MR ROBOTHAM THE GREAT

a man-size lightweight-electric powered robot for four to seven function R/C

by PETER HOLLAND

Engineers and electronic buffs ... pass this one by! Although Peter's commercial robots *are* solid and sophisticated, his example here has been designed specially for aeromodelling types — it has the minimum of complication and can make use of that old 27MHz four-seven function gear. Follow in the purring footsteps of this 6ft. 3in. entertainer, which has gained national and international acclaim by the media.

THERE HAVE been robots in the Holland household for over 50 years, long before the writer had the advantages of radio control. Most have been made for entertainment of the family and friends, rather than for doing manual tasks. In those early days, **Meccano** was a valuable aid in building the mechanics — control was by cable or photo-electric links and those with on-board batteries tended to be heavy.

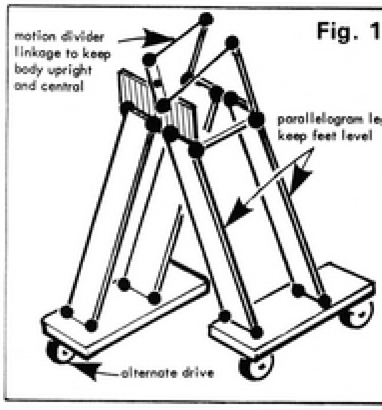
In the early 1950's I designed the first *Mr. Robotham* for the Model Maker Plans Service which is still being sold. The prototype of this free-running lightweight still survives. A duplicate had pulse radio control with a superregen soft valve system to control its walking (signal on left foot forward, signal off right foot forward). To turn the pulse was stopped on or off! Double the size at 4ft. tall, the next *Robotham* had six channel reed R/C for walking and signing autographs with a cam programmed hand mechanism.

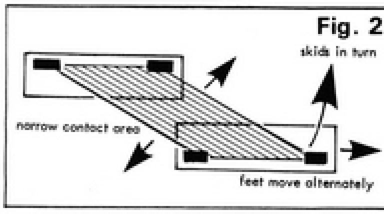
Radio control as we know it today brought the possibilities of rather more human movements, although some of the functions are switched via micro switches from servos. The field is wide open for the experimenter in robotics to have a crack at building mechanical men, menacing monsters or crazy contraptions. The advent of 35MHz for aircraft leaves many old 27MHz four, five and seven function outfits spare for this close range operation without too much interference. It seems a shame too use just two functions of these sets when driving cars or boats — robotic modelling puts 'em to good use.

The Golden Boy

The 50th anniversary of the Model Engineer Exhibition in January this year was the debut of *Mr. Robotham the Great*, presented here for you to build. The term 'Great' (as he will tell you via his tape recorder in the left boot), is to differentiate him from his earlier brothers and to indicate his size; all 6ft. 3in! There he would go 'walk about' among the foyer crowds, stooping down (a thing robots don't usually manage to do) to talk to children and tweak their noses.

Right from the start and on the backs of





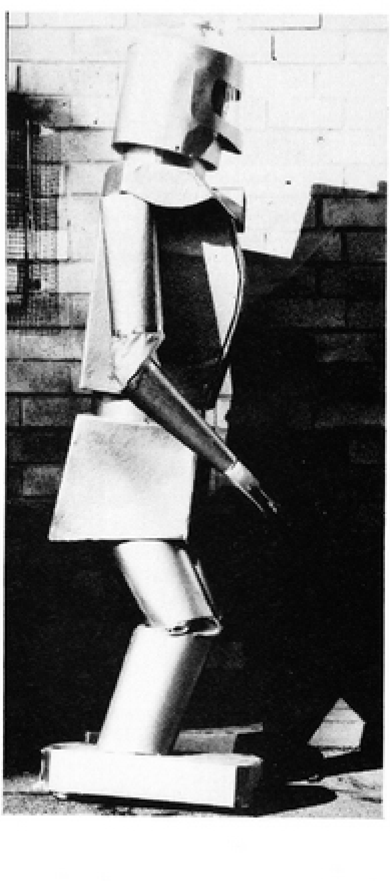
many envelopes, he was designed to be light in weight, so as to be economical in current demands, safe in public and above all, quick and sprightly in movement. This chap only weighs 7½lb. plus the tape recorder so four 1.2Ah fast rechargeable Ni-Cad cells keep him going for about half an hour.

