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A Heat Pump Assisted Shower

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required, but, this must be gradually increased as the water temperature from the tank decreases. By means of electronic control the instantaneous heater would operate to maintain a constant discharge temperature. Normally, this direct

INTRODUCTION

Compact fully hermetic heat pump compressors of 500 W electric rating and less have recently become available. These have a low capital cost for their capacity while their performance characteristics compare with those of larger compressors. A particularly important feature is that they can be fully insulated while motor losses are recovered by means of a cooling coil in the oil sump.

A quite separate development has been the appearance in the marketplace of a large variety of instantaneous electric shower heaters. These incorporate compact electric resistance flow boilers with a total rating of about seven kilowatts.

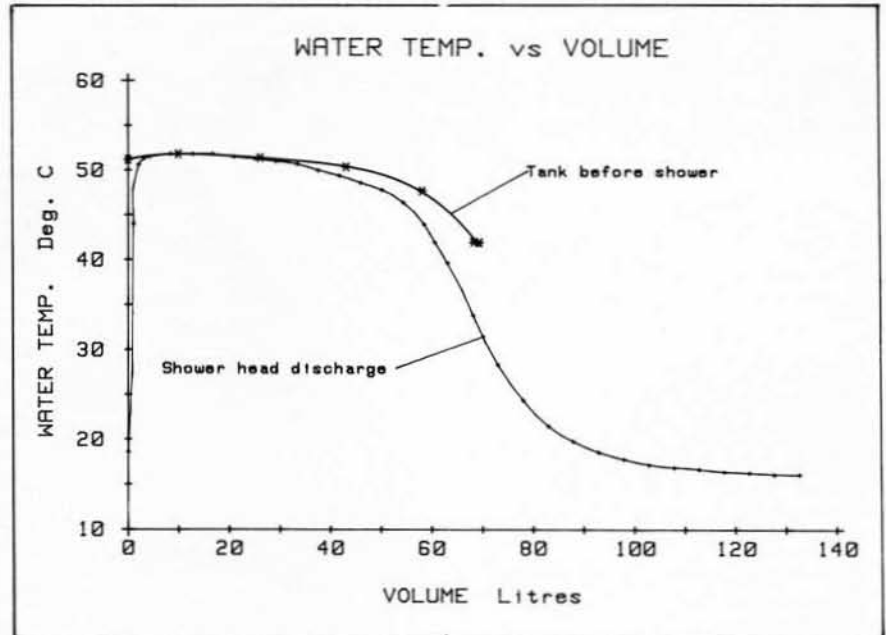
While the efficiency of a resistance heater is very high it represents poor utilization of high grade electrical energy when compared with air source heat pumps which can provide water at 'showering' temperature with a coefficient of performance of 2.5 to 3 and thus consume only 0.33 to 0.4 times as much electricity. The high cost of a heat pump of 7 KW output, however, precludes its use as an instantaneous heater for such applications, as it is unlikely to run for more than an hour per day.

A system is proposed consisting of a low powered heat pump, a storage tank and an instantaneous heater (Fig. 1) which, it is felt, may yield a favourable overall cost, in addition to reducing the primary energy consumption. Some preliminary work has been carried out in exploring this concept. It was considered at the outset that an overall C.O.P. of 2 should be readily achieved. Values close to this have been realised with the first experimental prototype.

The applications of the work are not limited to domestic shower units, but, extend to many situations where hot water is to be supplied intermittently and there are ample periods for slow pre-heating of the water by a heat pump.

CONCEPT OF THE HEAT PUMP ASSISTED SHOWER

A storage tank of water is heated over a period of time by a heat pump which cuts out when the temperature reaches a pre-set level. At this point the water at the top of the tank is at the required temperature (46 deg. C approximately for a



shower) while the temperature at the bottom of the tank is somewhat lower due to stratification (Fig. 2).

The storage tank is well insulated and, after the initial heating phase, the heat pump cuts in occasionally under the action of a thermostat to compensate for standing losses.

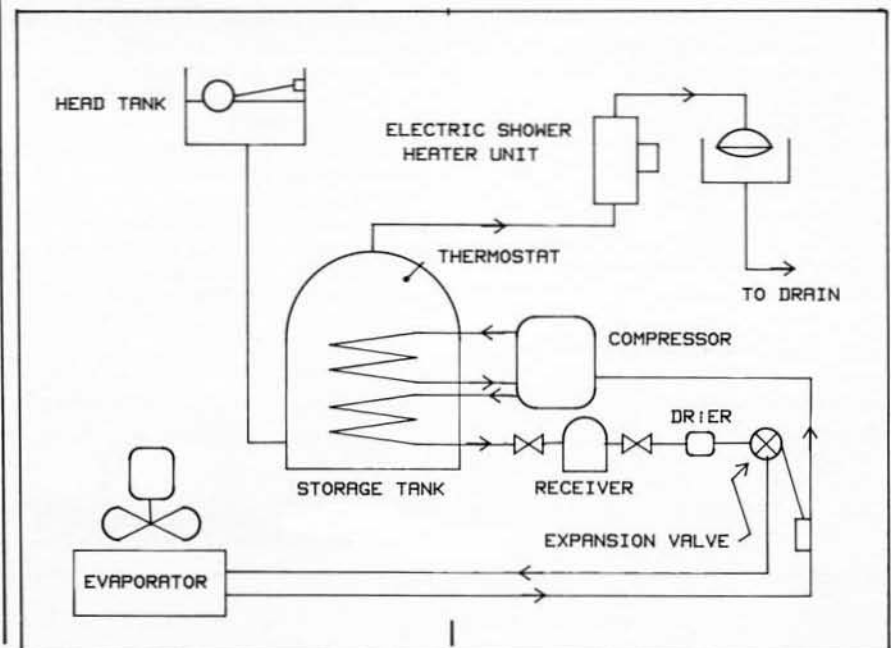
Since the temperature of the water in the storage tank varies over the running period from that of the water supply to about 46 deg. C the mean condensing temperature of the heat pump is quite low and this favours a good C.O.P. value.

When the shower is first turned on little or no direct heating is

heat would be only a fraction of the total supplied to the water. For domestic use a total direct heater rating of 2 kW would be sufficient, while, in a commercial situation, a 6 kW flow heater would guarantee continued hot water availability, even after the stored pre-heated water had been used up.

SUMMARY OF FINDINGS

When operating with evaporator air intake temperatures in the range 16 to 19 deg. C and providing several 'showers' per day at a constant temperature of 50 deg. C the calculated overall C.O.P. of the plant, taking



account of the heat pump consumption, shower pump consumption, shower heat consumption and standing losses, was 1.93. The heat pump performance included in this figure was based on actual test results. The power consumption of the direct instantaneous heater was calculated, assuming that it could be automatically controlled to maintain a constant discharge temperature and could do so at an efficiency of 90%.

CONCLUSIONS

It is felt that the results to date provide a basis for further investigation of the concept of using a low capacity heat pump to provide pre-heated water in conjunction with a direct electric flow heater for final heating and temperature control.

Automatic electronic control of the discharge temperature by using a thyristor to vary the heater power dissipation is relatively straightforward and inexpensive. However, the operation of the temperature controller has not been dealt with in this phase of the work.

A hairdressing salon would be a very suitable location for a heat pump assisted water heater. The evaporator could be situated indoors in this case and would, in effect, recover the latent heat transferred to the room air by the use of hair dryers.

