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May 9th ~~MAY~~ '69

Dear Mr Lowy,

~~An old friend of mine~~ — ERIC BISSETT — suggested to me recently that I should write to you about one of my gadgets. I retired from the Royal Australian Navy back in 1956 after 44 years service mainly in the Marine Engineering field. I am interested in all sorts of subjects but mechanical gadgets seem to be my abiding hobby. In retirement I have had full scope for my hobby and have produced such things as a solar hot-water service, a self-propelled garden spray, a 3-D sketching machine and viewer, a reflecting open fire place, a home-cooling system, a dynamic balancer for laundry spin-dryers, a knitting machine, a rug-making machine and a few other minor things. Even in this electronic and space age there is still an almost limitless range for the mechanical gadgeteer. However, all this is almost by-the-way.

Most engineers in their youth have spent a lot of time thinking about perpetual-motion machines. They get nowhere but learn a lot in the process. Another thing they go for is clocks and in this I am no exception — I have always been fascinated by clocks and one of my ambitions over the years has been to have a home-made clock.

I haven't got a real workshop and my equipment consists of a small welding machine, an electric soldering iron and the usual simple hand tools. Haven't got even a power drill. This means that everything I make has to be very simple and of the simplest materials — generally a mixture of wood, mild steel rod, fencing wire, galvanized iron sheet, aluminium sheet and nails and screws.

This self-imposed limitation of equipment and materials would obviously place many types of gadget right outside my capacity. One result however is that in thinking out how to make something I am forced to as-it-were refine my ideas down to the limit of simplicity.

With this rather immodest introduction I will come to the real point of this letter. I have made several attempts at a clock mechanism and last year I finally succeeded — anyway, to my own satisfaction. It has been running since last September but has to be stopped about once a week for a few seconds to clean out a tube. (This weakness could be overcome but is of so little consequence to me that I haven't bothered.)

The main characteristics of the clock are as follows :-

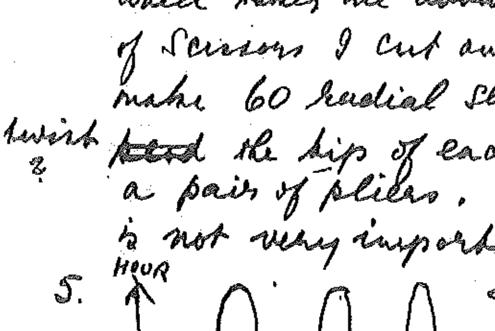
1. The motive power of the clock is water. It uses an average of $\frac{1}{1000}$th oz per sec i.e. a little over 4 pints per day. As I have fitted it with a 1-gallon tank it is thus a 48-hour clock. To increase it to an 8-day clock I would only have to increase the reservoir to 4 gallons. No other alteration would be necessary.

2. If kept at normal room temperatures (say from 60°–80°F) the clock is accurate within a minute a day

3. The clock has the normal hour and minute hands and a sweep second hand on a 5 inch diam face

4. There are only 3 wheels in the whole clock and all are identical – 60-teeth wheels. Each wheel takes me about 1 hour to make. Using a pair of Scissors I cut out a disc of alum^{m} sheet and make 60 radial slits round the periphery. Then twist ~~bend~~ the tip of each tooth at right angles with a pair of pliers. The exact spacing of the teeth is not very important

5.

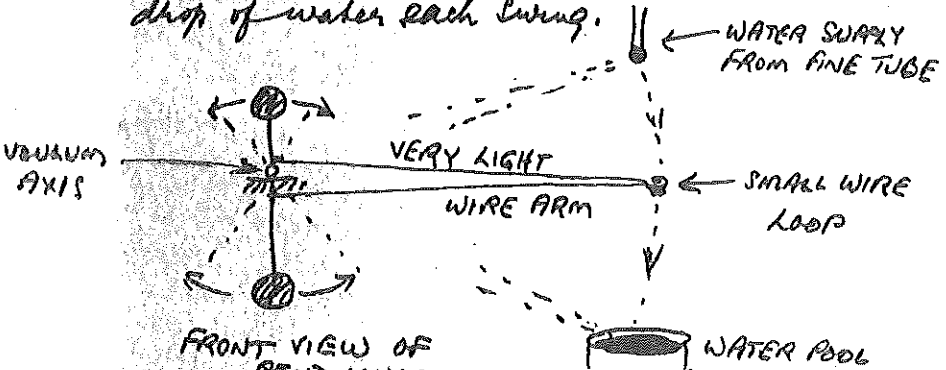


The arrangement of the 3 wheels and the hands is roughly as shown (teeth not shown)

The Second wheel is driven by a pawl operated by the oscillating pendulum – one tooth per swing.

The minute wheel is also driven by a pawl which is operated by a spiral wire cam attached to the second wheel. And of course each full revolution of the second wheel advances the minute wheel by one tooth. The hour wheel is driven in a similar manner except that there are 5 wire cam segments attached to the minute wheel so that the hour wheel is advanced one tooth every 12 minutes thus giving $\frac{1}{12}$th of a rev.n of the hour wheel for each full rev.n of the minute wheel.

6. The heart of the clock is the pendulum which is directly driven by the weight of portion of a drop of water each swing.



FRONT VIEW OF PENDULUM

It is a compound pendulum roughly as shown, adjusted to give a complete to and fro swing in 1 second. The axis is solid with the pendulum and the axis ROLLS on the supports thus eliminating friction and wear. A vertical slot on each support maintains alignment so that the wire loop cannot miss picking up water at the top of the swing but the slots are slightly wider than the full side to side roll of the axis.

