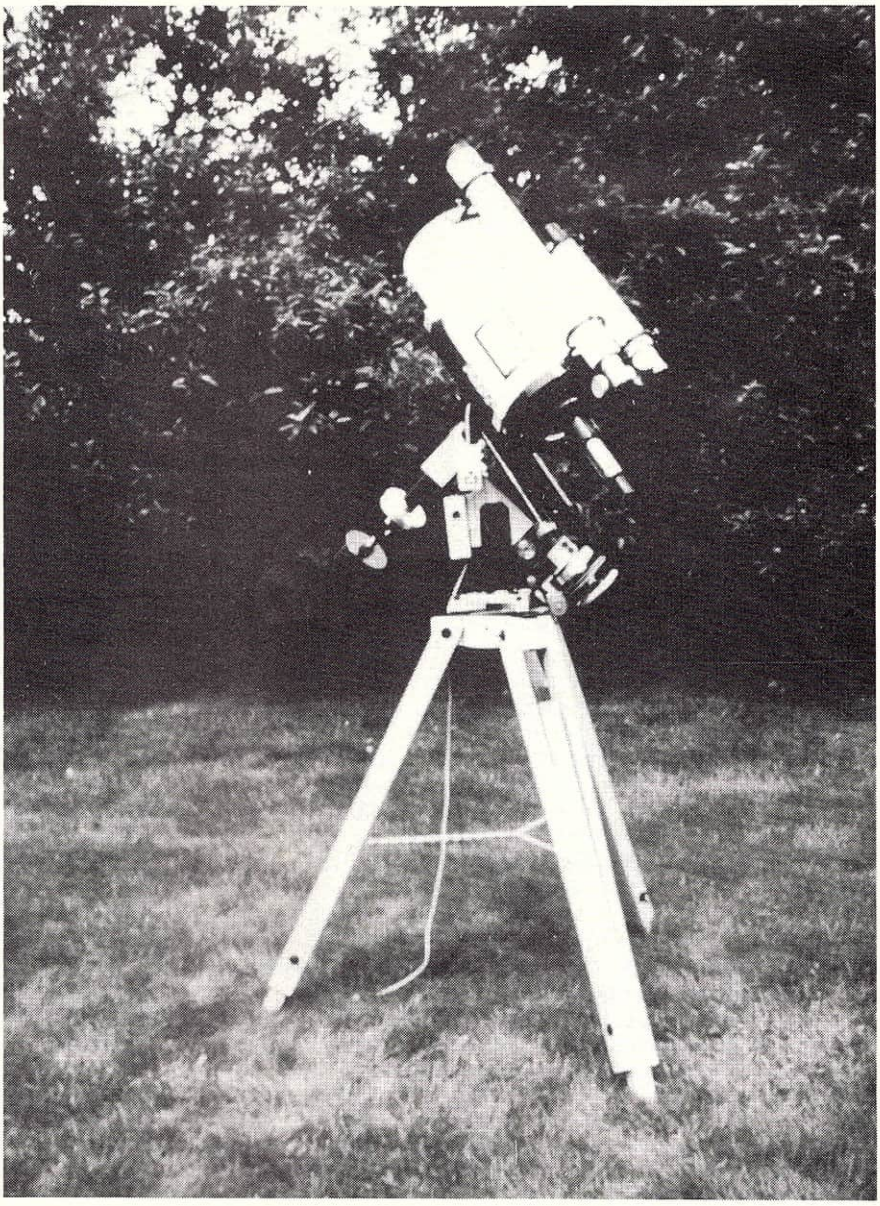

telescope control

seeing distant stars . . .

Stopping the movement of heavenly bodies (on a photographic plate at least) is the purpose of this article. A camera mounted on a telescope can, with a long enough time exposure, enable the more distant stars to be observed. To do this the telescope must be able to track the star accurately for the period of the exposure. Two 24 V synchronous motors are used to enable the telescope to traverse at an accurate speed in either direction.

An important part of astronomy is of course observing stars and other heavenly bodies. Observations can be carried out with the aid of a telescope or even, in some instances, with the naked eye. A vast number of stars still remain unseen however and in order to study them, somehow these (or some of them at least) must be made visible. The method of doing this is to take a photograph of them through a telescope but in order to be any good it must be a time exposure.

Exposure times varying from some minutes or even hours are necessary for the very distant stars to become visible on film and this can cause some problems. During a fairly long exposure the 'position' of the star will change due to the rotation of the earth and the result on the film will not be a dot but a dash.

