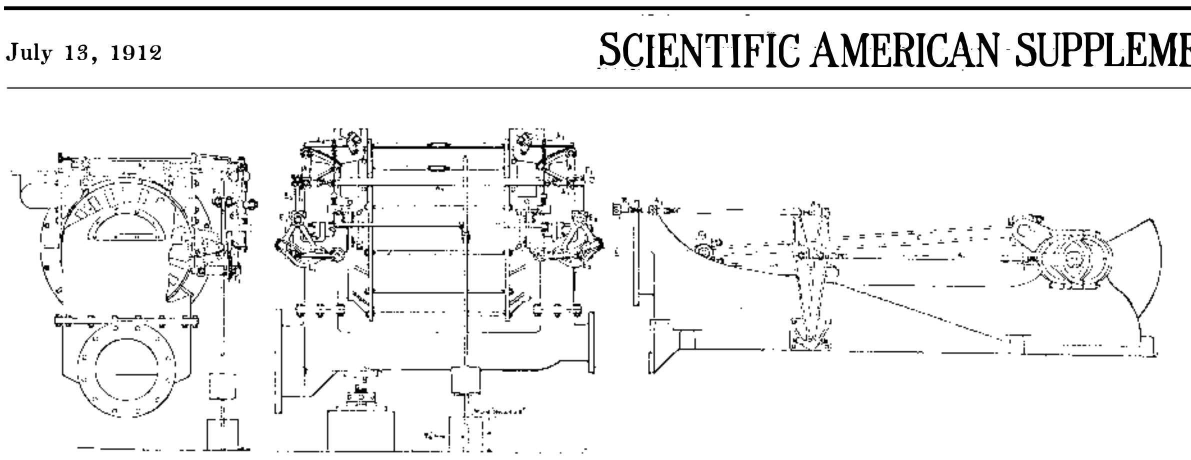


Figs. 2, 3 and 4.—Elevations of the Shuman-Haines Engine.

(End view with section through exhaust; side elevation of cylinder; elevation of frame and eccentrics.)

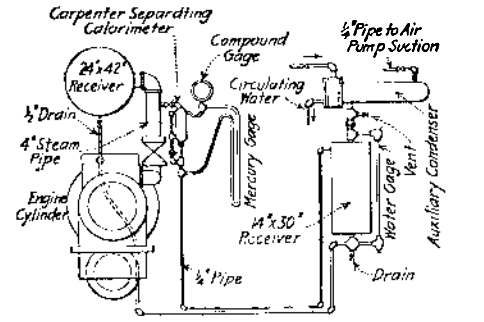


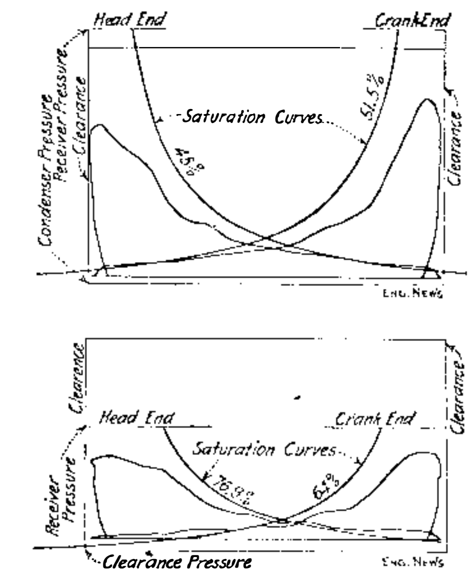
Fig. 5.—Diagram of Connections; Separating Calorimeter for Steam at Less Than Atmospheric Pressure.

obtained were proved, by subsequent tests, to be quite accurate. A separating calorimeter was connected in an auxiliary steam line extending from the main steam pipe to an auxiliary receiver, on which the same vacuum was maintained as on the engine, and through which a fair sample of steam could be drawn by suction. The scheme adopted is shown diagrammatically in Fig. 5. The quality of the steam in most of the tests which I conducted, did not differ greatly from 96 per cent. In a few of the tests conducted with very low pressures the quality approximated 90 per cent.

