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# SOFT TECHNOLOGY

Alternative Technology in Australia

No.5 Aug-Oct 198l

# Editorial.

An interesting article was sent to me recently. It appeared late. last year in the British daily newspaper "The Guardian". For those to whom the argument is "old hat", please be charitable and forgive me for reproducing extracts of it to present the author's case here.

The main thrust of Anthony Tucker's argument is that it was the events of the late '30s and early '40s which have dictated the source of our peacetime power - namely nuclear energy.

At the turn of the century, he states, when Rutherford was identifying the alpha particle, other physicists were playing around with a crude electronic toy which produced a small current when it had a light shone upon it. By the 1930's due to growing understanding of the nuclear structure and radiation came the postulation that large amounts of energy could be released from both the fission and fusion processes. Simple photovoltaic cells had also been developed by this time.

He says that "for the first 30 or 40 years the development of the potential of these parallel discoveries was balanced by the absence of investment". Events, however, of the '40's produced an imbalance. Although sunlight may be the cause of all life, it had no place in war. Massive investment of resources, human and material was then ploughed into producing the instruments of death. With the end of the 2nd World War, the distortion in investment became institutionalised and the energy form which had been chosen for weaponry was now the choice for peacetime. Anthony Tucker then makes the following statement.

"When historians look back from the next century, if there are any in the next century, they may well see 'this as the greatest error of technical social and political judgment ever made by mankind".

We have been spoiled with an abundance, 'til now, of oil. We have become used to energy in a concentrated and adaptable form. It is dangerously limiting to believe that diminishing crude oil must be replaced by an equal1 concentrated and adaptable fuel source.

A recent study of energy options in Sweden showed that two distinct routes to an energy secure future for that country are possible. One based on nuclear and the other on renewable energy. Neither were without technical difficulties. Though Australia's energy needs are different and therefore the renewable solution will be of a different form, we too face that choice

Fraser's assertion recently that Australia would have nuclear power within 20 years and Hayden's attempted reinterpretation of ALP policy indicate that these politicians see either no choice or have already made up their minds. We have only ourselves to blame if they get their way.

BOB FULLER

*Anthony Tucker is a science correspondent.

FRONT COVER: High temperature trough reflector under test at Monash University. Note the silicon cells mounted above the collector.

This issues was produced by Mick Harris,Tony - Miller, Alan Hutchinson, Geoff Hopkins, and Glenn Sneddon. Comments, criticisms, articles and other contributions are welcome and should be sent to the "Alternative Technology Association",366 Smith Street, Collingwood, 3066.
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# Contents.

# Energy Flashes ...

## Wind Power for South Australia

The South Australian government is to fund the establishment of a pilot wind-powered generating mill on the west coast. Research has shown wind power could provide up to 25% of the state's electricity needs. South Australia has a large number of good sites for wind power and is one of the states of Australia with the greatest potential for wind energy.

The Electricity Trust of S.A. has been interested in windpower for nearly 30 years, but did not follow it up. E.T.S.A. is now renewing its interest, and several engineers have travelled to the U.S. to examine alternative energy developments, including windpower.

## R&D Alarm

Last December news arrived from Japan that Sanyo Electric Co. Ltd. was successfully mass producing amorphous silicon solar cells, and planned to start marketing its cells for household and industrial power applications from April this year. What's more, the cost of these cells was said to be something like 65 cents (U.S.) per peak watt, compared to something like $6.00 per peak watt for the cheapest U.S. cells.

Well, investigation revealed the report was not true. According to Sanyo, it will probably be two to three years before the firm starts marketing solar cells for large scale industrial use. The cost and nature of these cells is at this stage uncertain.

It seems the original report was inspired by wishful thinking rather than concrete fact. We will have to wait a little longer for cheap solar cells.

## Solar Village

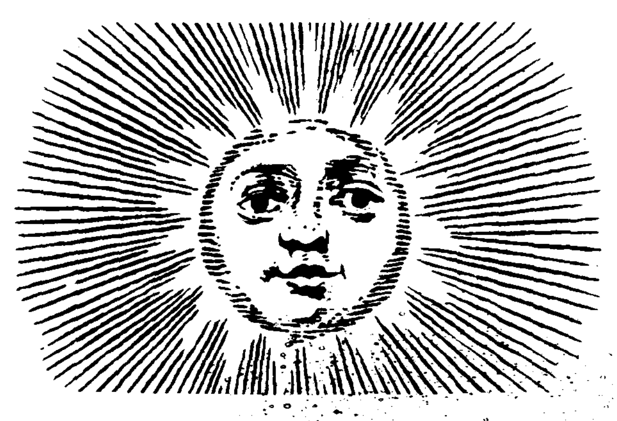
The N.S.W. Housing Commission will soon call tenders for a 15-house "solar village" at Bonnyrigg in Sydney's Western Suburbs.

The N.S.W. Minister for Mineral Resources and Technology, Ron Mulock, told the first annual conference of the local government energy association of N.S.W. on May 4 tenders for these dwellings would be called soon.

The homes, expected to be completed in November, "will be designed and located in such a way that the least possible amount of energy will be required to heat and cool them".

They will incorporate five new designs drawn up in conjunction with members of the School of Architecture at Sydney University. Homes will also be equipped with various model solar heaters which will be monitored for efficiency tests.

Mulock said the State Government had contributed funds to 26 of the 58 solar energy projects current in the state last year.



# Electric Fuel Gauge

CSIRO scientists have developed an instrument which monitors battery performance in electric vehicles. The instrument, Sirobic, could act as a forerunner of an accurate "fuel gauge" measuring and recording the amount of charge passing to and from a battery.

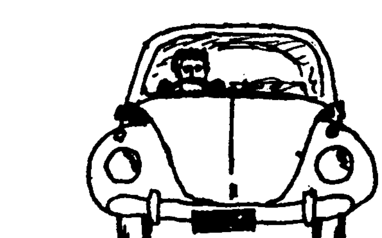
The instrument also measures and records charge and discharge times as well as the number of charge and discharge cycles per battery. It also measures and records the operating temperature of the battery.

Sirobic was developed by John Hamilton of CSIRO's Division of Mineral Chemistry principally to find out why lead-acid traction batteries used to power 20 tonne locos and smaller vehicles in underground mines were suffering, a relatively short service life.

Hamilton is also developing another battery acid, Sirobarm, which monitors battery charging rate and sounds an alarm if the rate is so high it could damage the battery.

"Given too high a dose the battery will become excessively hot and this leads to too much gassing in the electrolyte which causes corrosion of the grid and plate shedding".

"In fact the service life of a lead-acid battery is greatly reduced when used at temperatures above 45°C".



# Solar Gas

A petrol station in West Chicago in the United States is using electricity from a new type of photo-voltaic system to fill the petrol tanks of its customers.

The experiment is being carried out by the Amoco Oil Company to test a new solar cell developed by the Solarex Corporation subsidiary, Semix Inc.

Conventional solar cells are wafers cut from a single huge crystal of purified silicon "doped" with boron and phosphorous to induce the flow of electrical current when exposed to sunlight. The Semix cells are poly-crystalline, cut as squares from cast bricks of treated silicon, and are said to be much cheaper to manufacture.

Virtually the entire power needs of the service station are generated by 5184 solar cells mounted in 72 panels, with a total area of about 55 square metres. These produce a maximum of five kilowatts of electricity.

In sunlight, the cells feed direct current to an inverter which transforms it to 115-volt alternating current, some of which is used immediately to power petrol pumps, cash registers and lighting. The rest is fed into 140 lead-acid batteries which provide a power reserve when the sun is down. The batteries can provide five days of power needs.

# ALCOHOL
## the fuel of the future?

The realization that fossil fuels and especially oil based fossil fuels are moving steadily towards depletion has triggered a renewed interest in alternative energy sources. The cries for increased funding for investigation into solar, wind, biomass and other renewable sources of energy has led to a greater emphasis in research of these energy sources.

While many of these renewable sources of energy do offer real solutions in both the short and long term, few offer a satisfactory solution to the problems associated with the supply of motor fuels for transportation.

What is needed is a portable, easily stored, highly concentrated energy source which if possible, when used does not involve major changes in currently established technology for its widespread use.

Most of the conventional alternative energy sources involve collection of energy that is by its very nature, diffuse. For example, solar energy or wind energy must be collected and concentrated to be of practical use. This often involves a considerable amount of space and equipment neither of which is practical for use in the case of transportation.

To overcome this problem, a product which is the result of the collection and concentration of a renewable resource could offer a solution. One way of getting this is by collecting solar energy by the use of plants and then further concentrating the energy in these plants to produce a liquid fuel such as alcohol.

Alcohol offers a number of advantages. As already stated it is a concentrated, portable fuel that can be easily stored and relatively easily utilized. It can be mixed with petrol replacing lead as an anti-knock additive. This is desirable for the health of the community especially children in densely populated areas. Rising levels of Carbon Dioxide in the atmosphere could have damaging environmental effects and a move to non-fossil fuels produced by plants could be beneficial in this respect. Another spinoff is a renewable liquid fuel industry could stimulate decentralization.

These advantages have led to the establishment of a number of experimental ethanol production pilot plants and research establishments, which are now racing against one another in an attempt to reduce production costs of alcohol.

<u>ALCOHOL PRODUCTION</u>

The production of alcohol takes place when plant material is fermented and the resultant alcohol is distilled off. The main crops being used or being considered for alcohol production are sugar cane, cassava, sweet sorghum, fodder beet, sugar beet, and any one of a variety of grains. If the raw material contains starch then hydrolysis of the material is also required.

The first step in alcohol production is the preparation of a "mash". This is a mixture of water, the raw material, or crop, as well as enzymes and yeast. Next the mixture is heated in the fermentation vessel1 and fermentation allowed to proceed. After fermentation is complete, the solid and liquid components of the mash are separated. Solid material can be used as a food supplement for livestock. Finally the liquid which has been separ-

# ALCOHOL

ated off is distilled by heating and the condensation of the vapour to form alcohol.

## THE PROBLEMS.

Bearing in mind the advantages of alcohol as a fuel and the fact that alcohol production is a well known and understood technology then why hasn't alcohol been used more extensively as a fuel. One of the major factors has been cost.

### Cost

Ethanol from renewable agricultural sources such as sugar can and cassava is currently economically unattractive when compared to the price of petroleum products. At the end of 1979 estimated retail costs for pure alcohol fuel were something like twice the retail cost of motor spirit for that time. Since that time increases in the cost of petrol have improved the economic attractiveness of power alcohol. However, it still remains more expensive than petrol.

