Colin Rae has worked in the Theatre and Television Equipment Industry all his life starting 30 years ago as a theatre apprentice in his father's company, Rae Stage Equipment. He joined Mole Richardsons in 1964 and formed Telestage Associates with his brother in 1972. He considers his forté is common sense engineering!

ALL THE WORLDS A COMPUTERISED STAGE

by Colin Rae

THE use of the computer in industry and commerce is acknowledged and in most respects welcomed.

On the stage to date the computer has enjoyed overwhelming acceptance in the field of lighting control but to date the influence on mechanical equipment has been limited to a few major installations. Our personal involvement has made us cautious of the electronics man to the extent that we seriously question the full magnetic control for scenery handling equipment.

The early systems involved simple TTL logic* with numerous components, many separate cards which made commissioning long and arduous and very expensive with long term reliability to say the least, slightly questionable.

The method of control of each machine was based on analogue measurement for position with tachogenerator speed monitoring so that synchronous working and group operation would be practical. This has added to the complexity as analogue to digital conversion is necessary to be compatible with the computer storage. The drive method must also have a distinct bearing on the control equipment.

Our experience being dominated by the use of variable frequency A.C. servo amplifiers of either 6 or 12 phase operation. These solid state drives normally operate in the range of 0 to 20 Hz and when properly commissioned give smooth speed control. The advantage of using this method of drive some years ago was that we could deal with the electrical signals for speed command, acceleration and position finding deceleration such that the overall integration seemed logical and practical, as all things including power were derived electronically.

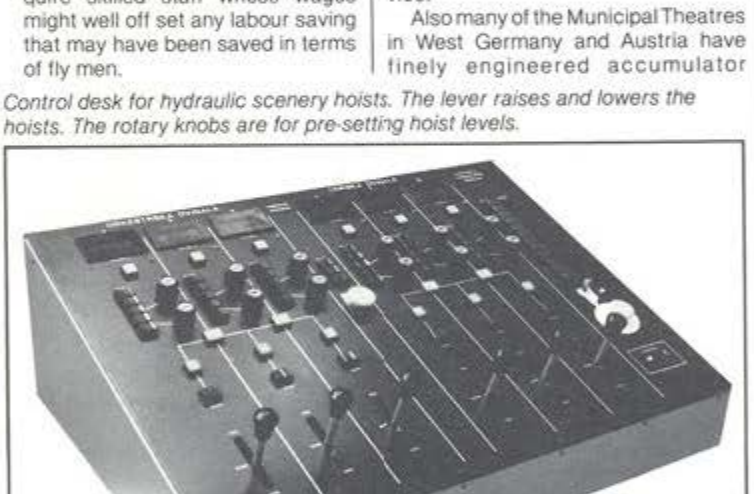
All these things have proved to be possible but at a cost which has proved to be horrendous, our latest system controlling in excess of 100 services for the National Theatre of Macedonia in Skopje includes much of the latest techniques including five micro processors, an electro pneumatic automatic interconnecting machine, V.D.U. screen data readout and tape control memory, the problem is not making the system work, it is the time that commissioning of the electronics has taken. We have spent one and a half years in commissioning this equipment.

Our concern is really that every system is so custom designed that either the Theatre must employ graduate electronic engineers to look after the equipment or try to persuade one of our installation crew to join the Theatre staff. We are not keen on the latter and a suitable graduate may not be found in the former.

This experience has shown us that solid state computer logic is very impressive when complete and working reliably but any prospective purchaser must recognise:—

1. The costs will be very high as there is no standard.
2. Commissioning and run up can take anything from six months to two years for a full system.
3. Maintenance and after care will require skilled staff whose wages might well off set any labour saving that may have been saved in terms of fly men.

Control desk for hydraulic scenery hoists. The lever raises and lowers the hoists. The rotary knobs are for pre-setting hoist levels.



What are the alternatives?

We see two major methods of offering power operation without tears and neither would we state, need a computer to give the Theatre a value investment.

Which equipment really needs variable speed and presettable deads?

The answer is scenery flying and point hoists certainly, house curtains need speed control and revolves or stage wagons may with advantage be controlled with variable speed.

We have seen solutions where these drives have been provided by our competitors using industrial 3-phase thyristor D.C. motors with full regenerative feed back and custom built front ends and control panels, these are fairly successful and we understand they have been used to good effect in the United States of America.

We have not pursued this course as we have certain reservations on the use of D.C. machines concerning noise level and to some degree the low speed torque. The basic D.C. motor would probably have a rotor speed of either 1500 RPM or 1000 RPM at maximum speed set, therefore, the need for a gearbox and brake would be obvious and in certain countries, of course, the regulations might deem it necessary to fit two brakes to meet the safety regulations.

We have very much based our current installations and future schemes on the use of fluid power. Fluid power has had a chequered history but it should be remembered that apart from spectacular failures like "The cable cylinder" system in the United States, many systems have been literally operating for 100 years or so.

Systems such as the installation in the Budapest Opera House, I believe originally installed by an Austrian firm in the 1880's and only just in the last couple of years being taken out of service.

Also many of the Municipal Theatres in West Germany and Austria have finely engineered accumulator hydraulic systems using either compressive or tensile rams as the prime movers.

Many of these systems incorporate simple but accurately made devices to allow remote control for both speed and height position. Virtually all of these equipments have proved reliable and safe in operation over a realistic time span.

We, therefore, on the grounds that hydraulic equipment generally is now universally used in the industrial field in everything from earth moving to remote controlled factory operations, have opted to follow that direction. With the latest development in hydraulic valve technology we now have at our disposal superb proportional pressure compensated flow valves for accurate control of speed, the latest seal technology almost guarantees leakproof rams and safety load holding lock valves have reached extremely reliable standards.

The major advantage in using this equipment is that the proportional valve can be provided with solid state electronics to meet our control function criteria as standard industrial packages.

This obviously has a price advantage as it means that less equipment has to be custom built and, therefore, the research and development costs are very much lower. The service provision can in many cases be obtained from the local agent of the hydraulic supplier of the original equipment.

The next question is what method should be used to apply the fluid power to the load?

In the field of scenery flying there are various ways and methods which can be adopted, systems tried and proved successful to a lesser or greater degree include:—

1. Multiple purchase compression rams which largely are not considered favourably by us due to the large size of ram necessary to accept the very high compressive forces which in turn puts up flow rates and pump sizes etc.
2. The multiple purchase tensile ram which we do favour in new installations where cost is a major consideration.
3. The linear ram systems operate direct to the scenery load and many Theatres prefer to have some counterweight assistance. A fluid motor powered winch that can be placed at the base of most conventional counterweights to overhaul the weight frame with up to a 50% of its contract load out of balance. This system offering a power operation in Theatres that exist with traditional counterweighting, power to size ratio of fluid motors is far superior to electric drives allowing the drives to be fitted with minimum counterweight modification.
4. A similar device i.e. a fluid driven head sheave block, this works on a frictional principle using a 200+ degrees of wrap to enable adequate traction, again to transmit up to half the contract load using permanent counterbalance loading.

Both these systems offer to the Theatre the major advantage of being able to revert to manual control easily and quickly in cases of power failure or even some necessity to scenic need which makes hand control more applicable.

Finally, a new development is a very small fluid motor with a three sheave friction system which actually operates by driving the hand line hauling rope in a traditional counterweight system as an assistor.

All these systems have been tried either in complete installations or in prototypes and our Company are currently installing in the Ivan Cankar Centre in Yugoslavia the powered head sheave version and have several small installations of the tensile rams now working.