There are penalties, however: he will blow over in a wind, prefers smooth surfaces and although he came through the buffeting of crowds during nearly two weeks of ME Exhibition, several TV performances and school play, he sometimes needs a patch or two after 'nice quiet' children's parties!

After nearly a year of use, I would not make him any heavier or more sophisticated, he tends to be treated more as a person in our household, rather than the traditional lumbering collection of ironwork that go under the name of 'robot.'

The walk

Early Robothams use a paralellogram leg action and motion dividers to keep the trunk



Heading: Robotham the Great in profile. "Come down and see me sometime," says Peter's six-year old son James. Left: Robotham obliges by stooping — who would realise that the structural legs were rigid at the knee?

Fig. 3

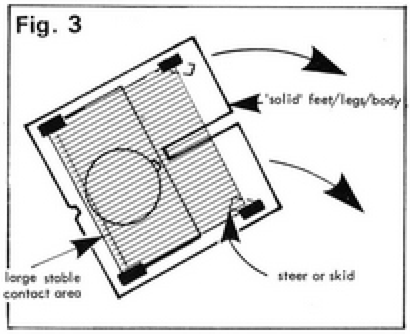
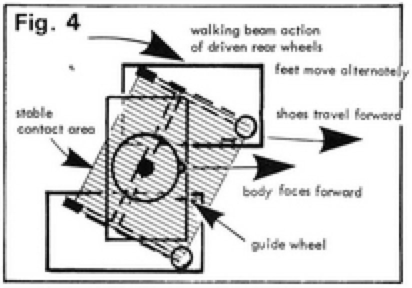


Fig. 4



upright — see Fig. 1. This system, whilst giving a fairly natural looking gait, can be prone to instability if the stride is long (Fig. 2). Other designs get around the problem by using rigid legs, body and all and driving the thing like a tank (Fig. 3).

This is not so 'realistic' for if legs are to be used, they might as well be used as legs, not spacers between the body and the ground. This machine (you cannot call it a model, 'cos it's full size) allows the feet, rigidly connected to leg spars (or bones) to do your tank-like action in the style of what is known as a 'walking beam,' but the body maintains a natural straight path, facing forward.

Covers or trousers and flexible hips accommodate the movement and loose shoes are each guided by their own little tracking wheel to travel rather more forward than in an arc, see Fig. 4.

Turns are made by keeping power to the outer foot motor, the shoes skid and the whole machine rotates about the other foot's drive wheel.

Castors in the toes allow free and rapid changes of course, and reduce drag that would normally be imposed by the 'dead' foot.

All the foregoing is relevant to robots propelled by wheels or tracks — there are other methods but these tend to be rather more complex to construct or drive, even though some can step over obstacles and mount steps — wait for this year's ME Exhibition!

What do you need?

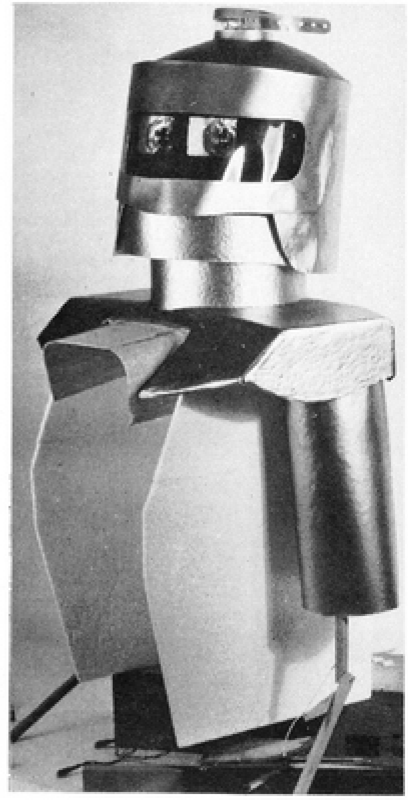
I use a four function radio system with two linear and two rotary servos, but with a spot of linkage work, either could be used for all jobs. The plan shows a mechanical selector to feed five of his functions but a seven function outfit could be used. There's really nothing electronically complex about the big *Robotham*.

Materials should not be hard to find either, ¼in. thick expanded polystyrene ceiling tiles provide the skin material for all the boxy bits.