**Ethanol Yields for Various Crops**
(Averages only)

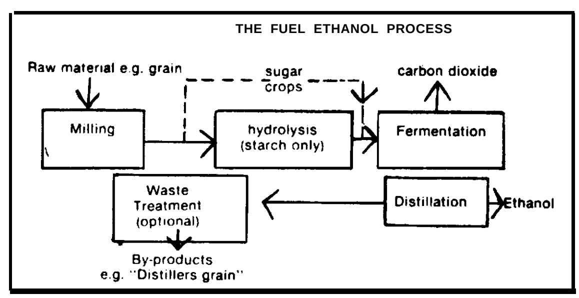
| Crop | Ethanol Yield (l/t) | Crop Yield (t/ha) | Alcohol Productivity (l/ha) |
|---|---|---|---|
| Cassava | 168 | 30 | 5100 |
| Sugar Cane | 89 | 85 | 7600 |
| Sugar Beet | 100 | 40 | 4000 |
| Fodder beet | 50 | 110 | 5500 |
| Wheat | 320 | 1.25 | 400 |
| Corn | 340 | 3 | 1000 |
| Barley | 300 | 1.5 | 450 |
| Potatoes | 110 | 25 | 2750 |

### Production

Even assuming the problems related to the cost of alcohol production could be solved, real doubts still exist as to what extent we could supply the amount of fuel needed with the available agricultural land. A study carried out in 1979 found that alcohol production from agricultural and forestry materials, (without changing existing food and fibre production from crops), could produce a net production of about 400 Petajoules per annum, or over half the annual use of liquid fuel for transport in Australia at that time.

The environmental effects of such widespread cultivation of energy crops must be considered. Pollution of both air and water from processing plants is likely to be a problem. In Brazil where large amounts of fuel alcohol are produced, disposal of distillery residues has been found to be a major pollution problem. Competition with other land uses such as recreation and nature conservation are also likely to create friction.

Another implication, is in a world where adequate supply of food is a constant problem in many countries how can production of a motor fuel rather than production of food be justified.




### Technological

Apart from any problems related to the cost and production of alcohol, technical problems exist in a changeover to the widespread use of alcohol.

Fuel alcohol can be used as a blend, (often referred to as gasohol) or by itself. Few changes are necessary to a vehicle with blends of up to about 20%. When alcohol is being used by itself a number of modifications are necessary. These include an increase in the compression ratio to 12:1, modif-

# ALCOHOL

ications to the carburettor and distributor calibration as well as the tuning. These modifications could present some technical problems if required on a large scale. Also some degree of engine redesigning could be necessary.

The need for these modifications can be traced to the different characteristics of alcohol. Ethanol has a higher octane rating than even Super petrol, but at the same time only 62% of petrol's energy content. Alcohol needs much more heat to vapourise and this is the major reason for the high compression ratio. Both the equipment and expertise is not available for a rapid, large scale changeover, to the use of ethanol as a fuel.

## The Future

Many of the problems associated with power alcohol can be solved with research and development. Even without reduction in production costs the economics will continue to improve as the price of oil rises. However, research is going into cost reduction as well as technological refinement.

An important area of research involves the enzymes used to convert starch to sugar. Enzymes are an expensive component of starch conversion, however, at the moment they can only be used once. If the technology could be developed to make it possible to re-use these enzymes substantial savings could be made. Another way in which enzymes could reduce costs is by the development of enzymes and bacteria to convert cellulose material to ethanol

Development is also taking place in the distillation process. One approach involves the development of solar distillation equipment. In another, the entire distillation process is replaced by the use of membranes that selectively pass alcohol but not water and other impurities. The use of solvents for the extraction of alcohol could also reduce costs.

Research into alcohol production is not limited to overseas countries. In Australia, Ampol Petroleum Pty. Ltd. is experimenting with a continuous fermentation fuel ethanol pilot plant in an old brewery in Petersham, Sydney. The plant will use wheat to produce about 2.5 million litres of ethanol a year. If the plant is successful a larger 20-100 million-litre-a-year demonstration plant will be built.

Other Australian research includes a pilot plant at Sarina, Queensland, by CSR to evaluate continuous fermentation technology. CSR is also responsible for a small-scale trial marketing of a petrol-alcohol blend in Mackay. Other work includes an evaluation of prospects for sugar and ethanol production on the Ord River, as well as a feasibility study of a commercial fuel ethanol industry in Tasmania.

The desire for the mobility offered by private transport and the many other uses of oil products will ensure that an energetic look for alternative liquid fuels will take place, At the moment, alcohol shows perhaps the best prospects of filling at least partly the gap resulting from the eventual reduction in supply of oil products. In the short term, the economics of the situation will slow the emergence of alcohol as a significant transport fuel. However, in the long run the only restriction could be the land available to grow fuel crops.

MICK HARRIS

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# Do-it-yourself
# SOLAR WATER HEATING

## Part 1. Build It yourself?

In the last issue of Soft Technology, Bob Fuller discussed some of the design criteria for solar water heaters and gave comparative data for a number of commercially available panels. In this issue, I will examine the possibility and feasibility of building your own collector.

There are a large number of design alternatives and only experience will dictate the particular design that is best suited to your needs. I have based this article on plans drawn up by T. D. Berrill and supplied to us by Alternatives of Torwood, Qld. It is only one of the many different types of panel a do-it-yourselfer could tackle, but following this plan through in detail in this article will enable readers to build one exactly the same or to vary the design to suit their own needs.

Building your own solar water heater can have many advantages. It should work out cheaper than a commercially available unit, so the pay-back time will be reduced. Don't be alarmed by my cost estimate of $181.86 for a home made collector. Very few of you would be interested in building your own at that price because the saving over a commercial unit would be minimal. However, you would only have to outlay that much if you had to buy absolutely everything new and pay full retail price. As I've pointed out, a more realistic figure is around $100 for a 1.5 square metre panel, if you're able to scrounge around for a few of the materials.

You will probably find that building your own solar collector is a very satisfying process as you watch your system evolve, and no doubt you'll understand the principles of solar water heating much better. BUT, before we start, a few words of caution. It won't be a bed of roses for all. First, there's the time aspect - some people can knock up a solar heater in a few hours (an evening, perhaps) while others may have to spend night after night, ironing out mistakes, acquiring the knack of handling the costs and the materials etc. Which description fits you best and does it matter? If it doesn't really matter whether you spend one night or five in the workshop, great. The satisfaction gained will almost certainly justify the effort.

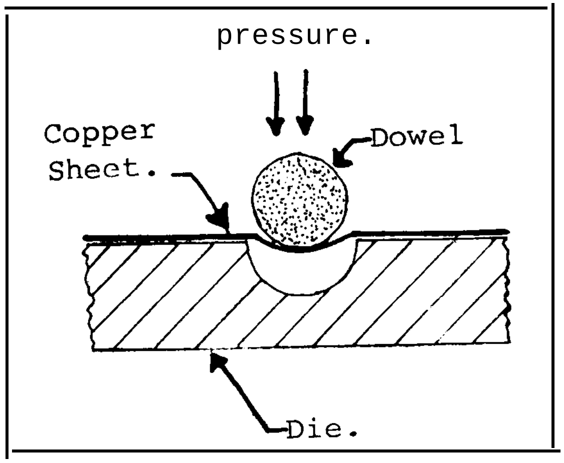
If you do make your own, be prepared to ferret around for information - from written sources, building advisory centres, people who've already built their own etc. The information is all there to be found, it just needs a bit of hunting to find it. Those who decide to buy a commercially available unit have ready access to "experts" before and after they buy, but they have to pay for the service. Do-it-yourselfers generally save money and learn from the experience, turning out units that vary widely in appearance and performance. The choice is yours.

## PART II. Let's Build

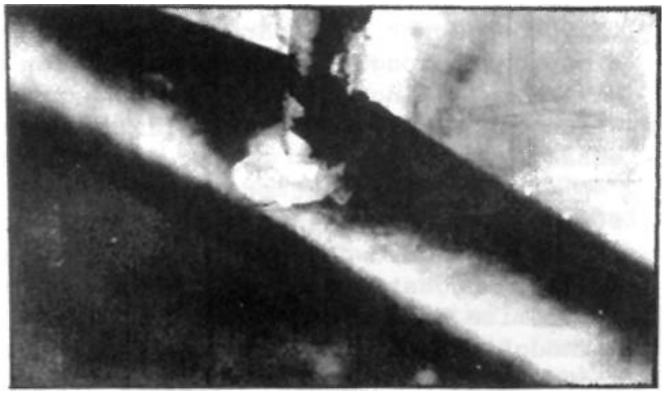
It will be up to you to choose the final dimensions of the panel you'll build I will describe a panel which will finish up as 1.5 metres X 1 metre (1.5M$^2$), but it is very easy to vary the dimensions to suit your own needs. The diagrams refer to a panel a little smaller than the one I'll describe but I chose 1.5M$^2$ because a panel of that size is a little more practical and partly because it made pricing easier.

The first step is to form your absorber plate. I've chosen a plate made from copper, although aluminium is a viable and cost-saving alternative (refer PART lV of this article). The copper sheet (0.55mm thick) required for a panel of this size will be 1.5 metres long by 900mm wide. Beginning on one of the narrow edges of the copper sheet, mark a line 60mm in from the edge, running from top to bottom. This will be the line of your first groove for the riser tubes to sit in. You'll have to use the best means available to you for making the groove, but a commonly used method is the die and dowel system (see diagram). This requires a length of dowel 15mm in diameter (the same as the riser tubes) and a wooden die block with a semi-circular groove a little larger than the dowel in diameter. The groove in the copper sheet is made by positioning your marker line along the length of the die groove, laying the dowel on the top of the sheet and gently hammering the dowel until the sheet forms into the shape of the die groove.

Follow this same method every 150mm (6") until you have formed grooves across the whole length of the sheet. Our panel of 1.5M$^2$ should have 9 grooves in it. Now, cut your header pipes to length. My preference is to use pipes of 25mm (1") diameter, but you could successfully use 18mm (3/4") diameter if you want, especially if you're going to be using a forced circulation (pumped) system instead of thermosyphon. cut the pipes to a length of 1800mm. Turn the copper sheet over so that the crests (or raised sections) are visible and the troughs you made with the dowel are on the underside. Mark 'TOP' clearly on one of the longer edges and lay one of the header pipes along this top edge so that it extends 25mm beyond the copper sheet on the left-hand side. Working with as much accuracy as possible, place a score line on the header pipe corresponding to the centre line of each of the grooves in the sheet. Mark this header pipe 'TOP' and follow the same steps on the bottom edge, except that the header pipe should be placed to extend 25mm beyond the copper sheet on the right hand side.




