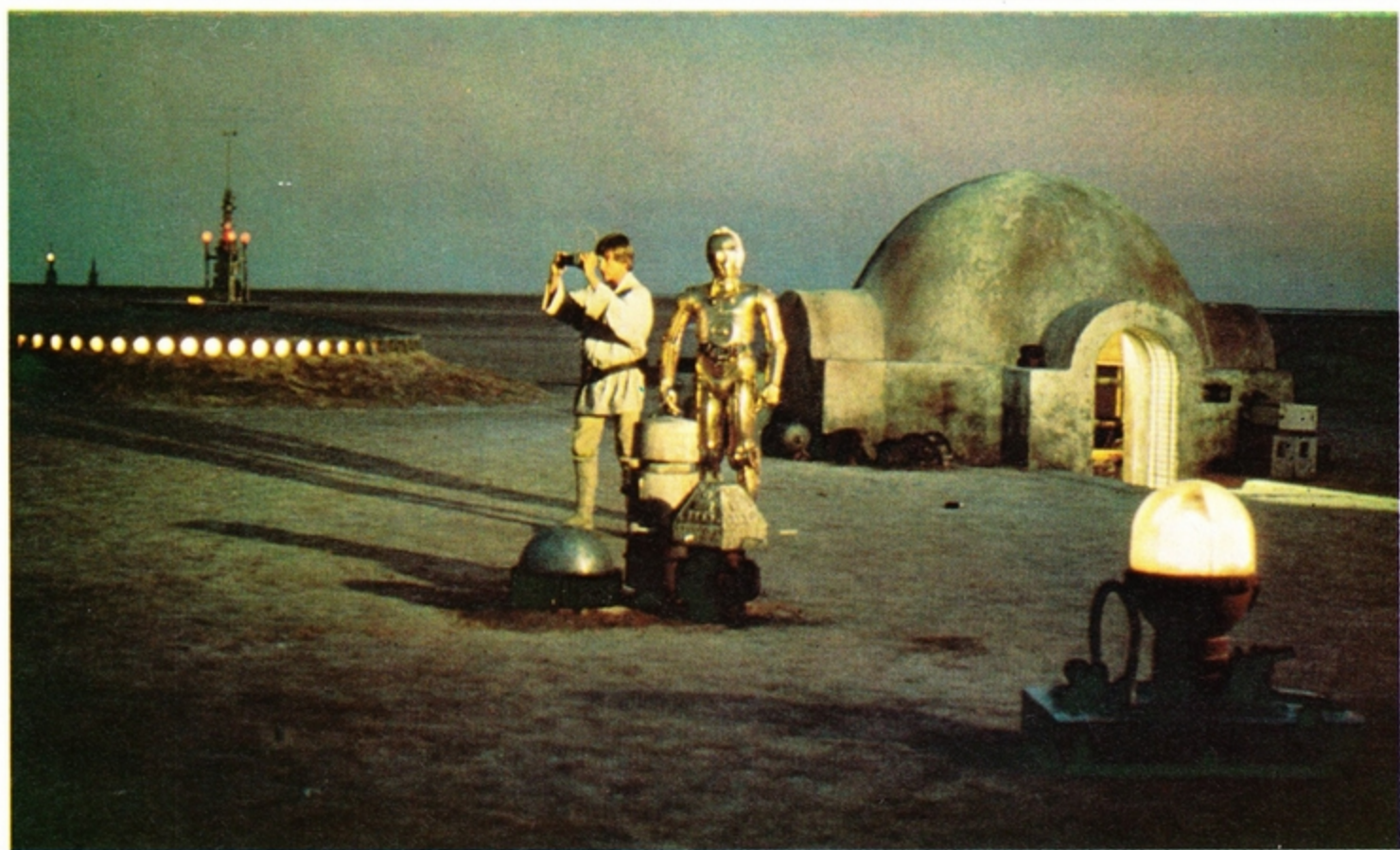
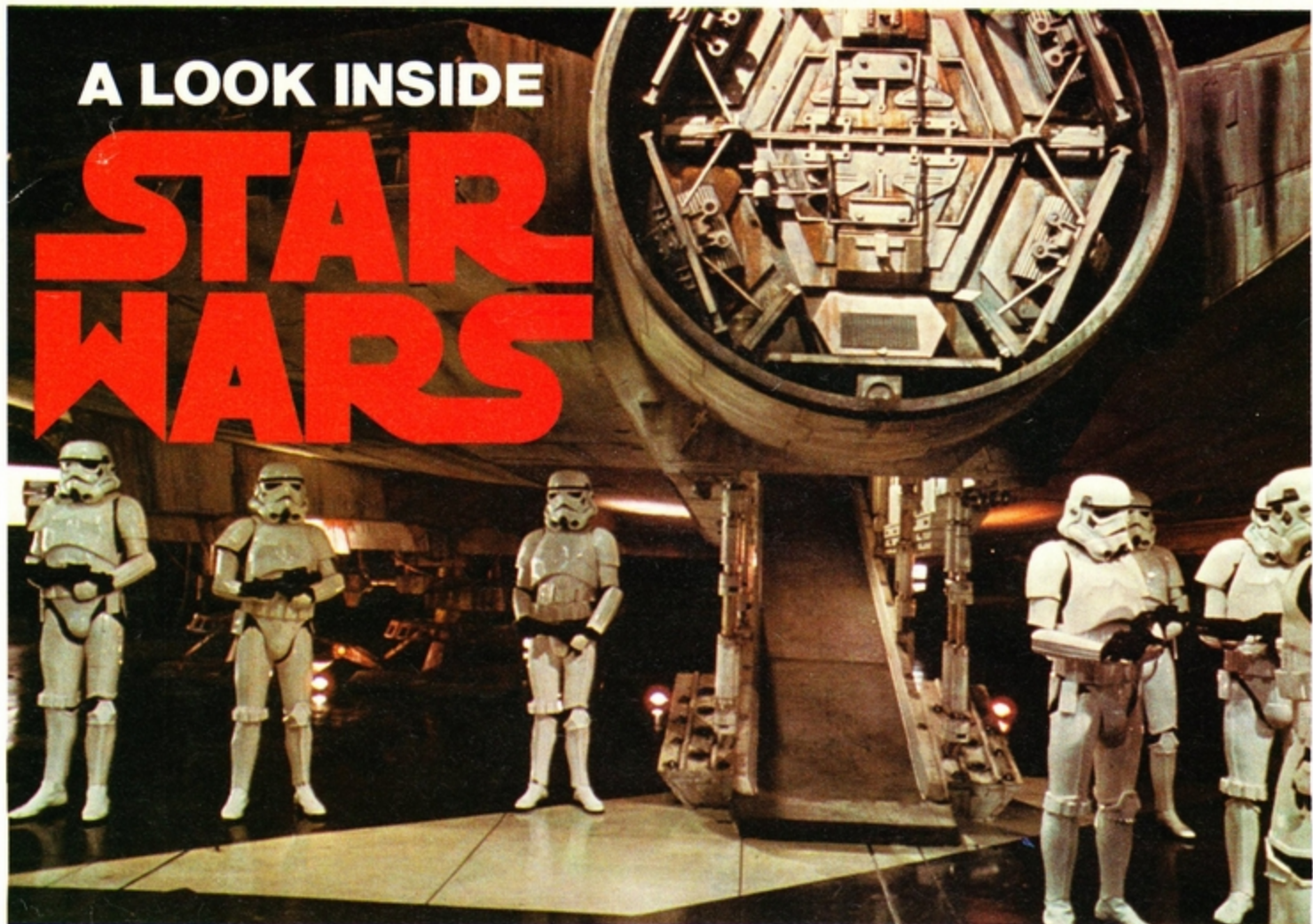


