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Tues. 9th Dec '69

Dear Mr Lowry,

RE WATER CLOCK

I feel I owe you an apology for my long silence after all the interest you showed in my home-made clock. Certainly I must make some explanation of what is happening and if you see Mr Fowler perhaps you would be good enough to let him know the position.

I completed the clock for the Museum some months ago — at a guess I would say 4 or 5 months ago. When I say "completed" I mean that it is almost exactly the same as the first clock but with some minor improvements, and it has in fact been running all this time though with occasional stoppages.

It is these stoppages that have caused me to withhold delivery to the Museum. Here, with the clock under my daily care, I can prevent the stoppages by keeping the fine plastic water tube clean every 3 or 4 days. But when it goes to the Museum I want to feel that, apart from keeping the main tank refilled with water, the clock will run for at least 2 or 3 weeks with no attention whatever.

The whole trouble is concerned with the

flow of water through the fine plastic tube from the constant-level tank (i.e. the small tank with the float in it) to the "dripping point" as I call it (where the pendulum picks up its 1/1000 th oz. of water each swing).

The flow of water thro' this fine tube varies due to two causes :-

(i) The clogging effect In spite of having added Copper sulphate to the water, and also having a filter in the system, the fine tube slowly clogs and there is a slow but steady decrease in the rate of flow of the water till — if I take no steps to correct the condition — the clock will stop due to inadequate water supply in a few weeks.

(ii) The temperature effect. The viscosity of water at 90°F is only half that at 40°F which results in the flow of water at 90° being approx. double what it is at 40°

I felt that in the Museum, where the clock could receive attention only once a week, the combination of these two effects would result in occasional stoppages and that the clock would become regarded as unreliable. Having come to this decision I started looking for a method of

automatically controlling the water supply.

I don't do much work on it each day — all sorts of things crop up and hold me up — and I don't seem as quick at ideas as I used to be. However in the last 3 months I have been toying with all sorts of ideas for this automatic control. There have been 2 or 3 which are quite suitable in principle but just too difficult for me to make.

In theory it is quite easy to design a device that will maintain a flow of 1oz per 15 minutes within + or − 2 or 3 o/o and I almost completed one such device but in the end I gave it up. At present I am trying to tackle the problem from a quite different direction. Instead of basing the design on the amount of water flowing every 15 minutes and then increasing the flow if the amount is less than 1oz (or decreasing the flow if it is more than 1oz) I am basing the new design on the amplitude of the swing of the pendulum. The amount of the swing would be checked every few minutes (possibly every 10 to 15 minutes). If the swing is more than a certain desired amount the flow of water would be slightly reduced and vice versa.

If I can make this device sensitive enough

it should maintain a fairly constant swing
pendulum under the following adverse
conditions:-

(i) gradual clogging of the fine tube
(ii) rises or falls of temperature of as much
as (say) 10°F per hour
(iii) any slow alteration in the friction of
bearings and pawls due to lack of oil
or change in viscosity of oil etc..

If we cannot maintain absolutely clear water there will of course be a final clogging of the tube ~~beyond~~ at which the automatic control has reached its limit of adjustment. Cleaning of the tube would then be necessary. However I am hopeful that cleaning of the tube once every 4 weeks would be all that is necessary. It is a simple operation taking only a few seconds - Simply withdraws the end of the fine tube and poke a bit of wire thro' it 3 or 4 times.

I like this idea of maintaining a constant amplitude of the swing of the pendulum much better than my earlier ideas. I am fairly confident that I can make it and that it will work satisfactorily. However I wouldn't hazard a guess when I will have completed it.

I might have said earlier that I also consider

overcoming the temp. variation problem by fitting the clock in a glass case with a thermostat and a rule heater to maintain the clock at a constant temperature of (say) 80°F or so (i.e. the highest temp. that would be likely in the museum). But this method would not have overcome the clogging problem.

My proposed pendulum-curing control device will unfortunately detract from the simplicity of the original clock — it may in fact be cumbersome and complicated — but it will have an interest of its own. I can imagine that enthusiasts might often wait a few minutes to watch the control device operate.

Above all, my own impression of Museums is that an exhibit which really works is infinitely preferable to a stationary model particularly if it looks at all unlikely that it ever did work.

Hence my anxiety to produce a reasonably reliable working model.

So with humble apologies if you have been disappointed in the awful delay I send you kindest regards, — my wife joins me in all this — Xmas greetings and our hopes for a Happy New Year for you and your wife.

P.S. I think I need as a motto :—
"PER ARDUA AD CLEPSYDRA!"

Yours sincerely
E. S. Nurse (E.S. NURSE).