Thin acetate sheet or tracing film (drawing office suppliers) can be used for the tubular parts. The framework is spruce strip and a few pieces of plywood. There's balsa and piano wire and small electric motors. Three of my motors came from the junk box and other pensioned-off robots. New ones from your model shop are not expensive and simple friction and belt drives are used in preferance to gearboxes on all but two drives ... I have an aversion to screaming gears.

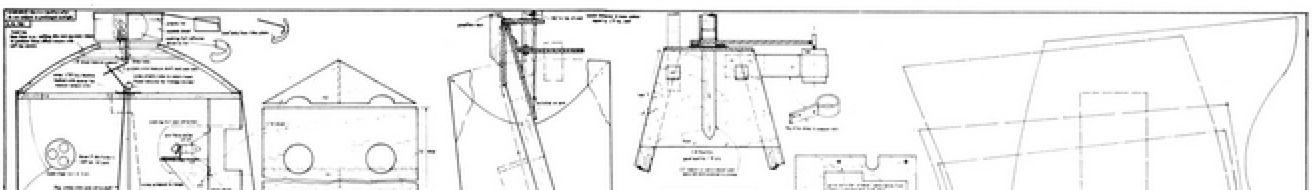
Construction

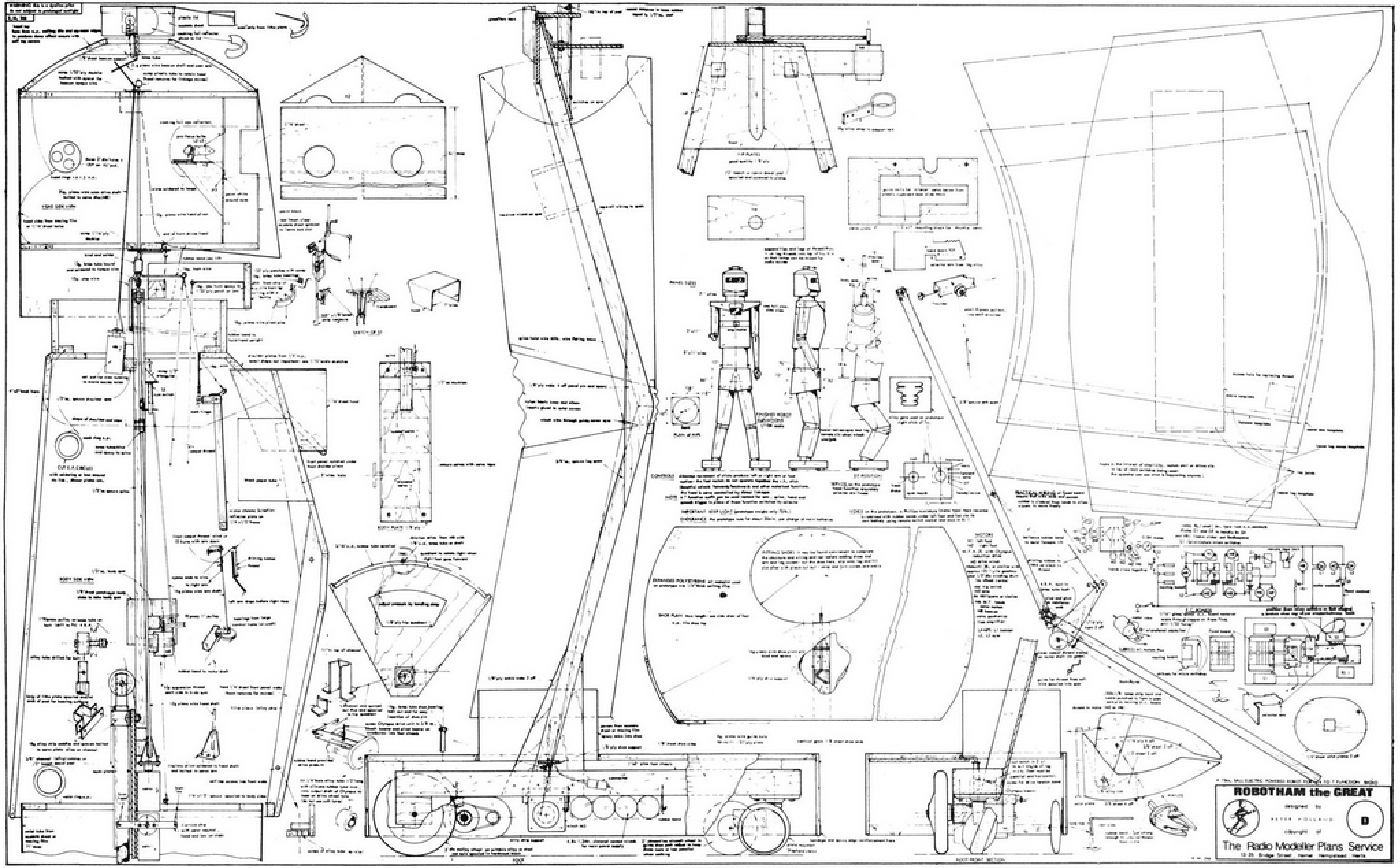
Start with the legs: strips of ⅝in. square spruce form the spars and are joined rigidly at the knee with ⅛in. ply webs — there is a lot of strain on these joints so pin and glue them well. Assemble them to the ply hip plates to



