proportional to its density, as is nearly

the case with air, we may express the

pressure on the piston in any other posi

tion, such as KL or DC, by K *l* and D *c*,

the ordinates of a rectangular hyperbola F *l c,* of which AE AB are the asymp­totes, and A the centre. The accumulated pressure during the motion of the piston from EF to DC, will be expressed by the area EF *c* DE, and the pressure during the whole motion by the area ABF c DA.

“ Now it is well known that the area EF *c* DE is equal to ABFE multiplied by the hyperbolic logarithm, of = L.AD/AE and the whole area ABF *c* DA is = ABFE ×

(1 + L.AD/AE)

“ Thus let the diameter of the piston be 24 inches, and the pressure of the atmosphere on a square inch be 14 pounds ; the pressure on the piston is 6333 pounds. Let the whole stroke be 6 feet, and let the steam ho stopped when the piston has descended 18 inches, or 1.5

feet. The hyperbolic logarithm of 6/1.5 is 1.3862943.

Therefore the accumulated pressure ABF c DA is = 6333 × 2.3862943, = 15112 pounds.

“ As few professional engineers are possessed of a table of hyperbolic logarithms, while tables of common logarithms are, or should be, in the hands of every person who is much engaged in mechanical calculations, let the following method he practised. Take the common logarithm of AD/AE, and multiply it by 2.3026 ; the product is

the hyperbolic logarithm of AD/AE

“ The accumulated pressure while the piston moves from AB to EF is 6333 × l, or simply 6333 pounds. Therefore the steam while it expands into the whole cylinder adds a pressure of 8781 pounds.

“ Suppose that the steam had got free admission during the whole descent of the piston, the accumulated pressure would have been 6333 × 4, or 25332 pounds.

“ Here Mr Watt observed a remarkable result. The steam expended in this case would have been four times greater than when it was stopped at one fourth, and yet the accumulated pressure is not twice as great, being nearly five-thirds. one-fourth of the steam performs nearly three-fifths of the work, and an equal quantity performs more than twice as much work when thus admitted during one-fourth of the motion.

"This is curious and important information, and the advantage of this method of working a steam-engine in creases in proportion as the steam is sooner stopped ; but the increase is not great after the steam is rarefied four times. The curve approaches near to the axis, and small additions are made to the area. The expense of such great cylinders is considerable, and may sometimes compensate this advantage.@@\*

“ It is very pleasing to observe so many unlooked-for advantages resulting from an improvement made with the sole view of lessening the waste of steam by conden sation. While this purpose is gained, we learn how to husband the steam which is not thus wasted. The engine becomes more manageable, and is more easily adapted to every variation in its task, and all its powers are more easily computed.

Let the steam be stopped at Its performance is mult.

1/2 . . . . 1.7

1/3 . . . . 2.1

1/4 . . . . 2.4

1/5 . . . . 2.6

1 . . . . 2.8

1/7∙∙∙∙.3∙

1/3 . . . . 3.2

&c. &c.

“ The active mind of its ingenious inventor did not stop here. It had always been matter of regret that one-half of the motion was unaccompanied by any work. It was a very obvious thing to Mr Watt, that as the steam admitted above the piston pressed it down, so steam admitted below the piston would press it up with the same force, provided that a vacuum were made on its upper side. This was easily done, by connecting the lower end of the cylinder with the boiler and the upper end with the condenser.”

Hitherto we have considered the condensing steam engine of Watt in its application to the purpose of working the large pumps used to draw water from mines or to supply reservoirs from a lower Icvel. This, indeed, was the most obvious and immediate application of the steam-engine, which was at first introduced as a substitute for the atmospheric pumping engine of Watt.

The steam-engine of revolution of Mr Watt was an invention subsequent to the mining steam-engine or “ water-commanding machine." Previous to the time of Watt, indeed, there had been a few attempts made to produce a revolving motion by means of steam, such as the case where the engines of Savary and Newcomen drew up water, which, falling upon the buckets of a wheel, produced its revolution. There had also been many attempts to apply the atmospheric pumping-engine directly to this purpose—Jonathan Hall, Kean, Fitz­gerald, Mr Oxley, John Stewart, and Matthew Wasbrough, had all contrived some means of producing a revolving motion from the reciprocation of the great beam of the pumping-engine; hut Watt’s engine alone had the power of being rendered an efficient and economical motive power.

We shall take the present opportunity of describing Mr Watt's method of communicating the force of the steam-engine to any machine of the rotatory kind.

,, VV, fig. 44, represents the rim and arms of a very large and heavy metalline fly. On its axis is the concentric-toothed wheel U. There is attached to the end of the great beam a strong and stiff rod T, to the lower end of which a toothed wheel W is firmly fixed by two bolts, so that it can not turn round. This wheel is of the same size and in the same vertical plane with the wheel U ; and an iron link or strap (which cannot be seen here, because it is on the other side of the two wheels) connects the centres of the two wheels, so that the one cannot quit the other. The engine being in the position represented in the figure, suppose the fly to be turned once round by any external force in the direction of the darts. It is plain, that since the toothed wheels cannot quit each other, being kept together by the link, the inner half (that is, the half next the cylinder) of the wheel U will work on the outer half of the wheel W, so that at the end of the revolution of the fly the wheel W must have got to the top of the wheel U, and the outer end of the beam must be raised to its highest position. The next revolution of the fly will bring the wheel W and the beam connected with it to their first positions; and thus every two revolu

@@@\* All these calculations, however, proceed upon the supposition that *steam* contracts and expands by variations of *pressure,* in the same ratios that *air* would do.