The engine raises a weight, and it is the function of the fly wheel to absorb the water, thus permitting great rapidity of motion of piston when steam is applied. 76-7

From this mode of operation, the balanced (commonly called "Cornish") valves and the general simplicity of its construction, there is little or no friction excepting its own weight; little, indeed, that in calculations neglecting its windage is allowed for. In an engine of 75 horse power, not more than a pint and a half of oil is used each 24 hours, the piston getting taller. 76-8

In the crank engine, although the steam may be cut off at the same point as in the Cornish engine, the effect of its construction (steam not being regulated by a fly wheel), the same degree of rapidity during a part of its stroke is not practicable nor even desirable. The fly wheel and shaft would break off before such a motion were attained.

Again, in the Cornish engine, the power is applied at the extremity of the weight to be moved, while, in the crank engine, it is applied near the center, being subject to a friction caused not only by the heavy fly wheel, but also by the whole power of the engine pressing on the journals of the shaft. And, further, I am of the opinion that there is a vast deal of the power of the engine absorbed by the fly wheel.

The superior economy is, third, because there is not so much leakage of steam in the operation of the Cornish engine as in that of the double engine.

Theoretically, pistons are steam tight, but practically there always is some or a less leak, and that engine to whose piston, steam direct from the boiler is applied for the longest period in a given time, is of course liable to the greatest amount of leakage. Now let us compare the two engines under consideration: let them each have ten feet strokes and ten strokes per minute. In the Cornish engine the piston will descend, steam being applied in, 1.4 seconds, the piston will travel at the bottom in .9 second, and will ascend at top of stroke in .34 second. In the double-acting engine the piston will descend, steam being applied in .3 second, and turn at bottom in .5 second, steam applied in .9 second, and turn at top of stroke in 1.2 second. These tables I do not pretend are mathematically correct to the minute fraction of a second, yet they are near enough correct for all practical purposes.

By examining them it will be seen (there being one engine ten strokes per minute that, in the Cornish engine, steam direct from the boiler, is on the piston 1.4 seconds per stroke, and consequently 12.1-2 seconds per minute; while in the double-acting engine steam is on the piston 4 seconds each stroke and 40 seconds per minute. Hence, in the matter of leakage, the ratio between the two will be as 12.1 to 40. But this is not quite a fair comparison, the cylinder of the Cornish engine being larger in bore than that of the other, the ratio between the two in this respect being as 1.12 to 1. Now, by working out the proportions, we find that the double-acting engine is liable to more than one hundred per cent. more leakage than the Cornish engine.

Just let us further understand, as it were, as a corollary to the foregoing proposition, that the Cornish engine may be made to perform its up-and-down strokes at any required speed, or, in other words, is perfectly adjustable, thus admitting of the use of the same or even less quantity of steam required by the amount of work to be done, or other circumstances attendant upon any particular case.

And in the fourth place, this superior economy arises because, in the Cornish engine, the condensation of the steam is more effectually performed than in the double-acting engine—a more perfect vacuum being formed.
To understand the action of the Cornish engine in this particular, I will proceed with the description of its working where I left off above, in the consideration of the first reason.

After the engine has been brought to a stand, the piston being again at the upper end of the stroke, the exhaust valve opens, and the engine rests an instant; the first jet of the exhaust forcing all the water, air, and vapor, from the condenser; then the injection valve opens, and the fresh stream of cold water effects instantaneously a more perfect vacuum than could otherwise be obtained—then the steam valve opens for the next stroke, &c.

The escape of the exhaust, the injection of water for condensation, and the admission of fresh steam in the Cornish engine, are each separately under the control of the engineer; and allowing the engine more or less time for condensation, is called by them giving her more or less “bark.”

I have given a few reasons which I trust will be sufficient to lead to further research in this surprisingly much neglected subject—the economical use of the steam power. These are some of the points in which the Cornish engine has a decided advantage over the double-acting condensing engine. It seems almost impossible to give reliable mathematical demonstrations to prove all of its advantages—the best tests I know of, after all, being the indicator and the coal heap.

In closing I would wish to notice Mr. Halsey’s remarks on page 147.

In his attempt to point out the absurdity of the principle, that “the economy of the engine is as the diameter of its cylinders,” he overlooks the other long recognized and universally established principle, that “the piston should move through a space of from two hundred to two hundred and twenty feet per minute to perform economically.”

It would be “alured” in the extreme, to add to the economy of an engine by an increased size of cylinder, and at the same time subtract from it by the neglect of some other well known principle.

There are double-acting condensing engines, built by the same mechanics, under the care of the same superintending engineers, clothed and attended to in the same manner, cutting off their steam at the same point, and in the performance of which the same reputation is at stake, as is the case with the so-called Cornish engines. And yet the result is as stated in my former communication.

I would be glad could arrangements be made in such a way that the expenses should not fall upon single persons—to accept a challenge from Mr. H., to the effect that the two engines of equal power be tried next to one another, with a forfeiture if one engine will not perform as we say. It is to be subject to the forfeiture if my engine will not do its work with twenty-five per cent, less fuel than his; he to be subject in like manner if it does.

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[We received the foregoing communication from Mr. West some time since, and have delayed its publication for one particular reason. A short time previous to the appearance of Mr. West’s article on page 123, this volume Scientia Americana, and since that period, this subject of the Cornish versus the common Double Engine, has been under discussion, week after week, in the London Mining Journal, and we wished to obtain a satisfactory conclusion of the whole matter, from that discussion. We must confess to a disappointment: none of the contributors to the above journal have explained the peculiarities of the Cornish Engine, nor pointed out its advantages in pumping as Mr. West has done in this communication.]