Indicator diagrams were taken during the test, special springs being carefully calibrated for the pressure conditions under which they were operated. Fig 6 represents the type of indicator diagram which was obtained when the entering steam, as measured in the receiver, was about ½ pound above that of the atmosphere. Fig. 7 represents the form of diagram when the initial steam in the receiver was about 7 pounds less than that of the atmosphere. On both the diagrams submitted, a saturation curve is drawn as a reference line. It will be noted that the expansion line is a long distance from the saturation curve at the point of cutoff, especially for the case of the higher steam pressure. However, it will be noted that these lines intersect before release, indicating that the moisture during expansion had re-evaporated.

With steam about 1 pound above atmospheric pressure and with a vacuum of 28 inches, the engine required 31.6 pounds of steam per brake horse-power-hour. With the same steam pressure, but with a vacuum of 28.8 inches, steam consumption was 28.8 pounds per brake horse-power-hour. These two tests indicate the very material effect of a high vacuum under such conditions of pressure.

With a steam pressure of about 8 pounds absolute (6.75 below atmosphere) and 27 inches vacuum, 37.8



Figs. 6 and 7.—Typical Cards from the Shuman-Haines Low-pressure Engine.

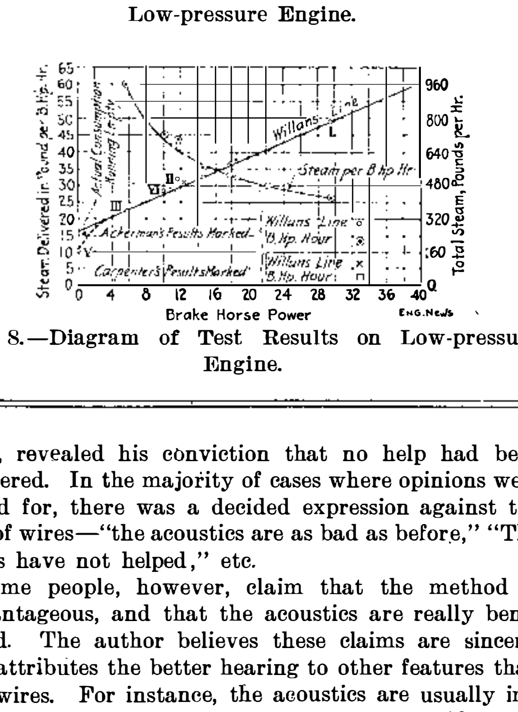


Fig. 8.—Diagram of Test Results on Low-pressure Engine.

pounds of steam were required per brake horse-power-hour. With the same steam pressure but with a vacuum of 28.66 inches, 35.7 pounds of steam were required per brake horse-power-hour.

As compared with the Rankine cycle, the efficiencies vary from 43.8 to 52.4 per cent, depending on the load and steam pressures. On the whole, the results will certainly compare favorably with any published results of any small steam turbines which I have seen.

An independent test of the same engine was made by E. P. Haines a few weeks previous to the tests made under my supervision, and these tests showed substantially the same results.

A. S. E. Ackermann, a noted mechanical engineer of London, England, made a series of independent tests on this engine a few months later than those which I have reported. Mr. Ackermann sent me the general results of his tests and also a diagram on which he had plotted his results and those which I obtained. His diagram is appended (Fig. 8). This diagram was constructed by using the total brake horse-power as abscissas and the total water consumption as ordinates. The plotted results all fall remarkably near a straight line. The fact that the results of the tests of many kinds of prime movers when plotted in a similar way, fall in a straight line, has been proved by numerous experiments, and this empirical law is for this reason a great aid in determining the accuracy of independent tests made on the same prime mover. The fact that my tests and Mr. Ackermann's fall on the same straight line indicate the substantial accuracy of both series of tests. The straight line which characterizes results plotted as explained is frequently referred to as Willan's line, Mr. Willan being a noted English engineer who first pointed out the existence of such a relation. The diagram also shows the steam per brake horse-power per hour for different load conditions.

Wires as a Remedy for Defective Acoustics*

By F. R. Watson

In the popular mind, one of the first aids for a hall with poor acoustics is to install a system of wires or strings with the expectation that in some way the defect will be cured. This prevalent idea is doubtless due to the fact that there are many halls where wires have been strung, and people naturally conclude that there must be some merit in the method. As a matter of fact, this popular impression does not seem to be well founded, for the author has inspected a number of halls thus treated, and has found no marked improvement in the acoustics.