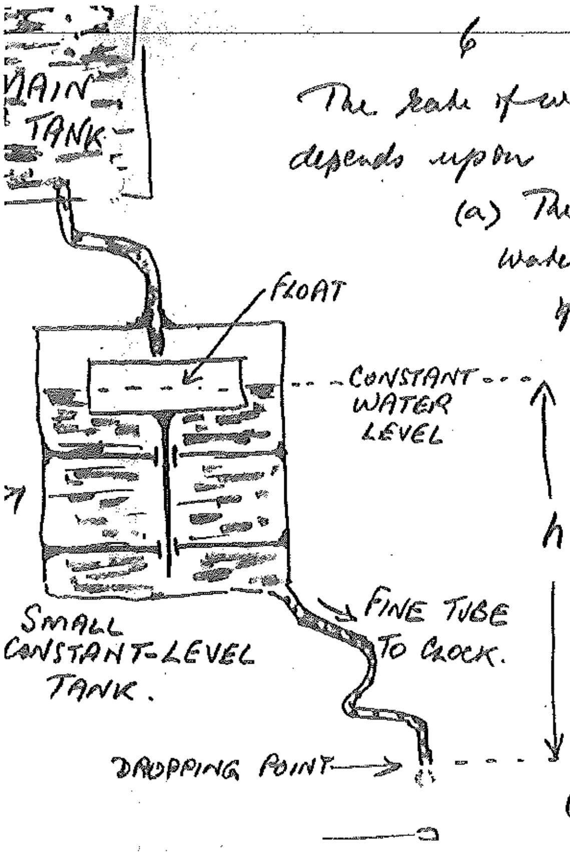
SIDE VIEW PEND^m

The driving pawl (not shown) is attached to the pendulum and drives the second wheel one tooth on each <u>downward</u> swing of the light wire arm of pendulum i.e. when there is the weight of the $\frac{1}{1000}$ th oz of water picked up by the wire loop.

It is a simple matter to adjust the height level of the water supply tube at the top and the water pool at the bottom so that the light wire arm attached to the pendulum delicately picks up the water drop at the top. Due to surface tension the drop of water is quite firmly held by the little wire loop and thus gives the required very light downward thrust. As soon as the bottom of the drop touches the water pool surface the drop is instantly released and the arm swings up empty ready for another drop.

There is a small clearance between the end of the wire loop and the end of the water supply tube so that there can be no <u>mechanical</u> shock when the loop picks up the drop of water and continues to rise slightly further before coming to rest at the end of its upward swing

7. The ~~rate of~~ water supply is maintained at a reasonably ~~rate~~ steady rate by interposing a constant-level tank between the main water tank and the water supply tube to the clock. This is shown in rough sketch on the next page.



The rate of water supply to the clock depends upon 3 factors :-

(a) The height h between the constant water level and the dropping point of the fine tube. (This can be maintained quite steadily with no trouble at all)

(b) The viscosity of the water, which depends only on the temperature. (This point CANNOT be maintained at a steady level in the ordinary home).

(c) The slow choking-up of the fine tube due to impurities in the water — presumably algae, dust &c &c.

In fact the rate of water supply is not very critical. My clock is placed right against a window in the kitchen where it is subjected to extremes of temperature. During the day the whole of the clock mechanism (without any covers at all) is exposed to the full radiant heat of the sun thro' the window for perhaps 6 hours of the day. During the night the air temperature a mere 6 inches away through the glass window falls to as low as 32° (a week ago) and 34° (last night). The clock is placed on a shelf <u>between</u> the window and the window blind. I could

ardly position the clock in a more unsatisfactory
lace. I have known the clock to use as little
, 5½ pints per day and as much as about 7 pints.
If the water supply is too fast the drop of water
lls from the end of the fine tube before the wire
loop has risen to the top to pick it off. If the
ater supply is too slow the amount of water picked
p by the wire loop is too light to overcome the
riction in the clock. However there is a very
ide latitude between these two failure limits.
The biggest weakness in the clock is the matter
the slow choking-up of the fine water tube to the
lock but, as I have indicated, it is only a matter
a few seconds to pass a length of fine wire up this
ube and thus clear it for another week or so. If I
re trying to further improve on the clock I would
xperiment with such things as adding some drops of
oison to the water, fitting fine filters, and even
hanging over to the use of (say) kerosene instead of
ater. But the clearing of the tube is so simple
hat I just haven't bothered.
So much for the technical details of the clock.
have no idea of the principle on which the old
riginal water-clocks worked but I rather think that
principle I have used is probably different and
possibly better.
My clock looks frightful. Its like a Heath-Robinson
contraption. When I make something and it works

well enough, I leave it as it is and go on to something else. If I were a real craftsman I should try to make it look more compact and beautiful. At the very least I should fit some sort of cover over it to keep dust off it and stop spiders spinning their webs on it. But it puts up with all this abuse quite cheerfully and visitors can inspect the working either thro' the window or in the kitchen without my having to dismantle anything at all.

Having said all this at great length I would only like to say that I would be very happy indeed if you were able to come out at any time whatever and have a look at it. From the position you hold at the museum it is obvious that clocks are very close to your heart and that you know 100 times more about them than I do. That is why I have gone to such length in my description, as I would not like you to waste your time looking at this thing of mine if it is already well known to you in principle.

Could you make it an occasion to bring your wife with you and have a cup of tea or whatever?

Yours sincerely

E.S. Nurse E.S. NURSE

CAPTAIN R.A.N. (RET'D)