds must be of Cast soft Iron & truly turnd, to elevate & depress the Racks to ye Height of 24 Feet by its 2 Revolutions.

iiii. The 4 Lifters or forcers behind each of wch must be a small Leverage back Wheel, truly fitted to direct the same to rise and fall easily & exactly perpendicular, to avoid friction & Loss of Water in ye Cylinders.

k.k. The large vertical Wheel: a small Segment of which comes through ye Floor in ye Dome for ye 4 Horses to stand & Draw on.

l.m. The arms, & ye main Shaft of the same.

n. The turnd T Gudgeon, with its Collar & Shoulder, both of wch must Clasp ye rim of the under Leverage Wheel, to keep all firm & Steady when in working.

o. The leverage wheel of about 4 feet in Diameter, with a Brass or Iron rim supposd to be truly turnd, and to have a Strong short Iron Spindle through its Center, & at each end a turnd Steel Collar & Shoulder bearing on 2 Cast Cap Brasses exactly level, & sunk into a Strong Arch'd piece of Timber well braced and Supported for this purpose. *

Fig. 3.

This draws lies horizontal, and the oval part is perpendicular.

p.p. Two small side Leverage Wheels exactly fitted to ye turnd part of ye great Gudgeon, between ye Collar & Shoulder: they are to be so placid & keyd, that their friction from ye Gudgeon may be alike when at Work.

q.q. The Steps which the Horses feet press, about 8 or 9 Inches broad, 2 Inches thick behind, & declining to an edge, being designd to make level ground & good footing for their hinder Leggs when they Draw.

r.r. 4 Horses only in view: to avoid Confusion, all drawing Horizontally in a Streight Line, & at right Angles, wherely these useful Animals will soon be taught a new & pleasant way of working to themselves, a more advantagious one to their Masters, & of greater Utility to ye Publick, for my observations on ye advantages of this Engine above others in ye Philos. Transac.° N.° 434

s. The fastening places behind ye Horses. Supposd to be strong arms below in ye Supporter, & a Cross bar above, at both of wch you may place small Sheeves or Rollers, ye upper part of them to be level with each Horses breast when drawing, & the Rope or Strap to come over ye same, in order to keep a right suspension of 1,500 more or less one or two Inches from a Plank. By this Method you will be exactly informd of ye Strength of each Horse, how long it continues, & when to relieve him, as Also when justly to correct ye Sloth full one, whose weight resting on ye Plank will always discover his Laziness.

t. The fastening places before being designd to direct their heads.

u. The Dome merely for Ornam.t in ye place of wch erect a Workhouse over ye a horizontal Windmill: or ye lower end of its upright Shaft: fix a Spur Wheel to work with the Coggs of ye great Wheel, thereby to assist ye Horses, or wn there is a sufficient force of Wind to do their whole Duty.

w. The Coupling Staples with their Brasses.

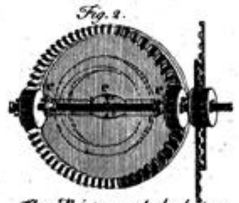
x. The Strong Catch wch confines ye great Wheel to the Frame.

y. The Screw or Key band to confine all close & tight.

z. The Cylinders wch are screwd together at their ends out of sight.

&. All ye same sort of Work chiefly for Uniformity in ye Draught.

Fig. 2.



NB. A single Shaft with the loose and fixd Wallowers, will be of great simplicity and advantage to the Publick, as being erected for less expence, and as it will work pleasantly any number of Racks for lifting or forceing, at either of its ends, or at both together: but chiefly, as it is easily adapted to the different sorts of Windmills, Waterwheels, &c. of all denominations already in use. It also serves for small purposes Vid. Fig. 2 in the Margin. The Pins 44 & the arms 55 which clasp the brasses 66 with the 2 oval figure 7 & its 2 teeth make this Regulator, which is workd by the Stud in the main Shaft.

* In large Engines & Machines where the motion is regular every heavy bearing should have one of these Wheels for, they save Power by greatly abating Frictions. Upon the Principle of these Leverage Wheels Captain Bome has publish'd what he calls his Friction Wheels the subsequent to my Specification thereof.