Thus, in Dr. Parkhurst's church in New York city where a thin network of silk fibers of large mesh was stretched horizontally about half way between the floor and the dome, there still persisted a reverberation and an echo. In the Royal Cathedral in Berlin, a number of silk cords are installed in a horizontal network, yet the acoustics remain very defective. A fishnet is stretched near the ceiling in one of the court rooms of the Berlin Rathhaus with no benefit to the acoustical properties. The Royal Albert Hall in London has a series of wires installed, and, while the acoustics there are improved, other features than wires have unquestionably produced the effect. The warden of a church in Nottingham, England, writes:

"Several dodges were tried to overcome the (acoustical) defect, such as stretching wires across the nave."

And so on for other cases that might be cited.

The conclusions of the author in regard to the inefficiency of wires have not always been in accord with the opinions of the auditors in the various halls mentioned. The janitor of Dr. Parkhurst's church, in answer to the question, "Does the net help the acoustics?" replied, "Some says it does, and some says it don't." In the Royal Cathedral in Berlin, according to the attendant's account, the Kaiser thought the wires produced no improvement while the Kaiserin thought they did. The direct question to the attendant as to his own opinion proved very embarrassing and brought only a shrug of the shoulders. Later conversation, however, revealed his conviction that no help had been rendered. In the majority of cases where opinions were asked for, there was a decided expression against the use of wires—"the acoustics are as bad as before," "The wires have not helped," etc.

* Reproduced from *Science*.

Some people, however, claim that the method is advantageous, and that the acoustics are really benefitted. The author believes these claims are sincere, but attributes the better hearing to other features than the wires. For instance, the acoustics are usually improved when a large audience is present. Also, the opening of windows produces a good effect. Furthermore, regular attendants in a hall with poor acoustics gets used to the defect, and, by an adjustment of the attention, are able in some cases to subordinate the disturbing factors and hear better than before. Thus, on one occasion the author fixed his attention on a particularly strong echo and was able to hear more distinctly than by listening to the words as they came directly from the speaker. On another occasion in this same hall the leader of the band had great trouble in conducting a certain selection. The piece being played was a xylophone solo with orchestra accompaniment. After some time the leader discovered that he was beating time to the *echo* of the xylophone. The players near the soloist kept proper time, the others near the leader played in unison with the echo. The result may be imagined.

While both observation and opinion indicate that acoustical defects are not helped by wires, it is interesting to look for further confirmation from the standpoint of theory. It is well known that if a loud tone is sung near a piano, certain wires of the latter will resound. Perhaps this phenomenon suggested the use of wires in auditoriums, with the hope that the objectionable sound would be absorbed or broken up in some way. But the conditions for the response of the piano strings are very favorable. There are many wires tuned to different pitches, so that certain ones are in tune, or nearly so, with any tone sung, and these are the wires that resound The wire in the auditorium would respond therefore to only one of the many tones present. To be effective on this score, there would have to be many wires tuned so as to cover a wide range of pitch. Secondly, the piano wire is backed by a sounding board, which absorbs considerable energy and communicates it to the wire. The response is thus very much greater than it would be without the sounding board. The wire in the auditorium has no such sounding board, therefore it absorbs less energy and has less effect on the sound. Finally, the piano occupies a considerable portion of the space of the room and gets energy not only directly, but also by reflection from the near-by walls and ceiling. On the other hand, the wire in the auditorium is small, and is struck by only a small part of the sound waves, direct or reflected, hence has a small chance to help matters. All of these considerations indicate the smallness of the effect to be expected.

One other way in which wires might be beneficial lies in the possible scattering of the sound waves. Here again, however, the small bulk of the wires allows but little effect. The sound waves pass around the wires in much the same way that large water waves on a pond pass by a stake projecting through the surface. It is only when the obstacle has some size compared with the waves that a disturbance is set up. If there were a large number of wires close together, the sound waves would be influenced. In halls, we find usually only a few wires installed, probably with the idea of having them inconspicuous.

From the various considerations mentioned, it is seen that the installation of wires in halls having poor acoustics is without marked effect. While much remains to be done on the problem of architectural acoustics, and though the means of cure can not be specified readily for each case, it is nevertheless of value to know that the installation of wires, as now used, will *not* serve to cure the trouble.

A Floating Moving-Picture Theater.—A floating moving-picture theater may be seen in the harbors of the Netherlands. The boat is 164 feet in length, has its own electric light plant and is otherwise equipped with the greatest comfort. The venture proved to be a success, as the theater is always well patronized by sailors and residents of the seaport.