Grip the first header pipe firmly in a vice and drill a 15mm hole (drill a guide hole first) at each of your score marks, making sure that the holes are in a straight line along the length of the pipe. Use a 25mm drill to hand chamfer the edges of the drill hole and form a slight well for the solder to sit in. After doing both pipes in this manner, line them up against the grooved copper sheet to make sure the holes and grooves match. Next, cut your riser tubes to length - they should all be 920 mm in length. Scallop the ends of these tubes so that they fit flushly when held against the side of the header pipe. Now it's time to start assembling. There are several methods available for attaching the riser tubes to the header pipes. My preference is to use 2% silver solder - 15% silver solder is also available and would do a better job, but it's also 8 times the price. Other methods available include brazing with copper-phosphorus rods, soft soldering and using brass



Use 2% silver solder for brazing.

compression fittings. Copper-phosphorus brazing is cheap and strong, but requires the use of oxy-acetylene welding equipment. Soft soldering needs only an L.P.G. or kero pressure burner, but the lifetime of such joints may be as little as 5 years in areas with hard water supplies. Compression fittings are easy to use but they will add too much to the cost of the unit so they are not really viable.

Assuming you are using one of the brazing or soldering methods, go about it in the following manner. Grip the header pipe in the vice. Take one of the riser tubes and push it gently into the first hole so that your scalloped end will be flush with the inside surface of the header pipe. Solder or braze this into place, taking great care to get a perfect seal. Commercial manufacturers use high pressure air and a water tank to test the seal of their joints, but because it's unlikely that you'll have such equipment available you'll have to rely on the extra care and time that you'll be putting into the job. Work across the header pipe until all the riser tubes have been fixed in place. You'll need some help from a friend for the next step - have someone hold the second header pipe on the floor. Gradually lower the riser tube assembly until the tubes line up with the holes. Make sure the header pipe is aligned correctly i.e. so that when affixed to the copper sheet the top header will extend 25mm on the left hand side of the sheet and the bottom header will extend 25mm on the right hand side. Gently coax each of the riser tubes into the holes in the header pipe and solder or braze them into place.

Your copper tube network is now complete. Lay it down on the floor and try the grooved copper sheet for fit, lining the TOP edge of the sheet up with the header pipe you marked TOP. If you've been working accurately, the grooved copper sheet should fit perfectly over the copper tube network, with the riser tubes resting in the grooves. Turn the whole sheet/tube assembly over so that the riser tubes can be fixed into place.

There are several alternatives for attaching the riser tubes to the copper sheet - brazing, soldering or clamping. Brazing and soldering is slightly preferable because heat transfer between tubes and plate will be marginally better. A 50mm length of brazing or soldering on each side of the riser, tube every 60 cms (2 ft.) is the minimum required. Use a thin bead of braze or solder. The thicker the bead, the poorer the thermal conductivity. You can certainly have your attachment points closer together than 60 cms if you wish, or even run your brazing or soldering the full length of the riser tube. Performance will be improved under these circumstances but the drawback is the extra cost of the brazing rods or solder, and the additional time it will take. Find the compromise that suits you best.

Copper clamps (or saddles) can also be used. Again, distance bet-

# SOLAR WATER

ween attachment points should not exceed 60 cms (2 ft.) but there is little to be gained by spacing them closer than this. Use a pop rivet gun or self tapping screws to fix them in place. I like to use a combination of the copper clamps and soldering. I use a few clamps to hold the assembly firmly and evenly together and I then proceed to solder the riser tubes in place.

If you've decided to use copper riser pipes in conjunction with an aluminium absorber plate (refer Part 1V), a heat transfer paste must be used to prevent the corrosive action of two dissimilar metals touching. Consult your local hardware person about the different types of heat transfer paste available.

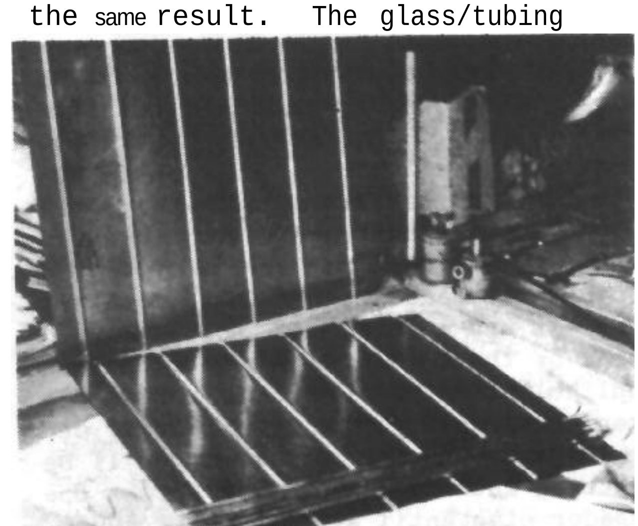
Turn the whole assembly back over again. Tap in, and then solder in place, the two Brass Yorkway stop-end fittings which are to be fitted to the 25mm extensions on the header pipes at the top left hand and lower right hand corners. The next step is to coat the exposed surface black to improve its absorptivity. In general, home-made collectors are coated with a flat black paint. There are a variety of types that could be tried and among them are -

1. Black board paint
2. Fireplace black paint
3. Any heat resistant paint e.g. as used on pot bellied stoves)
4. 3M Black Velvet
5. Monopot self etching primer (Vessey chemicals).

If you have any doubts, check the thermal characteristics with your paint supplier before making your final choice. Collectors can also be "selectively coated" (by electroplaters) with black chrome or dull nickel, both of which will improve the % energy absorbed and reduce the losses through re-radiation. However, this is usually an expensive process and will probably have to be ruled out on those grounds.

One problem encountered by do-it-yourselfers is that coatings tend to peel away from the absorber plate after prolonged exposure to the sun. Therefore, make your coating as thin as possible - dilute the paint if necessary. A thick coating will not improve the thermal performance. Use only the amount necessary to attain an even and thorough coating. The design we are following uses blackboard paint, which can be diluted with water if necessary.

The next step is to construct the outer casing. The design calls for a hardwood construction and I would suggest Oregon as a reasonable compromise between cost and durability. Although I have a few reservations about using timber for the outer casing: (see Part 1V). Cut the timber for the four sides to length so that you will have a box with inside measurements 1.5 metres X 1.0 metres. (Make sure this will be large enough to enclose your absorber plate). Now, measure the thickness of the 4mm glass with the U-shaped rubber strip along the edge. This will be approximately 7mm. You need to make a ledge on the top inside edge of your wooden casing 7mm (approx.) deep and 13mm wide (see diagram). An electric router will do this very easily, but perseverence with a saw and sharp chisel will yield much the same result. The glass/tubing



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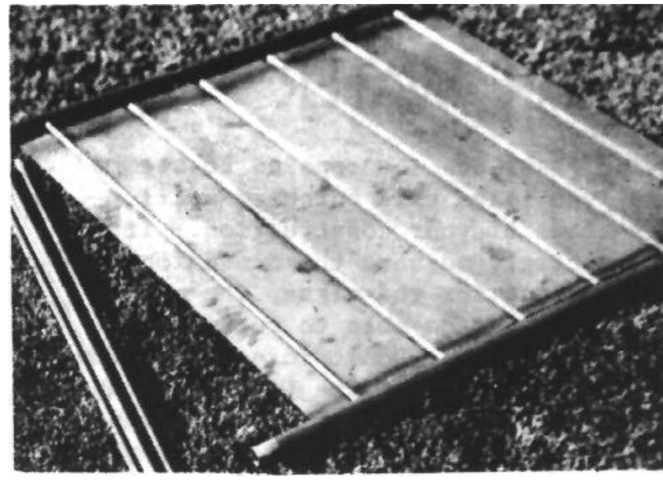
combination will rest on this ledge and be held in place by the aluminium right angle piece.

I would suggest butt joints as a simple yet effective means of joining the box together. Drill two fine guide holes at each corner making sure there is at least a 25mm clearance from the top edge, to allow for the aluminium right angle. Using plenty of wood glue, attach the left hand side of the box to the top and bottom side; with the 50mm self tapping screws. Fit the right hand side of the box but do not use glue at this stage.

Now, fabricate the bracing pieces and the right angle bends from the mild steel flat bar (see diagram). Drill the brackets (one hold each end) and right angle bends (2 holes each end with holes large enough for 6mm bolt;. Mark the location of the holes on the timber so that the brackets and bends will be flush with the bottom of the box, then drill these holes. Fit the bracket and bend in the left hand side for the time being. Make sure the corners of the box are perfectly square.

Paint all the woodwork at this stage using a good timber preservative (e.g. "Timbercoat"). After that has dried, remove the right hand side of the box (the unglued edge). with the box on a flat surface, lay the 50mm Fibreglass building blanket across the base. If it is larger than the base of the box, let it come up the sides - this will provide additional insulation against heat loss. Now, lay the sisalation (shiny side up) on top of the fibreglass. The next step is to position your completed copper absorber plate/ riser tube assembly in the box with an even gap at top and bottom. The inlet header pipe should be butting up against the left hand side of the box and will thus mark the position for the 25mm hole to be drilled. Drilling this hole is easy if you have a large enough hole saw, but it can also be done using a series of smaller holes drilled around



the edge of your markings. Either way, make it as flush a fit as possible.

Re-fit the absorber plate and push the inlet pipe through the hole. Now, hold the right hand side edge of the box up against the outlet pipe and mark the position for this hole. Remember that the mild steel bracing pieces are not yet in position and when these are fitted they will tend to push the insulation and the absorber plate up and will therefore affect the position of the hole. Drill the hole and then fit the last edge of the box, using glue this time. Carefully turn the whole structure over and fit the last bracing piece and right angle bend. cut the Asbestos Cement sheet to size for the base. Seal the corner joints of the box and, the inlet and outlet holes with a little Silastic, and then carefully hammer on the asbestos sheet using 25mm galvanised iron clouts.

The final step involves fitting the glazing. Many materials can be used for the cover, including glass (plate glass, toughened glass or low iron content glass), acrylic sheet, polycarbonate sheet and fibreglass reinforced panels. Each have their pros and cons. Plate glass is the material most frequently used, especially with home-made panels. It is relatively inexpensive, weathers very well, transmits a high % of incoming solar radiation and blocks exit of heat radiation. However, it breaks easily. Toughened glass can be purchased but it is more expensive.

I suggest that, if you're

buying glass new (as opposed to second hand) you leave this purchase until this stage of your construction. If you precisely measure the dimensions of the ledge for the glass, the glass merchant might be able to cut it to this exact size. Don't forget to allow for the thickness of the U-shaped rubber tubing (1-2mm on each side). Even if you're using second-hand glass, you might be able to find an obliging glass merchant who'll cut it to size, as glass cutting at home can be a tricky business.