In the course of construction: the simpler shapes of the body panelling are emphasised partly covered with metallic paper — it looks like hammered brass. The arm spars and elbow joint also show in this photo.

★ Full-size copies of this plan shown here at ⅕ scale are available as Plan RM246 price £3.50 + 40p post from RM Plans Service, PO Box 35, Bridge Street, Hemel Hempstead, Herts. ★





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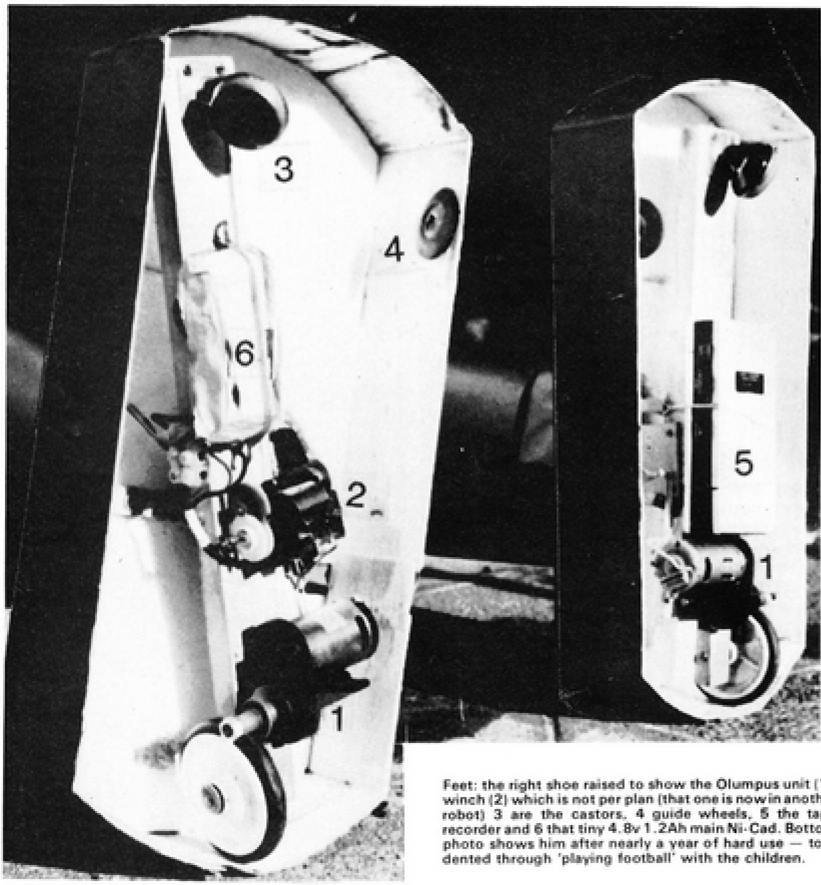


Feet: the right shoe raised to show the Olumpus unit (1). winch (2) which is not per plan (that one is now in another robot) 3 are the castors, 4 guide wheels, 5 the tape recorder and 6 that tiny 4.8v 1.2Ah main Ni-Cad. Bottom photo shows him after nearly a year of hard use — toes dented through 'playing football' with the children.

make a springy but strong inverted 'V.' Using the side views of the plan, set up the legs against strips of 1 × 2in. softwood which are to become the foot chassis and mark for notches to take the leg ends. These will not be quite in line with the legs, due to the combined angles. The feet must be parallel.

Add the body post (½in. dowel) and check that it is vertical.

