III. *The Deſcription of a new and ſafe Crane, which has four different Powers; invented by Mr.* James Ferguſon, *F. R. S.*

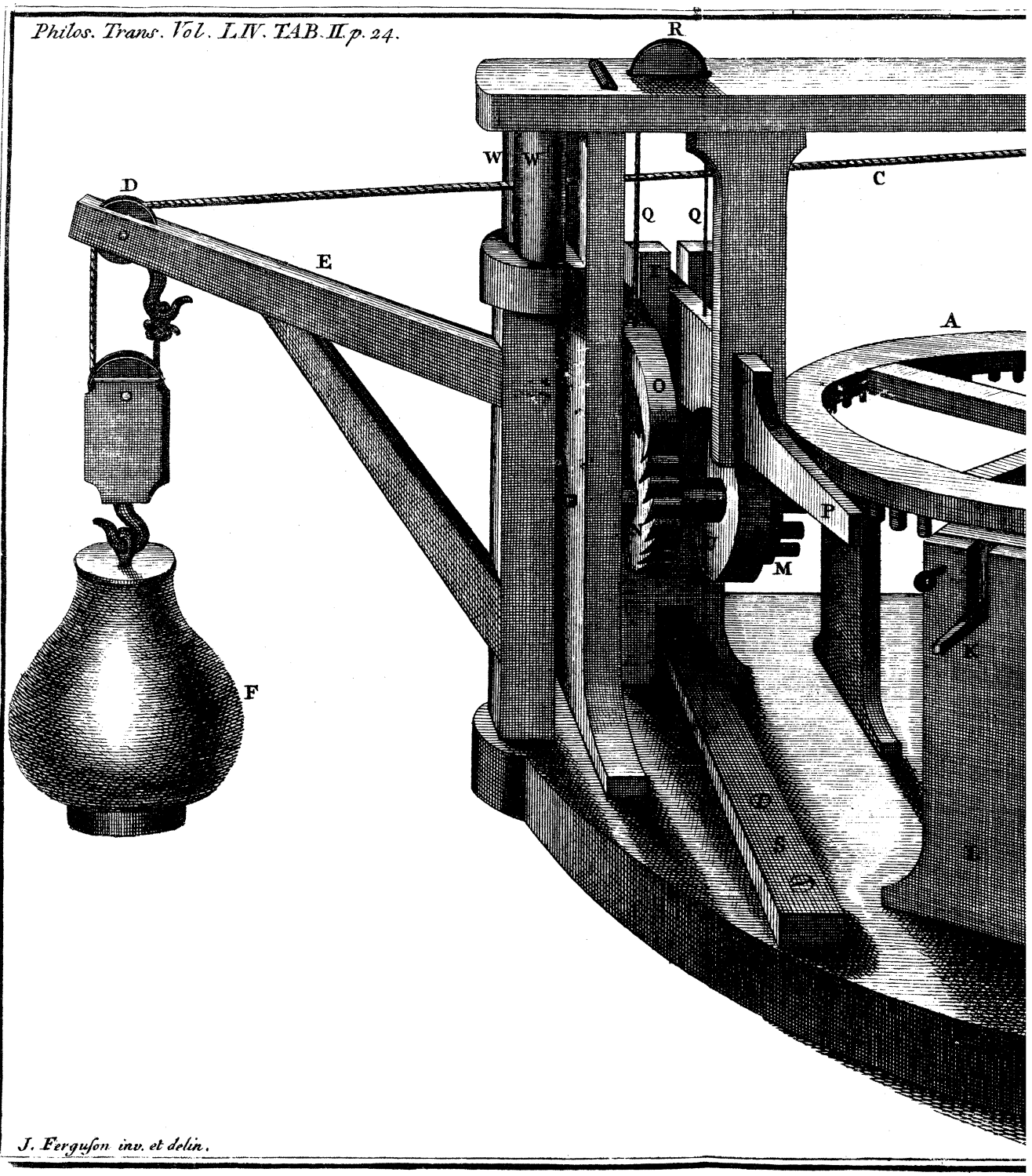
Read Jan. 19, 1764

THE common crane conſiſts only of a large wheel and axle; and the rope, by which goods are drawn up from ſhips, winds or coils round the axle, as it is turned by men walking in the wheel. But, as theſe engines have nothing to ſtop the weight from running down, if any of the men happen to trip or fall in the wheel, the weight deſcends, and turns the wheel rapidly backward, and toſſes the men violently about within it; which has produced melancholy inſtances, not only of limbs broke, but even of lives loſt, by this ill-judged conſtruction of cranes. And beſides, they have but one power for all ſorts of weights; ſo that, they generally ſpend as much time in raiſing a ſmall weight as raiſing a great one.