Now, line the edges of your ledge with Silastic. Fit the U-shaped rubber strip to the edges of the glass, butting the strip together at the corners. Carefully lower the glass into place on the ledge. cut the right angle aluminium strip to length for each of the sides, butting them together with a 45° cut at each of the corners. Drill holes in the aluminium for the 20mm self-tapping screws every 150mm or so. Screw the strip onto the wood. The aluminium strip (and thus the glass) will now be held firmly in place. Your solar collector is complete and ready for installation. Fittings will be needed on the inlet and outlet pipes - I'd suggest using a flanging tool to flare the ends and fit compression fittings. That will have to be the subject of a subsequent article on installing the collector.

## PART III. What It Would Cost to Build

The following prices were obtained by telephoning suppliers which I knew were, from my own experiences, reputable and reasonably priced. Thus they reflect what anyone would have to pay if they wanted to build this solar water heater using new components, bought with little, if any, hunting around for more competitive prices.

The total outlay of $181.86 is, therefore, the most that you should expect to pay, Enterprising do-it-yourselfers should be able to reduce the cost somewhat by scrounging around to gel your bits and pieces more cheaply. Here are a few ideas. Keep your eyes open for discount supply houses where you can buy new components for less than the normal retail price. One book that may give you a few clues is "The Bargain Shopper's Guide to Melbourne" (Published by Horan Wall and Walker). There are also quite a few trade supply houses that sell mainly to trades people, but will extend their 10% or 20% discount to you if you ask for it. Plumbers can be a help to you - they quite often have shorter lengths of copper tubing left over from big jobs and they may be prepared to sell this for what it cost them or even for scrap metal price. Glass, wood, insulation, flat steel and many other bits and pieces can be found quite readily and cheaply where houses or buildings are being demolished. Copper tubing, sheet metal and insulation can be retrieved from junked commercial freezer units, refrigerators or air conditioning units. Finally, don't forget the age old system of barter. You may find someone with all the materials you need who may be prepared to swap for something you have but no longer need. Ask around - the response might surprise you.

Anyway, this is how our pricing shapes up, using readily available materials and paying the normal retail price.

**PLANS OF COLLECTOR ON BACK COVER.

This total price may surprise you (it did me!) It's the absolute maximum that you should expect to be outlaying but, even so, it would be enough to discourage most people from building their own. If you've looked at commercial units, you've probably

| PRICE BREAKDOWN FOR PANEL OF 1.5m²' | |
|---|---|
| 4mm Plate g1ass, 1.5 metres X 1 metre | $35.91 |
| U-shaped rubber strip 5 metres long | 9.00 |
| Aluminium right angle, 25mm X 25mm X 3mm X 5 metres | 8.05 |
| Asbestos Cement (A.C.) sheet 1650mm X 1100mm | 9.80 |
| Mild Steel Flat Bar, 25mm X 3mm X 3 metres | 2.10 |
| Copper header tubes, 25mm Diam., 18 gauge X 3.6 metres | 13.43 |
| Copper connecting tubes 15mm Diam., 18 gauge X 9 metres | 15.93 |
| Hardwood timber, Oregon, 150mm X 25mm X 5 metres | 11.75 |
| 2 Brass plugs (Yorkway stop-end fittings) | 3.12 |
| Annealed Copper sheet, 0.55mm (24 gauge) 1.5 metres x 900mm | 44.00 |
| 50mm Fibreglass building blanket, 1600mm X 1100mm | 3.90 |
| Silver solder (2% silver) 4 bars | 3.28 |
| 12 Copper saddles | 1.44 |
| Blackboard paint | 3.25 |
| Sisalation 1.5 metres X 1 metre | 2.29 |
| 12 bolts 38mm X 6mm Diam. with washers | 1.32 |
| 8 Self tapping screws, 50mm long | 0.55 |
| 30 Self tapping screws, 20mm long | 1.05 |
| Silastic sealant | 3.99 |
| Timber preservative (e.g. "Timbercoat") | 7.70 |
| TOTAL | $181.86 |

seen some good quality ones of 1.5 sq. metres, some with selective surface, for about $190, so to pay $181.86 for a home built one is not realistic. However, most people who are contemplating such a project will have some of the materials at home already, or could get them for next to nothing. I, for example, could delete from my shopping list the plate glass, mild steel flat bar, timber, bolts, screws and timber preservative, so my outlay would be reduced to about $112, and careful shopping should knock another 10% off of that, to give a more realistic and attractive outlay of $100 or so. Everyone will need to do a few similar calculations before they make a final decision on the project. The commercial manufacturers keep their prices relatively low by buying in bulk and using the savings of mass production. About the best you can hope for with a home made unit is to put it together for between ½ - 2/3 of the cost of a commercial one, unless you're extremely fortunate in being able to get your parts at the right price.

The following companies supply prices

ACI Fibreglass (insulation)
McIlwraith's (copper, solder)
Yencken Sandy (glass)
Caroma Doulton (sisalation)
Building Plastics (Melb.) Pty. Ltd. (A.C. sheet)
Ritebuy Trading (mild steel flat bar)

# SOLAR WATER

A.F. Johnson Hardware (silastic, screws, bolts, paints)
Glenferrie Rubber Stores (U-shaped rubber strip)
Alcan Building Products (aluminium 90° strip)

**PART IV.** Comments on the Design

T. D. Berrill's design is fairly similar to many of the commercially available units and, with careful construction, should provide comparable performance and lifetime. I am not completely happy with the advice given about tube spacing - performance tends to improve (to a point) if the riser tubes are spaced closer together. Commercial units usually have a spacing of 120 - 140mm, so I would consider this the absolute maximum spacing for a home-built unit, i.e. less than the 150mm recommended on the design. The advice I usually give is to find a spacing which allows a compromise between performance and cost (closer spacing needs more riser tubes). This is often around 100mm and means spending about another $5 on copper tubing.

I question whether the use of hardwood timber for the outer casing is feasible for a unit which has to be exposed to extremes of weather for 20 years or more. The aim should be to have a unit which is as maintenance free as possible and I would lean towards a casing made of 26 gauge galvanised iron (including the base) rather than timber, which requires periodical upkeep.

Readers might want to consider the possibility of using aluminium sheet instead of copper for the flat-plate, a suggestion made by T. D. Merrill on the design. Many commercial units use this combination of copper tubes and aluminium plate because of the cost savings, but there is the hazard of corrosion in a system using such dissimilar metals. Some commercial manufacturers have experienced considerable difficulties. Your own choice of material will be determined principally by your budget. Copper is generally superior because it has good heat transmission qualities and because it is the most durable. Aluminium is cheaper (about 1/3 the price of copper) and so thicker aluminium plates can be used to compensate for the poorer transmission qualities. Aluminium, lmm thick, will give about the same performance as copper 0.55mm thick using the same riser tube spacing. You will save about $17 using aluminium instead of copper, but a heat transfer cement (thermal paste) <u>must</u> be used when attaching the copper tubes to aluminium flat-plate. It's needed to prevent the corrosive action of 2 dissimilar metals touching. This thermal paste tends to be expensive and thus reduce the cost advantages of using aluminium.

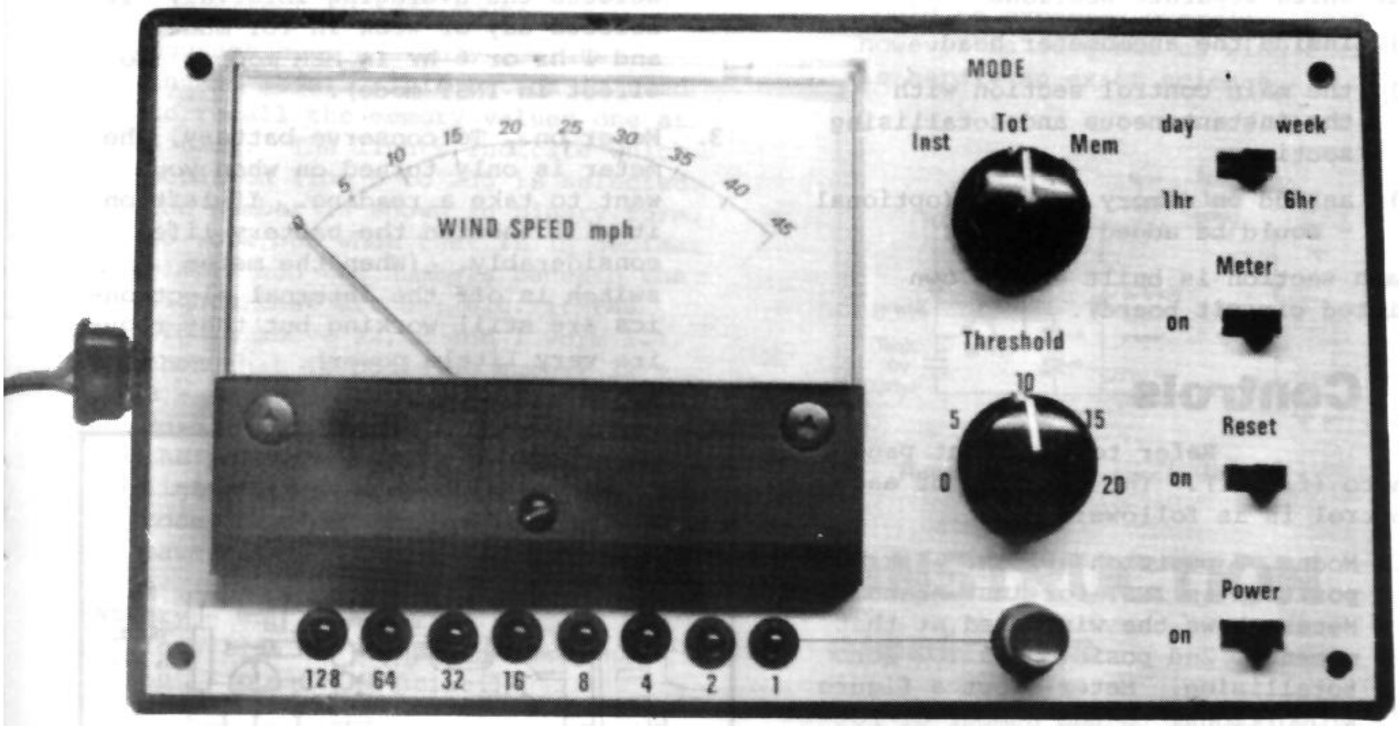
I think readers will be quite happy with the results they'll get from the collector. I'll look forward to hearing from you about how you fare with this set-up. There's several aspects we haven't touched on in this article, such as storage tanks, orientation, inclination, area of panels needed, choosing a site etc. etc., so there's plenty of scope for follow--up articles. Good luck to you all...

GEOFF HOPKINS

* Permission to reproduce the diagram used in this article was given by Alternatives,
37 Bangalla St.,
Torwood, QLD. 4066.
You can get your own set of plans (with notes) by sending them $3.90.

