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L. P. Sieg

ON THE RECOVERY OF THE ELASTIC PROPERTIES OF A PLATIMUM-IRIDIUM WIRE.

BY L. P. SIEG.

The writer has at various times discussed the elastic properties of wires made by alloying different percentages of iridium with platimum. In particular this study has been carried on with a 40 per cent alloy.[1] The principal feature of the previous work was a study of the torsional elastic properties of this wire; the wire in these cases being used as the suspension of various torsion pendulums. One of the facts of most importance developed in this investigation was that the period of the pendulum not only depended upon the amplitude (a fact discovered by Guthe)[8] but that the relation of the period to the amplitude was not always a constant one. In fact in the earlier investigation it appeared that the connection between period and amplitude was such a complicated one, that any further study of the elastic properties must first be directed toward this one relation of period and amplitude. A good advance in this knowledge was recorded in the paper previously referred to, but much remains to be done. Its importance in the theory of elasticity can hardly be overestimated.

It appeared in previous work with the wire that the relation between period and amplitude depended very largely on the amount of vibration which the wire had undergone previous to any one experiment. For example if the initial amplitude were 100°, the period changed by 3 per cent; if the initial amplitude were 200°, the period changed by 6 per cent; and if the initial amplitude were 600°, the period changed by 8½ per cent—all of the above dying down to zero amplitude. However, if the wire had been vibrated for some time at a large amplitude, then the percentage change in coming to rest from a smaller amplitude was much larger than those mentioned above. In fact it seemed that after the wire had been vibrated at large amplitude, it had acquired a peculiar elastic condition which could only be removed by annealing it at bright red heat. There was some little evidence that

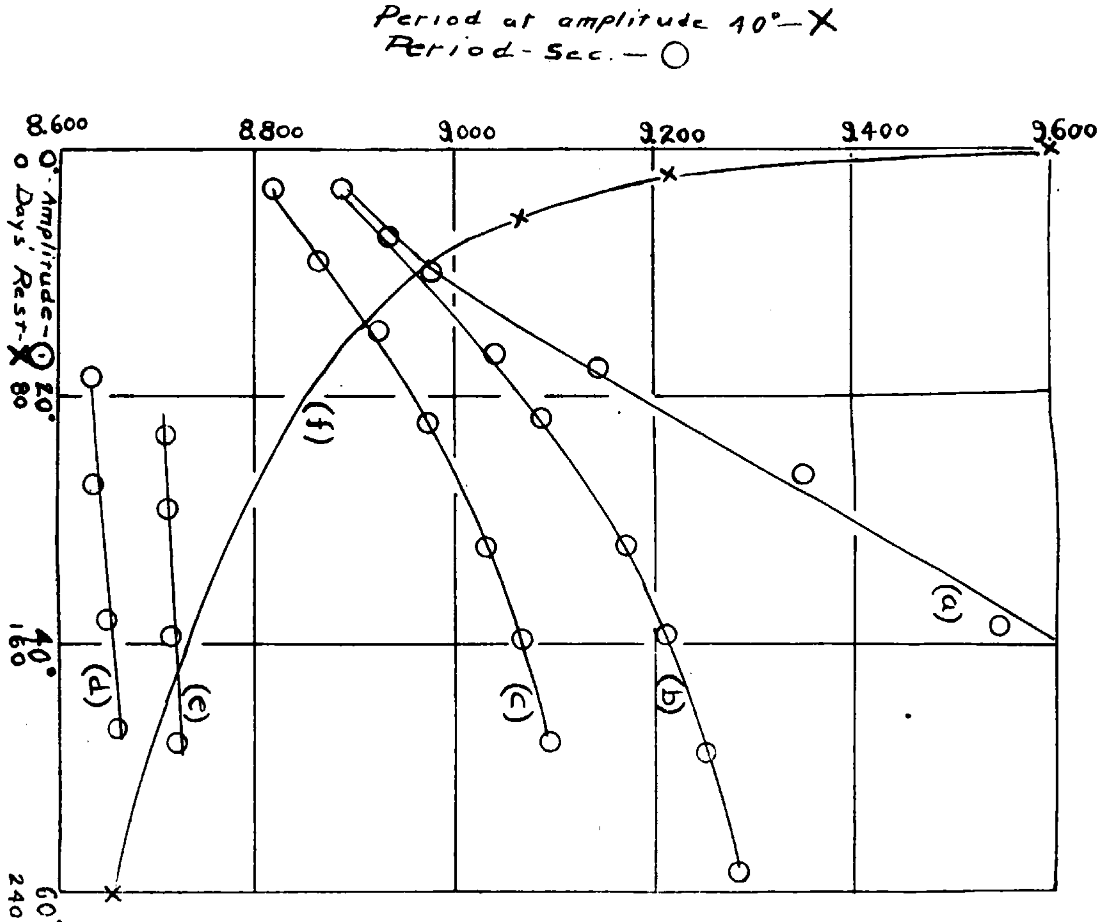
[1]L. P. Sieg Phys. Rev. 31, p. 421, 1910.