Theſe dangers and imperfections made me think of a method of remedying them. And for that purpoſe, I have contrived a crane with a proper ſtop to prevent the danger, and with different powers ſuited to different weights; ſo that there might be as little loſs of time as poſſible: and alſo, that when heavy goods are let down into ſhips, the deſcent may be regular and deliberate.

This crane has four different powers: and, I believe, it might be built in a room eight feet in width; the gib being placed on the outſide of the room.

Three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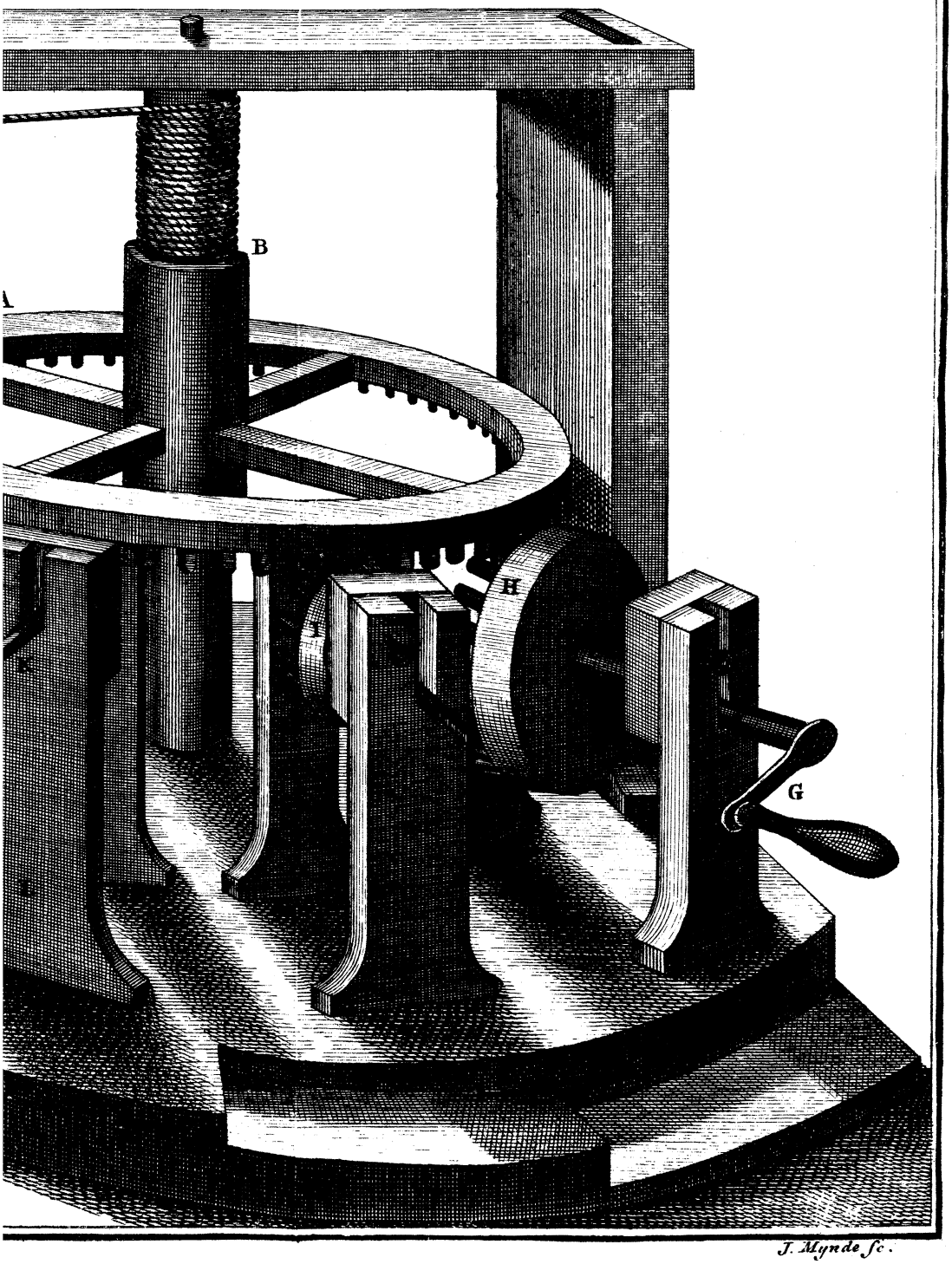

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Three trundles, with different numbers of ſtaves, are applied to the cogs of a horizontal wheel with an upright axle; and the rope, which draws up the goods, coils round the axle. The wheel has 96 cogs, the largeſt trundle 24 ſtaves, the next largeſt 12, and the ſmalleſt has 6. So that the largeſt trundle makes 4 revolutions for one revolution of the wheel and it's axle, the next largeſt makes 8, and the ſmalleſt makes 16. A winch is occaſionally put upon the axis of either of theſe trundles for turning it; the trundle being uſed that gives a power beſt ſuited to the weight: and the handle of the winch deſcribes a circle, in every revolution, equal to twice the circumference of the axle of the wheel. So that the length of the winch doubles the power gained by the revolutions of each trundle.