Would you like to know more about solar collector theory, design, installation etc? Geoff Hopkins is the author of the book "<u>Practical Solar Hot Water for Australia</u>". It is available from Friends of the Earth or you can send $6 to Geoff at 42 Story St., Parkville, 3052, VIC., and he'll mail you a copy.

fig.1




# Anemometer PART TWO

Last issue, we described the construction of the mechanized part of the anemometer. This article describes the electronics and a further article will describe the use of anemometers in wind surveys and the estimation of power available at a particular site.

## Introduction

A number of assumptions have been made about the readers familiarity with electronics. A level of understanding similar to that required to read the electronics hobby magazines such as Electronics Australia or Electronics Today is necessary. Sufficient background could be obtained from the Basic Electronics publications put out by both magazines.

No discussion of the electronic design is included because it is beyond the scope of this publication. Any queries should be directed to the author. A functional block diagram and a circuit schematic drawing are shown in fig 1 & 2.

To make construction easy three printed circuit boards have been used. This makes assembly a simple matter of inserting components into the appropriate holes in the board (following the layout drawing) and then soldering them in. As simple as paint by numbers! The components can be bought at the normal electronics distributors or if you can't obtain them I can supply them on request. The printed circuit boards are only obtainable from me.

The electronics is Split into three separate sections -

(a) inside the anemometer head.

(b) the main control section with the instantaneous and totallising sections.

(c) an add on memory section (optional - could be added later).

(each section is built on its own printed circuit board).

# Controls

Refer to the front panel photo (fig. 1. ) . The function of each control is as follows:

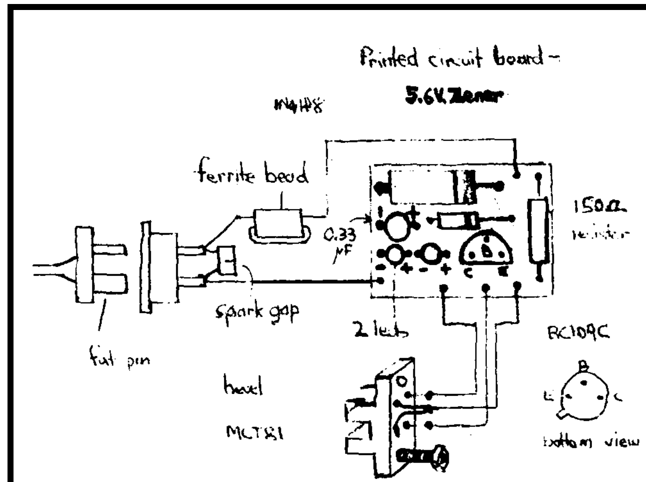
1. Mode. 3 position switch. 1st position is INST for instantaneous. Meter shows the windspeed at that moment. 2nd position is TOT for totallising. Meter shows a figure proportional to the number of rotations of the anemometer cups counted since the counters were last reset. If the length of time since the counters were reset is one day (or 1 week) then the meter will read directly in average windspeed. The meter is designed to be read at 1 day (or week) -intervals and reset to zero after each reading. You could read at say 2 week intervals but you would have to divide the meter value by 2 to get the true average over 2 weeks.

   The 3rd position is MEM for memory. The average windspeed is recorded at 1 hr (or 6 hr) intervals. 256 values can be stored. Meter reads average windspeed over the 1 hr (or 6 hr) period. The values stored in the memory can be recalled by using the advance button.

   The mode switch can be changed from TOT to MEM to INST and back again without interfering with the averaging process.

2. Day/week, 1 hr/6 hr. - This switch selects the averaging interval. It selects day or week in TOT mode and 1 hr or 6 hr in MEM mode. (No effect in INST mode).

3. Meter on. To conserve battery, the meter is only turned on when you want to take a reading. If left on it will shorten the battery life considerably. (When the meter switch is off the internal electronics are still working but they require very little power).




head layout diagram.

4. Reset. When switched on this resets the averaging counters (used in the TOT and MEM modes) to zero. It also sets the memory section back to position 0. (No effect in INST mode).

5. Power. For turning the whole instrument on and off.

6. Threshold. Used to stop the counters including winds in the average unless the windspeed is greater than the threshold value. This is designed for those situations where you have a generator with a known cut-in speed and you want to get some idea of how much

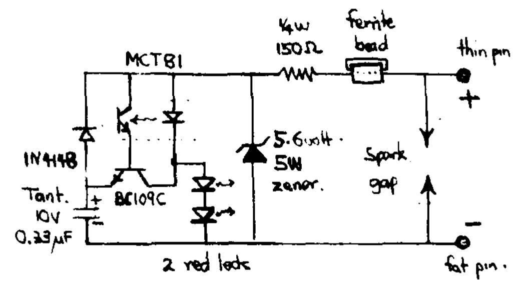
useful wind power is available. (No effect in INST mode).

7. Advance button (only operates in MEM mode). This button is used to recall the memory values one at a time. The lights indicate which position from 0 to 255 is selected. The number is shown in binary form. To work out what that is in decimal simply add the numbers beneath the lights that are on: e.g. if the lights above 32, 8 and 1 were lit, then that is position number 32 + 8 + 1 = 41. If the button is held down for more than 4 seconds, then the position resets to 0. The lights only operate when in MEM mode and with the meter on. (To save power).

Battery - use an alkaline battery for long life (3 times a normal one - but 3 times the price!)

Lightening protection - being up on a pole in stormy weather on a bare hilltop is a pretty good way of guaranteeing the odd lightening strike. Its not too much fun if the electronics die each time a lightening hit occurs, so fairly elaborate protection has been included. However, rather than tempt fate, it would be a good idea to arrange some sort of lightening rod spike above the anemometer head.

Accuracy - $\pm$ 20% would be as good as could be expected overall. This however is adequate as wind energy is hardly an exact science.




Anemometer head circuit diagram.

# CONSTRUCTION
## electronic

Tools needed - a soldering iron with a small tip (too big a tip is awkward and can destroy components by overheating), electronic resin cored solder, small square file, drill and bits.

### ANEMOMETER HEAD

Assemble the components on the small circuit board as shown.(on the other side from the copper pattern). Make soldered joints quickly to avoid overheating the components.

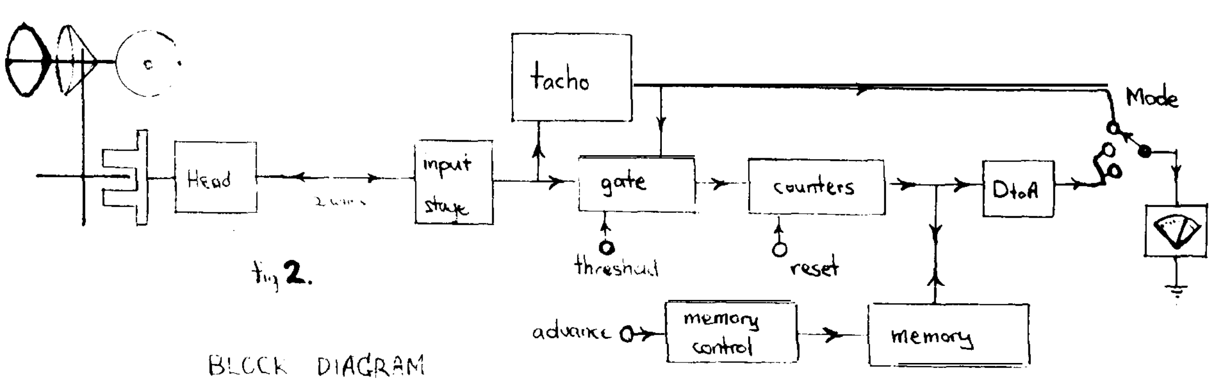
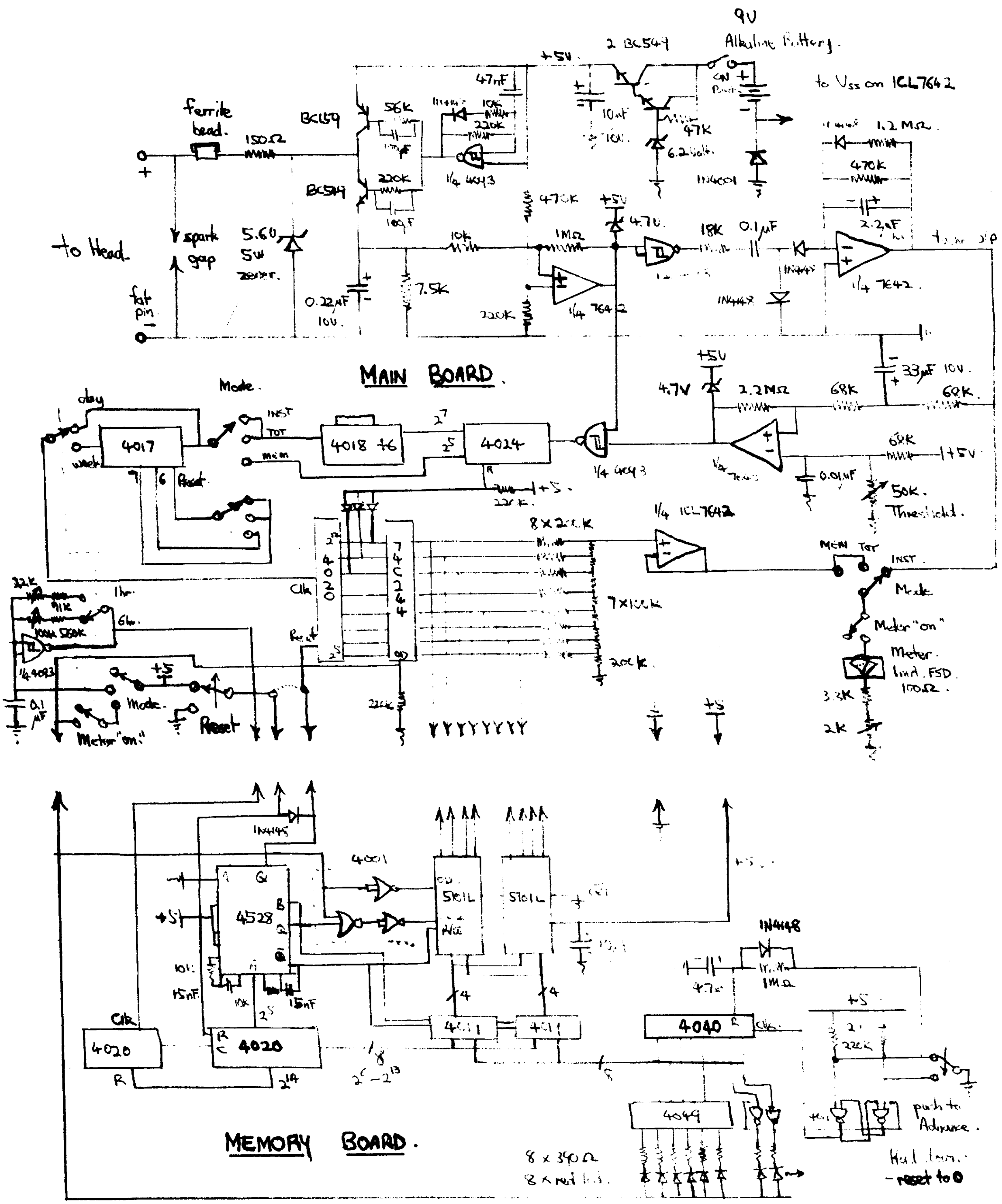
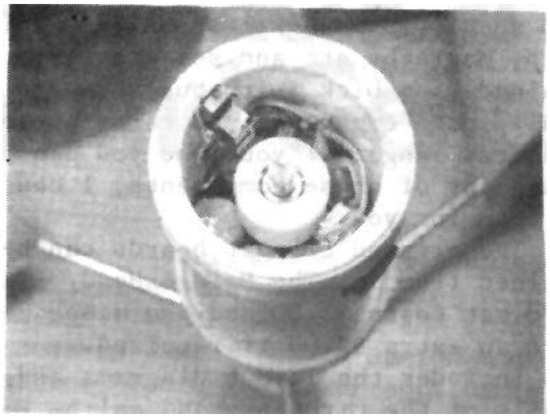



fig 2.