[2]K. E. Guthe, these proceedings, 15, p. 147, 1908.

after a period of rest the wire tended automatically to reach the annealed condition. However, at the time that this was noticed there was no opportunity to give the wire sufficient rest, so the point was not verified.

When the writer had finished his observations with the wire in April, 1910, his attention was turned to other matters, and as a result the wire was not disturbed for a period of about eight months. When the last experiments had been done on the wire, it had been vibrated a great many times at large amplitude, and had not been annealed at the end of the observations. So here was an excellent opportunity to observe if the period of rest had had any effect in restoring the wire to its elastic condition. The first experiment following this long rest was very carefully made, with the initial amplitude at only about 50°. This was necessary, for a much larger amplitude would have destroyed the annealing effect of the long rest, and so the effect sought for would have been completely masked. The results of this and of the subsequent experiments, to be discussed later, will best be observed by reference to the accompanying figure. In this figure there are platted two sets of curves, one which we are now examining, and the other to be discussed a little later. Curve (a) represents the relation between period and amplitude in the lower ranges of the amplitude for the experiment where the wire had been vibrated to an amplitude of 720°. The relation between these same two quantities after the eight months' rest is shown in curve (d). The curve showing the relation between these quantities after the wire is annealed, is shown in curve (e). It is interesting to see that the rest has not only restored the wire to its annealed condition, but has actually carried the elastic condition beyong that point. I believe that this is the first time that such a phenomenon has ben observed.

After this interesting observation, experiments were tried in order to discover if possible the rate at which the wire was automatically restored to its annealed condition. It necessarily follows that such experiments must be very tedious, for it is necessary to leave the wire undisturbed for long intervals of time between readings. This will account for the relatively few observations that I have recorded. In this same figure will be found two other curves of this series: one, curve (b), for an eight days' rest, and one, curve (c), for a twenty-two days' rest. It is hoped that further observations on this point may be made. It will be observed that the recovery of the wire is really very rapid at first, but becomes gradually slower and slower. In fact one is strongly reminded of the logarithmic form of the ordinary



decay curves. To bring this point out more clearly, curve (f) has been drawn. This curve is one connecting days' rest with the period of the wire at a certain definite amplitude—in this case 40°. To fill out the blanks in this curve, observations should be taken for the eighty, and for the one hundred sixty days' rest.

While the detailed study of this wire is of no great importance as far as its own place in elasticity is concerned, still it is hoped that sufficient information will be gained concerning its elastic behavior, so that the properties of more ordinary wires may be more clearly grasped. It is believed by the writer that all wires will be found to show these properties, only most of them to a much smaller degree. In this case we are, as it were, looking at the subject through a microscope. An investigation of phospher bronze wires is to be undertaken in a short time.