As the advantage gained by any machine or engine whatever, is in direct proportion of the velocity of the power to the velocity of the weight; the powers of this crane are eaſily eſtimated; and are as follows.

If the largeſt trundle be turned by the winch, it will make four revolutions for one revolution of the great axle on which the rope coils in drawing up the weight: and as the length of the winch is double the ſemidiameter of the axle, the power gained will be as eight to one: that is, a man will be able to raiſe eight times as much weight by means of the engine, as he could do by his natural ſtrength without it; allowance being made for friction.

If the weight be too great for this power to raiſe, the ſecond trundle may be turned by the winch, which will turn the wheel and axle twice as ſlow as

the largeſt trundle did; becauſe it makes twice as many revolutions for one revolution of the wheel and it's axle: and then the power gained will be as ſixteen to one, becauſe the velocity of the power will be ſixteen times as great as the velocity of the weight.

If the weight be too great for this power to raiſe (which we ſtill ſuppoſe to be exerted by one man) the winch may be put upon the axis of the third (or ſmalleſt) trundle, and then, in turning the winch, the power gained will be as thirty-two to one.

But if the weight ſhould be too great, even for this power to raiſe, the power may be doubled by drawing up the weight by a double rope, going under a pulley in the moveable block which is hooked to the weight, below the arm of the gib; for then, the power will be as ſixty-four to one. If the block has two pullies, and the rope be twice doubled below them, the power will be as 128 to one: and ſo on, by adding more pullies, according to any required proportion.

Whilſt the weight is drawing up, the racch-teeth of a wheel ſlip round below a catch or click that falls ſucceſſively into them; and ſo hinders the crane from turning backward, and detains the weight in any part of it's aſcent, if the worker ſhould happen accidentally to quit his hold of the winch; or chooſe to reſt himſelf before the weight is quite drawn up. The catch, in this crane, is conſtructed much in the ſame way as in the great crane at Briſtol, invented by the late Mr. Padmore, of that city.

In order to let down a weight, the man who works the crane pulls down one end of a lever of the ſecond kind, which lifts the catch out of the ratchet-wheel,

wheel, and gives the weight liberty to deſcend. But if the deſcent be too quick, he pulls the lever a little farther down, ſo as to make it rub againſt the round edge of a wheel, by which means he lets the weight go down as ſlowly as he pleaſes; and, by pulling a little harder, he can ſtop the weight, if needful, in any part of it's deſcent. If he accidentally quits his hold of the lever, the catch immediately falls, and ſtops the whole machine.