BLOCK DIAGRAM

**don't get put off if you can't make any sense of this circuit. I know quite a few electronic engineers who couldn't either!**





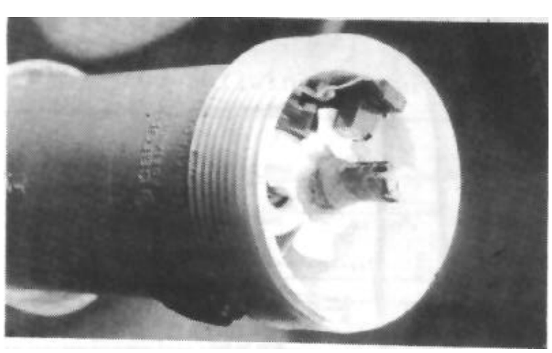
Mount the board by glueing it to the side and mount the MCT81 with a 1/8" brass bolt and epoxy glue to keep it still. (see photo). The board and MCT81 should be wired together before mounting. The leads to the socket should also be attached before mounting and the socket is then attached to the leads from outside the mounting hole. The socket can be glued or bolted on.

MAIN & MEMORY BOARD

Due to space limits it is not practical to include the information here and so the information is available from me. See parts list.

USE OF THE ANEMOMETER

The use of this anemometer to obtain usable wind **data** will be covered in the next issue.

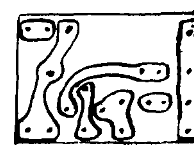


# Parts list

ANEMOMETER HEAD

| | | |
|---|---|---|
| 1 | BC109C or BC549C transistor | 30c |
| 1 | MCT81 Opto interupter (optical limit switch) | $3.20 |
| 1 | 1N4148 diode | 9c |
| 2 | small size LEDs (Light emitting diodes) red. | 20c |
| 1 | 5.6 Volt 5 Watt zener diode | 80c |
| 1 | ¼W 150 Ohm resistor | 3c |
| 1 | 0.33uF Tant. Capacitor 10V. | 25c |
| 1 | small ferrite bead | 20c |
| 1 | spark gap (from Ellistronics 289 Latrobe St. Melb.) could be omitted if unobtainable | 20c |
| 1 | 2 pin plug (McMurdo Q range) | 30c |

ANNEMOMETER HEAD BOARD.



MAIN BOARD

| | | |
|---|---|---|
| 3 | BC549 Transistors | 51c |
| 1 | BC159 " | 20c |
| 1 | 5.6V 5W Zener diode | 80c |
| 2 | 4.7V 400mW Zeners | 30c |
| 1 | 6.2V " " | 15c |
| 7 | 1N4148 diodes | 70c |
| 1 | 1N4001 " | 20c |
| 1 | 8 X 10 cm 1mA FSD 100 Ohm meter (Ham Radio supplies 104 Highett St. Richmond or Dick Smith($13) | $7.00 |
| 1 | 11 X 19 X 6cm Jiffy box Dick Smith | $3.75 |
| 1 | 50K Lin Pot. | 50c |
| 1 | 4 pole 3 pos switch C&K | $1.20 |
| 4 | 2 pole 2 pos slide switches | $1.20 |
| 2 | Knobs for Pot & 3 pos sw. | 50c |
| 3 | vertical Cermet trimpots 2K,22K & 100K. | 90c |
| 1 | Spark gap &ferrite bead as above. | 40c |

| | | |
|---|---|---|
| 1 | 2 pin socket (McMurdo Q rg.) | 30c |
| 4 | Tantalum capacitors (10V) 0.22uF, 2.2uF, 10uF, 33uF. | $1.20 |
| 3 | Polyester (greencaps) cap. 2 X 0.1uF, 0.047uF | 30c |
| 3 | Ceramic caps. 2 X 100pF, 0.01uF | 30c |
| 1 | 9V battery connector | |
| 33 | W carbon resistors 5% tol. 150,3.3K,7.5K,2 X 10K,18K 47K,56K,3 X 68K,91K,5 X 100K 6 X 200K, 5 X 220K, 2 X 470K, 560K, 1M,1.2M. | 99c |
| 5 | ¼W metal film resistors 2% 3 X 200K, 2 X 100K | 30c |
| 1 | ICL7642ECPD Intersil CMOS Quad Op amp 10uA bias. Order through Ellistronics or Radio Parts group- distrib. by R&D Electronics 257 Burwood Rd. Burwood. | $4.00 |
| 1 | CD4017 CMOS dec. counter | $1.20 |
| 1 | CD4018 CMOS ÷ N counter | 80c |
| 1 | CD4020 CMOS 14 bit counter | $1.20 |
| 1 | CD4024 CMOS 7 bit counter | 76c |
| 1 | CD4093 CMOS Quad scmdt. nand | 56c |
| 1 | MM74C244 CMOS Octal tristate buffer (Radio parts) | $2.20 |

MEMORY BOARD

| | | |
|---|---|---|
| 8 | red leds | 96c |
| 2 | tantalum capacitors (10V) 10uF,4.7uF. | 40c |
| 2 | polyester caps 0.015uF | 20c |
| 2 | 1N4148 diodes | 12c |
| 13 | ¼W carbon resistors 8 X390, 2 X 10K, 2 X220K, 1M | 39c |
| 2 | 5101L 256 X4 Cmos Ram. | $7.20 |
| 1 | CD4011 CMOS Quad nand | 28c |
| 2 | CD4019 CMOS Quad select | $1.19 |
| 2 | CD4020 CMOS counter | $2.40 |
| 1 | CD4049 CMOS hex inverters | 46c |
| 1 | CD4528 CMOS Dual monostable | $1.26 |
| 1 | push button switch C&K 8125 and knob | $1.60 |
| 1 | CD4040 CMOS Counter | $1.20 |

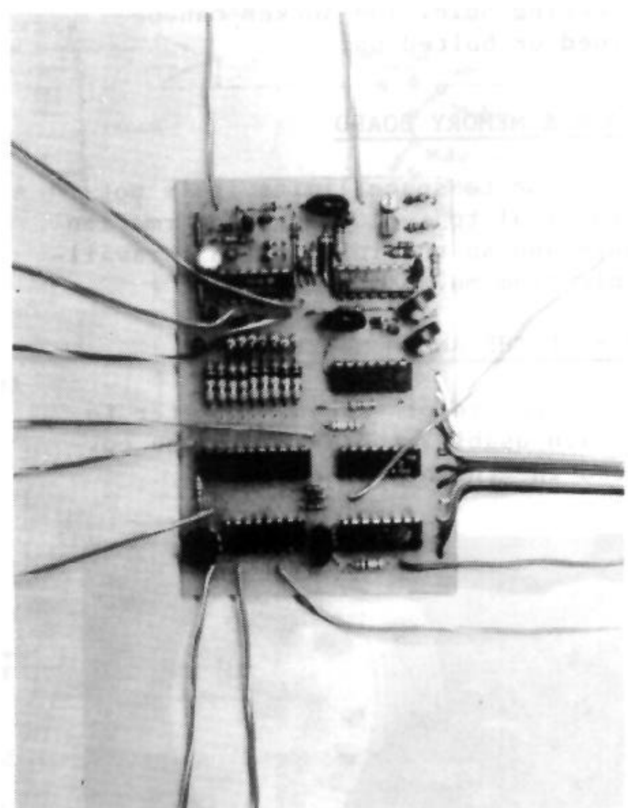
CONNECTING WIRE

| | | |
|---|---|---|
| 2 | 2 pin plugs McMurdo Q range | 40c |
| | speaker flex 6c/metre. | |

These components can be obtained from suppliers like Ellistronics, Radio Parts, Magraths etc and some can be obtained from Dick Smith but they are usually more expensive and carry quite a limited range. If you find you can't obtain any of these components, I can get them for you.

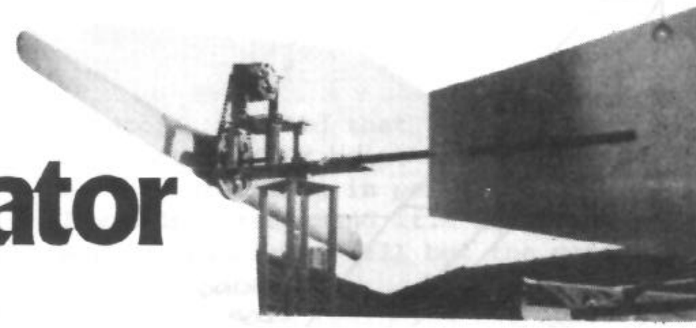
The printed circuit boards can be obtained from me. The Main & Head board set costs $3.00 and the memory board an extra $2.00 if required. This includes the layout diagrams and details of the circuitry and calibration procedure. I can supply a copy of the conductor pattern for anyone masochistic enough to want to make their own boards.

Correspondence to Alan Hutchinson
c/o Alternate Tech Assoc.
366 Smith St. Collingwood
Vic. 3066.
or ring 6049325 (B.H.)



the main board.

# A Practical Wind Generator



During the last couple of years I have been experimenting with home-built wind generators and trying to come up with a simple design that is practical for a low power application, such as home lighting or to power radio equipment etc. The design presented here is limited to about only 150W output in a 25 MPH wind but this is probably sufficient for minimum house lighting.