Around this dowel fits a length of aluminium alloy channel, free to swivel against the little litho plate rubbing facings shown on the plan.

A motor gives friction drive to a ply quadrant to rotate the channel in the opposite direction to that taken by the legs, a Milliperm or other small 6V motor is used, held in an alloy strap — simple, effective and adjustable. Little effort is called for, as the inertial force of the body helps the motor.

Were it not for the ability of the robot to stoop down to a sitting posture, one could add the wheel drives and castors to the feet and leave matters there. However, it seems a novel action to use, and this is why the leg spars are kinked at the knee ... read on ...

Ups and downs

Around that channel strip fits a pair of strip metal saddles bolted to what I call a 'body plate,' this transmits the rotary movement to the body and can be hoisted up the channel like a lift, whilst preserving the rotary drive. Keeping the weight low down, a Mabuchi 850 on a 'pile' gearbox turns a winding drum to do the hoisting. I used the centre from a model aircraft wheel for the drum.

With the body plate at the top, the body casing will be in the standing position, and from the body suspended on cords, the hips and leg covers. As it descends, the waist telescopes, the hips tilt and the leg covers bend at the knees like a string puppet, but the structure remains static. In fact Robotham is much like a puppet but with the strings *inside*.

The arms are freely hung from the shoulders and the forearms are hoisted up a winding shaft driven by another motor on a transverse body spar. So that each arm can be operated independently, a spot of pre-winding is done ... with the arms down, there should be some extra cord still on the shaft from each arm, wound in the *same* direction. Now, the left arm will start to rise as the shaft turns, slack cord to the right arm being taken up by a piece of shirring elastic in that arm. Reversing the motor lowers the left arm and raises the right one. Rubber bands help to balance the weight of the forearms to save current.

Main drives

Back to the feet, each has a MFA 20 motor fitted to an Olympus belt reduction unit. These conveniently bring the revs low enough on 4.8 volts to permit a direct friction drive to be used on the tyres of each 3in. drive wheel (these were by Fobel from the DIY shop).

Silicone rubber exhaust tube is used as drive rollers on alloy tubes mounted on the prop shafts of the Olympus. Constant pressure is provided for the drive (used on many other Robothams). The Olympus is screwed to a single hardwood bearer pivoted on a screw in the foot chassis, and heaved against the wheel by rubber bands just tightly enough to drive under normal load, but to slip when overloaded to near stall level. Too much pressure wastes current.

Boots, boots, boots ...

I made the mistake of fitting the shoes after assembling the feet to the legs, and had to cut a slot in each to pass them around the legs. You can do likewise if all the coverings are added after proving the mechanics. The plan shows how they are made. The only point to watch is their mounting on the pivot pin, which has to fit freely into a tube in the fit chassis. The shoes have to be lifted up the leg a little when charging batteries, changing or inspecting the drives, or re-winding the tape recordings.

No weight should be taken on the shoes, they just skate along, minding their own business. If the little guide wheels are toed in correctly, they will try to track out relative to the chassis and remain parallel to each other for much of the time. It is this, more than anything, that restores some realism to the walking action.

The head

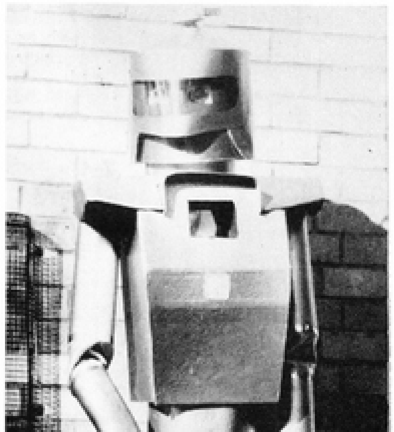
This should be made as light as possible. It is directly driven by servos — one turns it via a torque shaft, the other makes it nod via a cord. For this to happen the torque rod has tube and wire joint at 90° to its axis and a wire stop to prevent it from tilting right back. The jaw is pulled down when the 'nod' servo goes the other way.

Both these actions are returned by rubber bands — more puppet-like cord work. Whilst all this is going on, an old servo mechanism is turning a dummy scanner/flashing beacon to top of the head via a thin piano wire torque shaft. For access, the head top lifts off, so a drive crank like that on a toy boat is used.

The eyes wink, current is supplied via a double, normally closed, contact mounted near the head torque shaft. A wire lug on the latter pushes one or other of the contacts apart when the head turns fully.