A LOOK INSIDE

STAR WARS



Jim Perry looks behind the scenes and inside the robots

BY THE TIME this story is printed STAR WARS will have probably grossed 200,000,000 dollars worldwide. All those zeros are the result of six years work by writer-director George Lucas, and an end product that makes the TV series Star Trek look as spectacular as Number 96!

As early as 1971 George Lucas had the idea of filming a space fantasy. Originally he wanted to make an up-to-date version of Flash Gordon — but couldn't obtain the copyright to the characters created by Alex Raymond. Thwarted by this setback, he started researching the possible sources that inspired Flash Gordon. After a fair bit of digging, he realised that the Flash Gordon concept was probably based on a series of books by Edgar Rice Burroughs (of Tarzan fame) about "John Carter of Mars." In turn it looks as though Burroughs had been inspired by Edwin Arnold's "Gulliver on Mars" published in 1905. Jules Verne had preceded even this but never made his hero battle space creatures or have adventures on distant planets — the basis for a whole new concept (then) in adventure stories.

As soon as he finished American Graffiti George started writing Star Wars — that was in January 1973. He worked on the story virtually full time right up to and even during the actual filming in March 1976. At one point there were four different scripts, each one with a different blend of storyline and characters.

United Artists were the first to be offered the embryo idea, but they turned it down because they couldn't see the potential! Universal were more interested at first, but also gave it the thumbs down. Finally 20th Century Fox were persuaded to back it, but nobody thought it would be a big success — little did they know.

New Worlds

The first step after completing a satisfactory basic script concept was to visualize a whole new world. Collin Cantwell, who had worked on "2001 — A Space Odyssey", was brought in to design the spacecraft models. Starting off with simple sketches, Ralph McQuarrie began visualizing the characters, costumes, robots and scenery — finally producing a series of full colour paintings to give an idea of what George Lucas wanted in various scenes.