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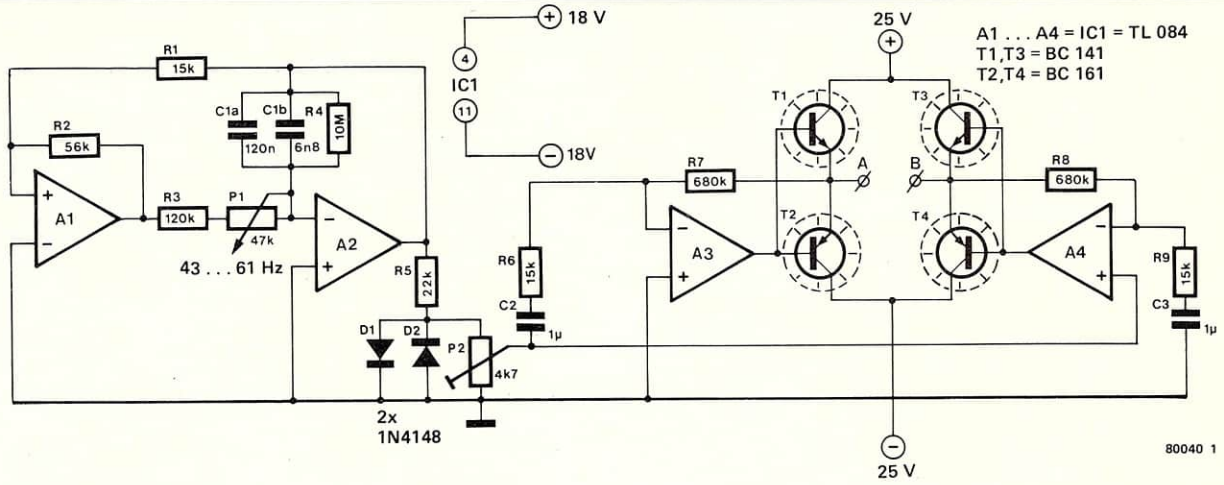

Since halting the rotation of the earth is a little beyond the scope of this particular article we will have to deal with the problem in a simpler manner. Following a star with the telescope can obviously not be done by hand if a clear image on the film is to be obtained. The movement will have to be so small and carried out so slowly that any star-watcher would probably revert to stamp collecting before sunrise. The answer is of course a motor drive.

Motor drive

For a motor drive to operate precisely a synchronous motor is an obvious choice. An electric clock motor could well spring to mind since the movement of the telescope can be compared with the hour hand of a clock. However, a clock motor will invariably be too weak and therefore, either a motor specifically designed to drive telescopes or a motor and gearbox combination must be used. It must be a synchronous motor because the speed of this type of motor is directly dependent on the frequency of the AC supply that powers it.

Almost all synchronous motors available in the U.K. have been designed for use with a frequency of 50 Hz. This provides them with a very stable speed, exactly what we want for our purposes – nice and simple! Unfortunately *not*, there is a snag. Yes, the motor speed should be constant but it must also be accurately adjustable within certain limits. This is necessary because the so called 'astronomic day' isn't exactly equal to our common or garden 'earthly day' of 24 hours, but slightly shorter. Moreover the length depends on the seasonal 'wobble' of the earth. We are currently working on an article to rectify this using PLL (Planet Locked Loop). The AC supply used to drive the synchronous motor must therefore be finely adjustable. This article provides the circuit for just such a variable frequency AC power supply designed for 24 V 50 Hz motors.

The AC generator

The circuit diagram for the AC generator is shown in figure 1. The two opamps A1 and A2 together form a triangular waveform generator. This waveform is 'rounded off' by R5 a the two diodes D1 and D2 because synchronous motor prefers a mo sinusoidal supply.

The frequency of the generator adjustable between approximately and 61 Hz via P1. The preset pote tiometer P2 is used to adjust the outp amplitude of the bridge amplifier.

A bridge configuration is used becau it is able to produce an output amp tude of twice the supply voltage lev In this case, the amplified AC volta between the points A and B has a pe value of 32 V. This results in an RM value that is fractionally lower than t desired 24 V that is needed to drive t motor.

Left and right

To be practical, the telescope must able to turn in both directions enable it to track any star in any p ition. Synchronous motors however v only drive in one direction, they are r reversible. The simple answer to this to provide the drive with two mot arranged to drive in opposite directio on one shaft. If one of the motors now supplied with power, the other v just free-wheel backwards.

The drawing in figure 2 illustrates h power is supplied to each motor. T points A and B in this drawing cor spond to points A and B in figure 1. T two relays Re1 and Re2 are controll by the three position switch (left, st right). Motor M1 is switched on by R and motor M2 by Re2. The switch a relays are arranged in this manner enable the two motors to be controll remotely which may well be desiral to prevent vibration of the telescope.

Since movement of the telescope will very slow, the LED's have been includ to give an indication of direction, if ar The capacitor C4 must be unpolarise that is, an electrolytic will not do. T control electronics require a stabilis supply of 18 V while the power sta T1 . . . T4 can be connected to unstabilised 24 V DC source.

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