Radio installation

The receiver has to be mounted on the hip plate or close to it, so that the servos are not too far from it. I used a long aileron extension lead to reach the uppermost of the two servos on the body plate (the one that turns the head). The plate rises some 11in. so those plugs may get pulled out. The other servos are used as selectors on a ply platform below the quadrant, the radio Ni-Cad and switches



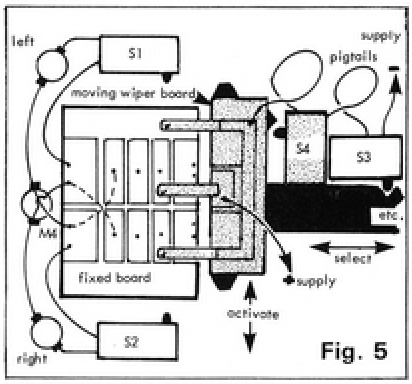


Fig. 5

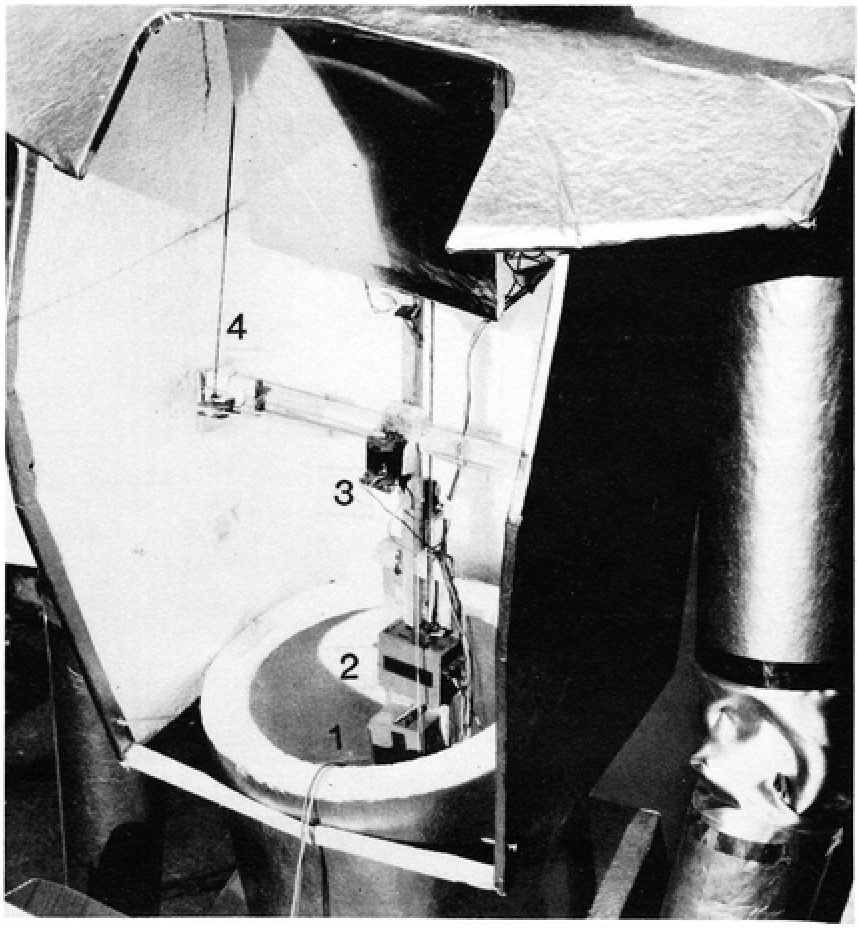
are on the leg spar. The aerial dangles down inside one leg and does not seem to pick up interference — all the motors are suppressed.

