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Gentlemen:

I have been investigating the problem of constant power control for the automated press currently being developed and have come to the conclusion that an "off the shelf" item does NOT exist which would suit our purposes. I have been in contact with eight suppliers and manufacturers of welding equipment and have ascertained that the welding controls have two basic flaws which make them unsuitable for our application: 1) voltage (or current) is monitored at the output of the control(not at the load) so that voltage drop in the line to the load is not measured, 2) power is not monitored, only voltage or current (hence, power factors are neglected). Actually, welding controls offer only rough power regulation and there is no means for knowing the actual power delivered to the load. On top of this inability to meet the precision we're interested in ( 2% regulation and 2% accuracy in measuring the power delivered to the load), welding controls cost more than a system to be described later which meets the requirements. Several quotes were received which ranged from $850 to $1350. It is estimated that the parts for the system herein described should cost less than $700.

Figure 1 is a block diagram of the constant power controller system which should meet our requirements. A commercial SCR power controller (such as the phase proportioning power controller by Vectrol, Inc.) is fed by the 208 volt single phase line. The output of the power controller, which consists of portions of a cycle of the 60 Hz wave and is proportional to the control input voltage, passes through an auto transformer and then to the welding transformer. Without the auto transformer and for low power to be delivered to the load, the output of the SCR power controller would consist of a series of spikes. By reducing the amplitude of the output of the power controller, the width of the spikes would have to increase in order to maintain the same power to the load. The power transducer probably operates better with larger portions of a cycle of the 60 Hz waveform than with the "spikes". So, for low powers, the auto transformer can be adjusted accordingly. A true rms watt transducer monitors the power delivered to the load. An attractive unit to accomplish this appears to be the A-C Watt Converter made by GOULD. Current transformer and voltage transformer produce the required magnitude of voltage and current

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range required for its operation. Full scale output is 5 V DC. By appropriate choice of voltage and current transformers, we can make this full scale voltage correspond to 10 kW.

My ideas concerning the set point circuitry have changed since receiving the enclosed letter from Vectrol, Inc. Mr. Strayton points out that the VPAC 500 (literature enclosed), has an optional amplifier which allows the comparing of the control signal with the set-point signal thereby causing the power control to alter its output to make these signals equal. Such a scheme is shown in figure 2a and also on the 2nd page of the VPAC 500 literature.

Figure 2 is a circuit which had been designed for use with a Robotron power controller (not equipped as the Vectrol model). In this circuit, an error voltage equal to the difference of the desired power voltage (from the set-point potentiameter) and the actual power voltage (from the watt converter) is amplified and added to the actual power voltage. This signal is then applied to the power controller control input. Figure 3 is a representation of this feed back scheme and shows that the output of the watt transducer will be made to equal the power selection voltage $V_1$ if the gain of the error amplifier, $K_3$, is large. Figure 4 and the rest of these pages discuss response time--somewhat unsuccessfully but if this circuit were to be used, it would be a simple matter and a few more hours to obtain meaningful results. However, since the Vectrol power controller appears to be exactly what we need, this doesn't appear to be necessary.

I received a letter from David in which he stated that the output current of the welding transformer was to go to 8000 amperes. This sounds a little high and for the following reason: By increasing the range of powers which are to be delivered to the load, we decrease the amount of regulation. That is, if the full scale output of the watt transducer is to occur at 8000 amperes, then, when you run at the lower (and more normal) level in the region of 1000 amperes, the output of the watt transducer is not 5 volts, but .625 volts. The ripple is 1% of full scale (50 mv) but this is nearly 10% of the .625 volts. The effect of this on the power controller is not known. Likewise, by increasing the range, non-linearities in the watt converter become more pronounced. Also, Vectrol doesn't make a watt converter which will handle 32 kW. I've been thinking all along that this maximum current would be 3000 amperes. By ordering Vectrol's largest unit, this could be increased to something over 5000 amperes.

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However, according to the specifications David sent, the secondary voltage might drop to 2.5 volts whith the 8000 amp load-this corresponds to 20 kW and the Vectrol unit would be able to handle it.

The operation of this thing, then, would work as follows: By adjusting the set-point potentiameter, the operator adjusts the deflection of the desired power meter to the appropriate value. The auto-transformer may be set to some experimentally determined value to give a "good" output waveform from the power controller. The power controller is turned on. After the desired time has elapsed, the timer actuates a relay which causes the control voltage to go to zero. The power controller turns off.

| | | | |
|---|---|---|---|
| Approximate prices: | power controller | 350. | (includes current limit) |
| | watt transducer | 200. | (no price received as of yet-guess) |
| | transformers | 100. | (current and voltage transformers) |
| | | $ 650. | |
| | meters, etc | 50. | |
| | | $700. | |

If you feel that this is a good system,(I am ready to order stuff. I feel confident that this can be made to work and that it will do a good job.

So far, this has been a pretty official letter: recall the "Dear Gentlemen" introduction, the business letter form, etc... Would it be "poor" form to sign this letter

Love and kisses,

J. Martin Neil

J. Martin Neil
Elizabeth H. Neil