Free power i.e., power from the wind, should not cost the earth so I have adapted domestic materials for the construction of the windmill. The most important factor (I have found anyway), besides power output in realistic wind speeds is reliability and safety, especially in my suburban block where a propeller coming loose could have serious implications with the neighbours. I chose a horizontal axis, high speed propeller set up as -

1. Darrius rotors are not easily constructed and are not self starting,
2. Savonious rotors in my limited experience prove to be too much of a problem to gear up to a speed where they will drive an alternator, and can be difficult to mount.
3. Other types of impellers commonly used such as "windmill" type multi-blade and sailwing suffer from the same gearing difficulty to attain alternator speeds.

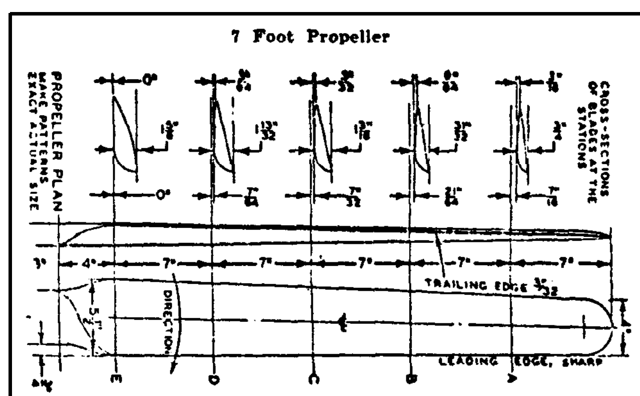
I have tried to stick to a minimum amount of gearing from propeller to alternator so as to reduce frictional losses and low wind speed start up problems.

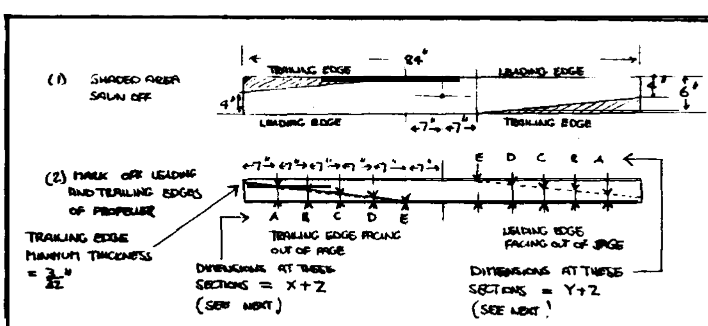
The propellor design here is a much copied design taken from the 1940 "Le Jay Manual", and "Autopower". The best wood to use is Queensland Maple, and the cheapest place to buy it would be Australian furniture timber in Port Melbourne (about $10.00).

The dimensions of the timber needed are - 84" X 6" X 2".

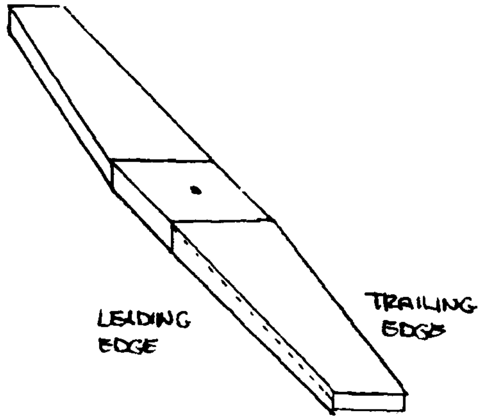
Basic tools are needed, such as spokeshave, saw, hammer and chisel, black and decker workmate and heaps and heaps of patience.

The design is as follows-



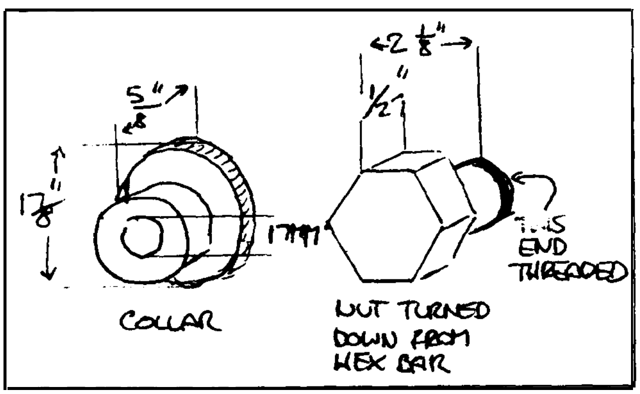




After marking out the trailing and leading edges as into step 2, scoop out the surplus timber with a spokeshave. Stencils of each cross section are then made up and each cross section can be formed. After sanding and balancing, the propellor should have a few coats of varnish applied to it.

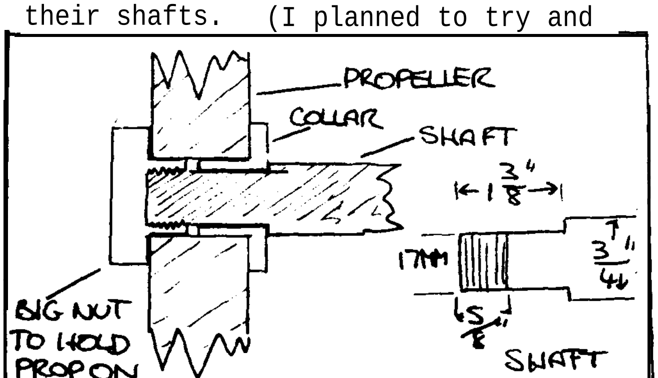



PROPELLER AND SHAFT

Once the prop. has been completed it is time to tackle the shaft it mounts on. Unfortunately this job will require a lathe to turn up the nut, collar and to step the shaft. A friend of mine who is a fitter and turner made mine for me for a couple of bottles of beer.

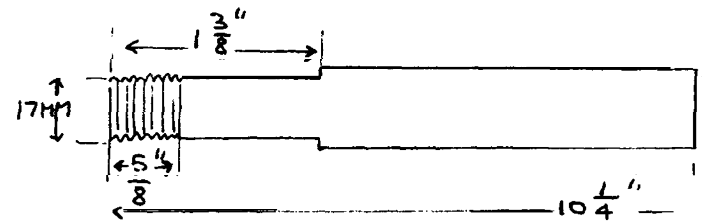



The nut was turned down from a 2" length of 1-7/8" hex bar and was threaded for a depth of 3/4". The thread I used had a pitch of 20 TPI. The reason I used this pitch was that all of the alternators I had lying around had this thread on the end of their shafts. (I planned to try and




directly drive a modified car alternator but unfortunately it only worked in very high windspeeds and produced little power.

The collar that fits into the prop. was turned down from a 5/8" length of 1-7/8" diameter steel rod. The collar has a hole through it, (also done on the lathe), with a diameter of 0.67" or 17 mm. Again this size was chosen to mount directly onto a modified alternator for experiments.




The shaft that the prop. screws on to is another lathe job. I used 3/4" diameter steel rod 10.25" long. The first 1-3/8" of the shaft is stepped to 0.67" and threaded with a pitch of 20 TPI for 5/8".

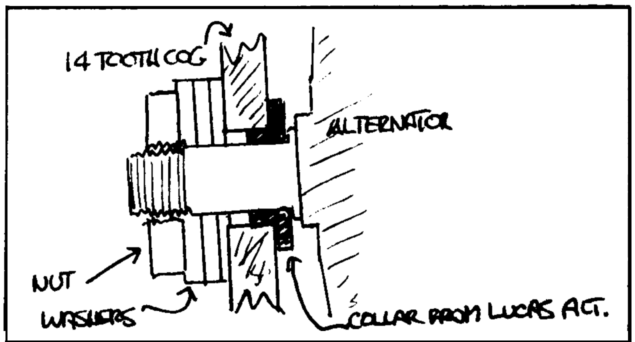
The shaft rotates on two 3/4" bearing blocks (3/4" ID ballraces with mountings), which I obtained along with the shaft at Trash and Treasure, Dandenong. SKF or someone would sell them as a stock item.

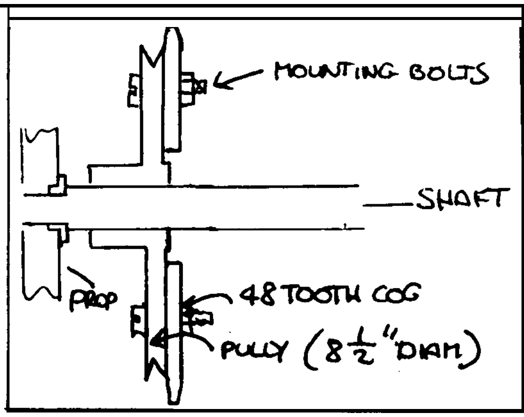
CHAIN DRIVE

To couple the power from the prop to the alternator I settled on a chain drive with a step up ratio of 3½ to 1. The chain drive consists of a 48 tooth rear wheel cog from a trail bike (I think it was an XL350). A chain from a trail bike (XL 350) and a 14 tooth from the same bike.

I mounted the 48 tooth cog to the main shaft by bolting the cog's eight mounting holes to an 8%" pulley that already would mount on my 3/4" shaft This pully was also procured from good old Trash and Treasure.

The 14 tooth cog fitted onto the alternator (Bosch 34 Amp), with a bit of fiddling as shown below. I found that a small shaft collar used on a lucas alternator matched the different diameters of the cog and the alternator. shaft.



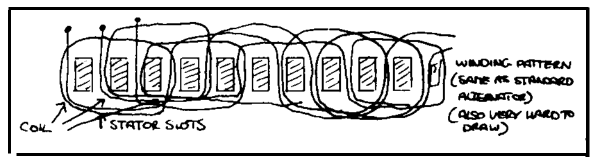

THE ALTERNATOR

The alternator mounts to the wind generator with a couple of brackets I had lying around. The brackets were drilled in a few places so as to adjust the slack out of the chain. I have tried 3 types of easily available alternators, (1) old Chrysler from 67 Valiant, (2) A Bosch 35 Amp from a 69 Holden and (3) A motor craft 40A from a 71 Ford.

All of the alternators were acquired from T.N.T. and the most I paid was about $6.00 for the motor craft alt.

I rewound the stators (stationary coils) on all three alternators, firstly to try them directly coupled to the prop. but this was unsatisfactory as it nearly needed a hurricane to put out useful power. The gearing ratio of 3½ to 1 was just about right for the rewound motorcraft alternator. I found that the Chrysler alternator after being rewound not to be very startling in performance, so I wouldn't recommend it. The Bosch worked reasonably well but the motor craft had the edge.

In rewinding the stators (stationary coils), I duplicated the original wiring pattern but increased the number of turns per coil to avoid short circuits from the enamel wire to the stator laminations. I used a block of wood cut down to the same cross section as 3 stator poles to wind the coils on, before manoevering them onto the stator.