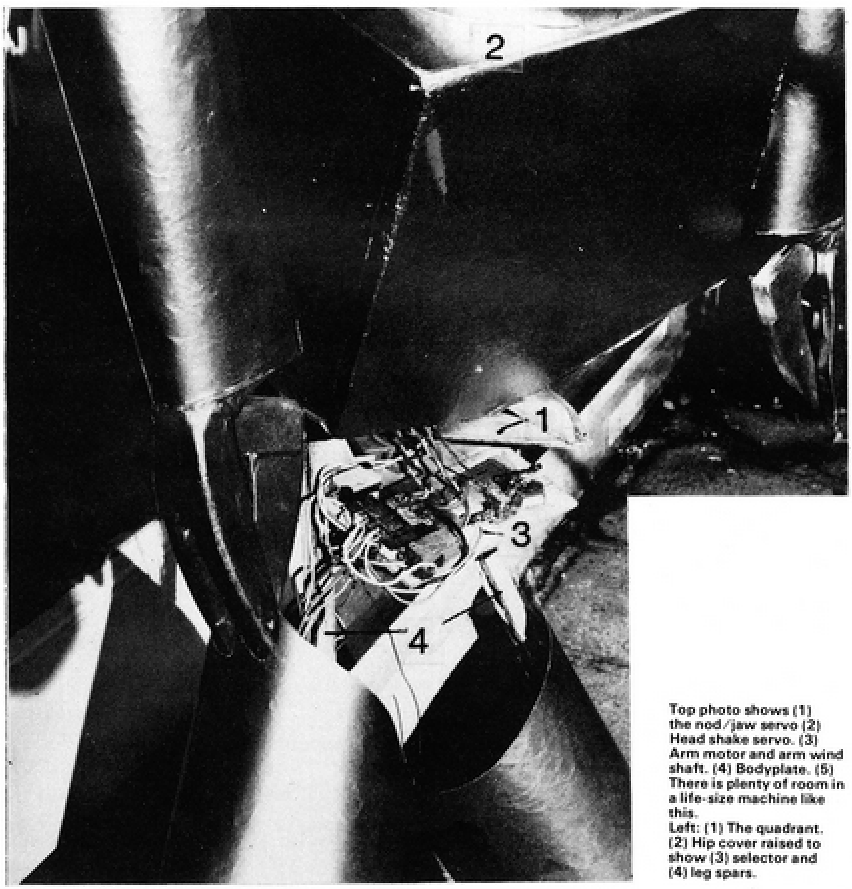
Selector

The main drive motors have to be switched alternately for walking and the hip motor turned on just before they start up. This, reversing and the spine winch, arm hand motors (which wind thread to open the hands) and tape recorder on/off are all switched by a printed circuit board, three brass wipers and four micro switches. The plan shows how to make it, wire it and use it. If you can cut a narrow groove in copper clad laminate with a sharp knife and solder without melting the lot — it should not present problems. The following should serve as guidance when setting it up (Fig. 5).

No current is fed to the system whilst any wiper is crossing between contact lands (those copper bars on the fixed board).

Microswitch S4 looks after the longitudinal ones selected by the 'aileron' servo and S3 handles those at right angles — the actual function selected by the 'throttle' servo.





Top photo shows (1) the nod/jaw servo (2) Head shake servo. (3) Arm motor and arm wind shaft. (4) Bodyplate. (5) There is plenty of room in a life-size machine like this.
Left: (1) The quadrant. (2) Hip cover raised to show (3) selector and (4) leg spars.

In action, the 'throttle' servo moves the wipers along the board until they reach the pair of lands that feed current to the appropriate motor or motors, S3 closes. The 'aileron' servo slides the wipers across to feed either positive and negative, or negative and positive to the selected lands, depending on which side or direction is to be energised, then S4 closes.

The foot motors have to be fed via additional mirco switches S1 or S2 so that the waist motor can steal a march on them and be ready to compensate for the jolt when they start up. This has to happen in both forward and backward walk control, the waist motor (M4) comes in with a small stick movement, full sideways movement brings in the main drives. In this way he can be made to twist his body whilst standing still, and dance the 'twist' on the spot, with either foot going fore and aft.

Action

Move the selector stick almost fully forward and Robotham is ready to walk, wiggle it from side to side briskly for short steps, more slowly for sweeping strides and hold it to one side to turn about.

Gentle turns are made by giving shorter strides on one side. In reverse the same action is used, and if driven into a corner, can be spun around by giving 'left' forward, 'right' backwards in a figure eight stick movement.

To move the arms: select 'arm' and move the stick across to whichever side is required to be lifted. Sit/stand action is chosen by sideways movement too. Hands open via a diode polarity selector, bottom left and 'voice' via a relay/diode combination, bottom right.

Whilst all this is going on the left hand stick can be used to animate the head, jaw and eyes — then with practice you can hold prearranged chat sequences manually synchronising the jaw to the tape recorder. Have fun.