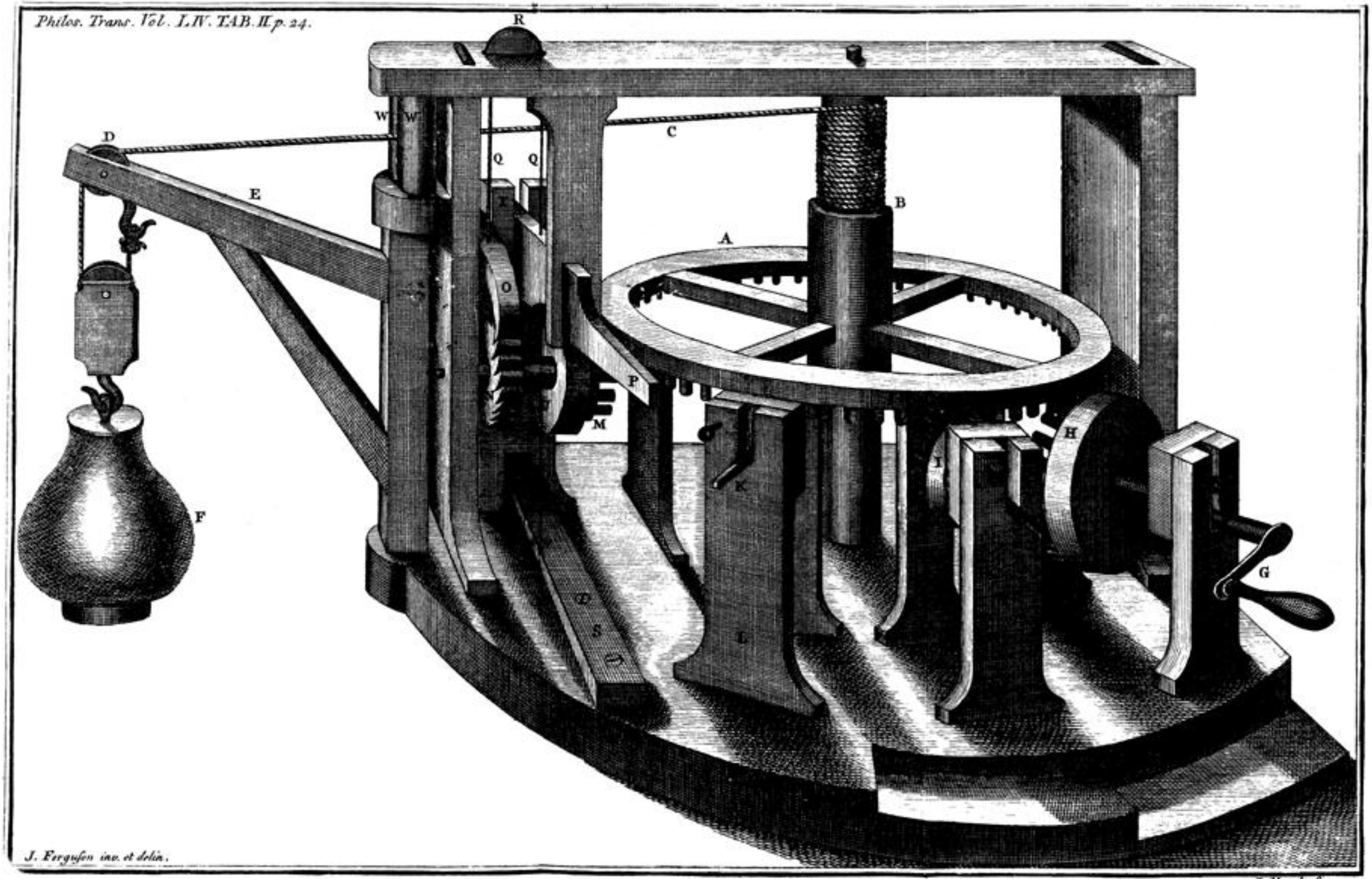
In the figure of this crane [TAB. I.] A is the great wheel, and B it's axle on which the rope C coils. This rope goes over a pulley D in the arm of the gib E, and is hooked to the weight F for drawing it up. G is the winch, H the largeſt trundle, I the next largeſt, and K is the axis of the ſmalleſt trundle, which is ſuppoſed to be hid from view by the upright ſupporter L. M is a trundle, which is turned by the great wheel; and on the axis of this trundle is fixt the ratchet wheel N, into the teeth of which the catch O falls. P is the lever, from which goes a rope QQ over a pulley R, to the catch; the end of the rope being fixed into the lever and catch. S is an elaſtic bar of wood, of which, one end is ſcrewed to the floor; and from the other end (out of ſight in the figure) goes a rope to the farther end of the lever, beyond the pin or axis on which it turns in the upright ſupporter T. The uſe of this bar is to keep up the lever from rubbing againſt the edge of the wheel U, and to let the catch keep in the teeth of the ratchet-wheel. But, when the end P of the lever is pulled down, it lifts the catch out of the ratchet wheel by means of the rope QQ, and gives the weight F liberty to deſcend:

but if the lever be pulled a little farther down than what is ſufficient to lift the catch out of the teeth of the wheel, it will rub againſt the edge of the wheel V, and thereby hinder the too quick deſcent of the weight; and will quite ſtop the weight if pulled hard. And if the man ſhould happen inadvertently to let go the lever, the elaſtic bar will pull it ſuddenly up, and the catch will fall down into the wheel, and ſtop the machine.

W W are two upright rollers, above the axis or upper gudgeon of the gib E: their uſe is to let the rope bend upon them, as the gib is turned to either ſide, in order to bring the weight over the place to which it is intended to be let down.

N. B. The rollers ought to be ſo placed, that if the great rope were ſtretched cloſe by their outermoſt ſides, the half thickneſs of the rope may be perpendicularly over the center of the upper gudgeon of the gib. For then, and in no other poſition of the rollers, the length of the rope between the pulley in the gib and the axle of the great wheel will be always the ſame, in all poſitions of the gib; and the gib will remain in any poſition to which it is turned.

When either of the trundles is not uſed in working the crane, it may be drawn off from the wheel, after the pin near the axis of the trundle is drawn out, and the thick piece of wood is raiſed up a little, behind the outward ſupporter of the axis of the trundle. But this is not material: for, as the trundle has no friction on its axis but what is occaſioned by its own weight, it will be turned by the wheel without any ſenſible reſiſtance in working the crane.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