ENGINEERING

Cheaper Electricity Is Hope From New Turbine Set-Up

Full-Sized Installation With Quartz Window Enables Scientists To Photograph Whirling Vibrating Blades

MORE EFFICIENT and safer steam turbines, meaning cheaper electricity for everyone, should come from the new, full-sized but completely experimental turbine installation just displayed at the Schuylkill Generating Station of the Philadelphia Electric Company.

The man behind this research, expected to furnish the bedrock of experience for tomorrow's sources of power, is F. T. Hague, engineer of the Westinghouse Electric and Manufacturing Company. In his laboratory studies he had pushed turbine steam operating characteristics up from 250 pounds to the square inch of pressure and temperatures of 600 degrees Fahrenheit (1920) to 1250 pounds pressure and temperatures of 900 degrees—hot enough to melt lead. What he needed for a final test was a full-sized installation of a plant boiler capacity which could create the 125 tons of steam needed, each hour, to run such an installation. The plant of the Philadelphia Electric Company provided such capacity.

Moreover, this installation had to have some means of looking inside it and seeing how the turbine blades were vibrating under the extreme shock. "To form a mental picture of this shock," Mr. Hague explains, "imagine a turbine blade moving 350 miles an hour abruptly entering a steam jet density moving 1200 miles an hour." Oscillations at the rate of 126,000 times a minute occur in the blades, or 181,440,000 per 24-hour day.

Just as trees sway in a gale, so too do the turbine blades sway and vibrate under this super-hurricane of hot, "live" steam. If the vibrations are just right the blades enter into what engineers call resonance. Eventually they break off as their sway becomes greater and greater. If conditions are properly arranged, however, the vibrations can be kept out of resonance and the blades will not break. But to determine this resonance and non-resonance condition, engineers have to be able to look inside and see what is happening.

While the turbine blades are whirling some 60 revolutions a second around the turbine shaft an automatic camera takes pictures through a tiny quartz window in the shaft at the rate of two a second.

"With this new apparatus," Mr. Hague explains, "a beam of light is carried through the shaft of the turbine and up into the blade itself, where mirrors reflect it out again, faithfully recording all vibrations. In this manner the harmonic movement of the blade can be recorded on film for any stated condition of operation.

"The light beam, supplied by an arc lamp, is deflected by a stationary mirror into the rotating shaft," he pointed out. "A slanted mirror inside the shaft throws the light beam through a hole in the rotor disc and then through a smaller hole inside the blade, towards a small curved mirror on the end of the blade. This curved mirror sends back the light by way of the slanted mirror in the shaft, to a screen.

"When the turbine rotates without vibration, the light point on the screen describes a circular path. But when the blade vibrates, the curved mirror mounted on the end of the blade deflects the light beam away from this path and waves or notches appear on the circle. The wavy circle described by the light is recorded on film by a specially designed speed camera.

"By study of the resulting pictures the stresses on the blades are deduced directly from the magnitude of the waves by proper calibration. By shifting the mirrors, it is possible to measure side-to-side as well as back-and-forth vibrations."

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MILITARY SCIENCE

Garand Rifle Modified To Give Bayonet Support

THE U. S. Army's new self-loading Garand rifle, now in quantity production, has had its muzzle end slightly modified and simplified, to support the bayonet more solidly. A number of minor adjustments have been found necessary in the quantity-manufactured rifles that were not apparent in the earlier rifles produced by slower, small-scale methods, but no major faults have been discovered. (*Army and Navy Journal*, Feb. 17)

Army Ordnance men hoot at rumors that the Garand can't "take it" under field conditions. Before it ever was adopted to replace the time-tried Springfield '03 model, it was put through the most severe treatment that hard-boiled Army men could think of. It was dropped off a cliff on rocks and hard ground. It was thrown into water and left there for hours. It was rolled around in sand, kicked around in deep dust, tramped into mud. Picked up and given no more wiping than was possible with the soldier's bare hands, it functioned with as much snap and smoothness as if it had come fresh from the gun rack.

Another criticism was that it would be difficult to clean caked carbon off the front end of the rod that takes the push of powder gases near the muzzle and operates the self-loading mechanism. This rod is released with no other tool than a small screwdriver, and the carbon scraped off with the same instrument.

The sights of the Garand, both front and rear, are coarser than those used in scoring world-beating records with the Springfield. However, it is pointed out, these sights are designed primarily for battle purposes, at 500-600 yard ranges. If fancy shooting is desired, special sights can be fitted on the target rifles.

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PHYSICS—MEDICINE

Radium's Rays Compared With Unit of X-Ray Dosage

FOR the sake of cancer sufferers the relationship between 1,000,000 volt X-rays and gamma rays from radium—two kinds of radiation which are similar physically and in their medical effects—are being compared at the National Bureau of Standards. Loan of half a gram of radium to the National Bureau of Standards by the National Cancer Institute established for the first time the relationship between the international unit of X-ray dosage and radium's gamma ray dosage. Such information will enable physicians and physicists to determine the relative economics of the two kinds of treatment and the range of usefulness of each.

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Something like a *League* of Nations was proposed for the 21 American republics in 1812.