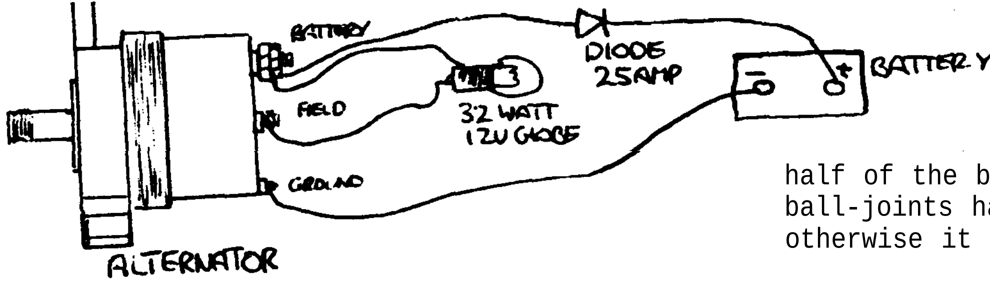



The Bosch and Chrysler alternators were rewound with 38 turns of 22 B&S wire per coil (6 coils per phase, 3 phases in all). The motor craft alternator was wound with 28 turns 20 B&S, 6 coils per phase, 3 phases altogether. The alternators cut in performance is as follows:

| Rev. per minute | 280 | 350 | 450 | 500 | 600 |
|---|---|---|---|---|---|
| Rewound Chrysler | - | 8v | 12v | 14v | 17v |
| Rewound Bosch | - | 10V | 14.5V | 16.5V | 18V |
| Rewound motor craft | 5V | 10V | 14V | 15V | 16.5V |

The motorcraft alternator put out more current and had the lowest cut in speed. At the tabulated voltages the alternator was supplying its own field current via the optimum resistance for that speed, so no external excitation was applied to the field.

All three alternators would self energise their fields at about 550 RPM and could be lowered until about 350 RPM where they would no longer self energise. In operation on the wind generator I connected a

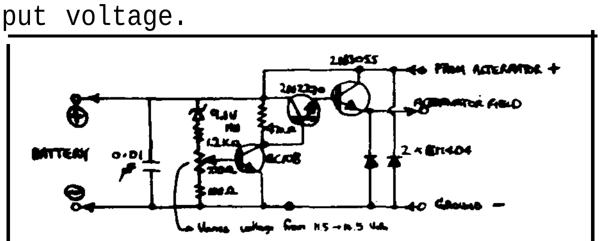



32 Watt blinker globe from a car in between the alternators output and the field input to serve as a current limit.

Between 1 and 1½ Amps is sufficient field current for the alternators and the 32 W. globe limits this current. I also included a diode in series with the output of the alternator after the globe to prevent discharge of the battery through the alternators field.

The diode used to prevent this discharge of the battery was scrounged from another alternators discarded rectifier assembly.

Overcharging was not a problem for me, as the wind generator charged 100AH nickel-cadmium batteries in my case and the best alternator would only put out about 9 Amps in a big wind. This represents about 150 Watts (9 times 15 volts) on a 15 ft. tower. I haven't put a windspeed to this output because I am plagued with turbulence problems at 15 ft., but I would say that the generator would start to charge at around 10 mph. If you are worried about battery overcharging without a regulator, this is the circuit that I experimented with. The Zener diode in the circuit determines the output voltage.



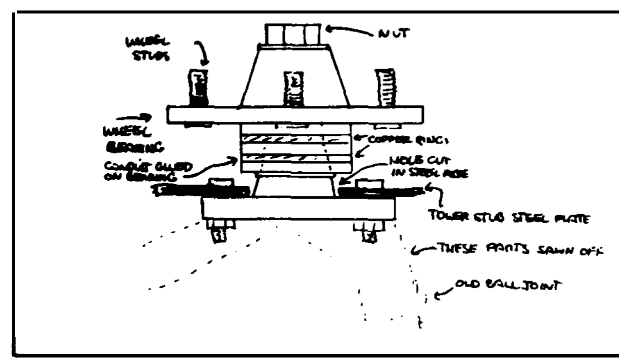

## TURNTABLE AND SLIP-RINGS

To enable the wind generator to align itself to the oncoming wind it must be free to rotate. I found that the front wheel bearing of an old EJ Holden made an excellent bearing for this job. The bits on the stationary half of the bearing that went to the ball-joints had to be sawn off, but otherwise it worked well.

The sliprings that carry the power from the generator while the generator is free to rotate are made from copper rings about ¼" wide. The copper rings were sawn from about 3" diameter pipe. These rings are then glued onto a piece of 3" PVC conduit roughly 1½" long, the conduit is then placed on the wheel hub as below.

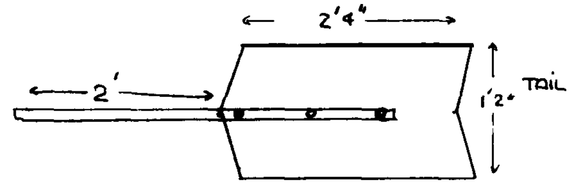
Two 3" X ¼" pieces of spring steel mounted on a block of bakelite rub on the rings and transfer the current from the rotating generator

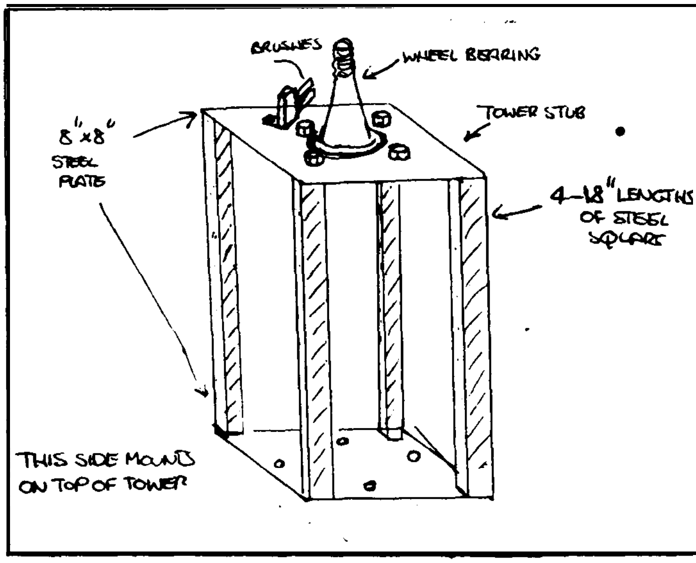
The studs on the wheel side of the bearing are bolted to the wind generator's frame.




## WIND GENERATOR FRAME AND TAIL

The frame that supports the alternator and tail is shown below I resorted to a welded frame after watching my previous bolted frame fall to bits in a big wind. A friend of mine did all the welding for me as I can't weld. I used three 8 X 8" piece! of steel plate ¼" thick, and one piece 16 X 8" steel plate ¼" thick and about 10 ft. of 1" X 1" 'steel square with 1/8 wall thickness for the tower stub and frame.

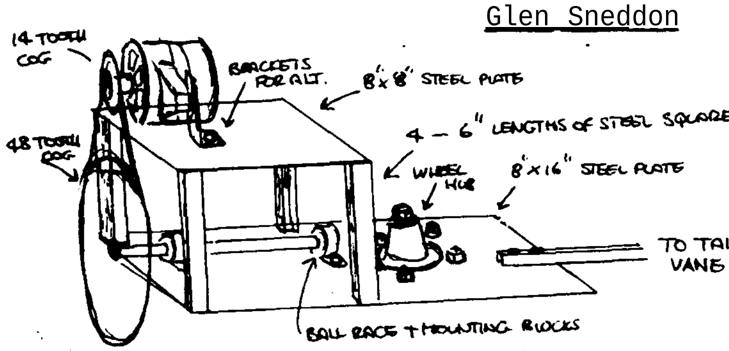





For the tail, a piece of 12 gauge aluminium sheet (like what they make big roadsigns out of) 28" X 14" worked well enough.

I have not allowed for any provision of wind generator shut-down in excessive winds as yet, but I will soon have a large gate hinge on the tail vane with a return spring on it. This will hopefully face the propeller out of the wind when the tail vane is folded parallel with the prop.

Glen Sneddon




Since the' writing of this article Glenn Sneddon has improved the design of his wind generator in a number of ways. Stay tuned for further developments.

# Book Review

'Title: SUN REFLECTIONS: Images for the New Solar Age

Author: John N. Cole

Publisher: Rodale Press, 1981

cost: $14.95

The title of this book "Sun Reflections", really is a very appropriate indicator of the publications content. The book reflects on solar energy, its past, present and future prospects. It does so through the use of not only straight forward written text but also by the use of art, photography, prose and poetry from people who have or had an interest or involvement in solar energy.

The book is one of those that contains some gems of information on solar energy where its been and where it is going. Ever seen a drawing of a solar fired cannon or a photo of "chariots 'of the sun from Scandinavia"?

The examination of the sun's significance in past myth and religion as well as the work of past researchers and scientists is particularly interesting. For example on the one hand we are given glimpses of the importance of the sun in civilizations such as those in Egypt and Mexico, while on the other we find Copernicus and Galileo and we see how their researches effected the perception of the sun.

If you would like to look behind the technology of solar energy and view its development from a creative, poetic and historical perspective, then this book could be worth your consideration.

Mick Harris

(Copy supplied by A.N.Z. Book Co.)

# ALTERNATIVE TECHNOLOGY ASSOCIATION

The Alternative Technology Association is a group of people interested in the use and promotion of Alternative Technology. Alternative Technology (which can also be thought of as Appropriate Technology), is technology that is ecologically sound and does not conflict with the environment by causing pollution or destruction.

The membership of the Association covers a wide variety of interests and skills. Solar and wind energy are areas of common interest, other important interests include: water power, methane digestion, agriculture, energy efficient houses and other buildings, crop fuels, bicycles, electric vehicles and alternative transport, domes, mudbricks,......etc.

WHAT DOES THE ASSOCIATION DO ?

* We hold regular meetings, with films and guest speakers talking on subjects of interest.
* These meetings are preceeded by a newsletter which provides details of the meetings, and also informs members of any current events of interest.
* We produce this publication, which has Australian based information on Alternative Technology.
* We hold other activities from time to time: such as day trips to energy saving houses and workshops where members can come and work on individual projects.

If you are not a member already, why not fill in the form below and become a member.........

Fill in this form and send it to the Alternative Technology Association: c/o 366 Smith st. Collingwood, 3066.

NAME..............................DATE....................

ADDRESS.................................................
POSTCODE............TELEPHONE.............
Please find enclosed my membership fee of
$10.00 normal membership.
$ 5.00 students, unemployed, pensioners, etc.

Areas of interest.......................................
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## SOLAR WATER COLLECTOR CONSTRUCTION