Meanwhile producer Gary Kurtz had the headaches of finding a suitable place to film, working out logistics and budgeting. In turn all American, North African and Middle Eastern deserts were visited; the aim was to find a suitable location for Tatooine, the desert planet home of hero Luke Skywalker. Finally the southern part of Tunisia was chosen, near Tozeur in the Sahara desert.

Partly as a result of the decision to film locations in Tunisia, but mainly because of the facilities and people available, the interior work was to be done at EMI Studios in Elstree. It was the only studio complex in England or America that could provide up to nine sound stages simultaneously, and the technical staff are among the best in the world.

Production designer John Barry and his crew began designing and building the huge number of props and sets in August 1975. In order to make things look realistic \$40,000 was spent on junk and scrap metal; anything from sewage pipes to jet engines were used to make scenery look realistic. One of the interesting aspects of Star Wars is that everything looks used — just like real life!

The job of making the robots was given to John Stears (alias Special Effects Worldwide), who won an Academy Award for his special effects in Thunderball. John had also worked on six other Bond movies — he fitted out the legendary Aston Martin that did everything except make tea!

John's job was to turn Ralph McQuarrie's illustrations into reality (or as near as possible). He was also responsible for the production effects. The main robot is R2-D2 (Artoo Detoo): the one that looks a bit like a dustbin with three legs. Artoo's partner is C-3PO (See Threepio), an android type. The only robot not made by John was Threepio, as he was just a casing designed by art director Norman Reynolds and sculptress Liz Moore — with Anthony Daniels entombed inside.

Besides Artoo types there were four other basic robot types used in the film, these were the Umbrella-type, Stick-type, Dome-type and Box robots. All of these were radio controlled — internal shots are given later in this article.

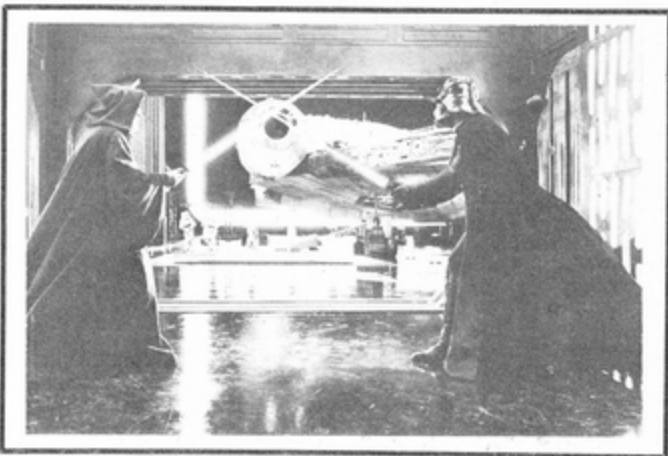
Now You See It . . .

As well as the variety of robots, John designed the Speeders used as transport on Tatooine, the multitude of explosions and the light sabres. The Speeder shells were moulded in fibreglass, and supported on a boom arm; after filming the boom was painted out frame by frame.

The light sabre effect was produced with the aid of reflective and non-reflective facets of the sabres. With a light mounted on the camera, the sabres appeared dark if their non-reflective part was towards the light, and glowed when revolved to expose their reflective section. By spiraling the reflective portion and spinning the sabre the effect of the light moving out was created.

Even though John Stears is an electro-mechanical wizard and special effects veteran, he hadn't made anything quite like Artoo and his (its?) fellow robots — even though his hobby is radio-controlled models. Asking for advice at St. Mary's College (University of London), where he met Professor Thring, the robotics expert, and Queen Mary's Hospital in Roehampton where he met artificial limb specialists, he gained useful information on pneumatics and electronics. The only problem was that when told the time available, everyone said it was impossible! In fact John did the impossible — with one exception: there wasn't enough time to produce a version of Artoo that wobbled on two legs.

The wobble effect was needed to make Artoo a bit more human and, as a final solution, a special Artoo casing was constructed for 3ft. 8in. Kenny Baker to wobble around in! Simple way of telling which version is in a scene is two legs



▲ Ben Kenobi (Alec Guinness) battling forcefully with the superevil (boo hiss) Lord Darth Vader (David Prowse) near the captured Millennium Falcon space freighter.

STAR WARS

STAR WARS

Kenny, three legs the real Artoo with radio control. In March, 1976, the production unit moved into Tozeur in the South of Tunisia, to begin the transformation of desert into desert (from a different galaxy), and construction of massive Jawa transport vehicles. The Algerian army caught sight of these massive props and thought they were real!

After eight weeks of preparation the filming started. During the first week the entire crew had to wear sand goggles due to a big sandstorm. The filming lasted two-and-a-half weeks on location before moving to Elstree for the next 14½ weeks, where all nine sound stages were filled with John Barry's 30 sets. Planets, starships, caves, control rooms, cantinas and a vast network of corridors from inside the Death Star were at Elstree — but the Alliance's secret hangar full of X-wing and Y-wing fighters had to be built at Shepparton Studios, because it was the only place in Europe big enough!

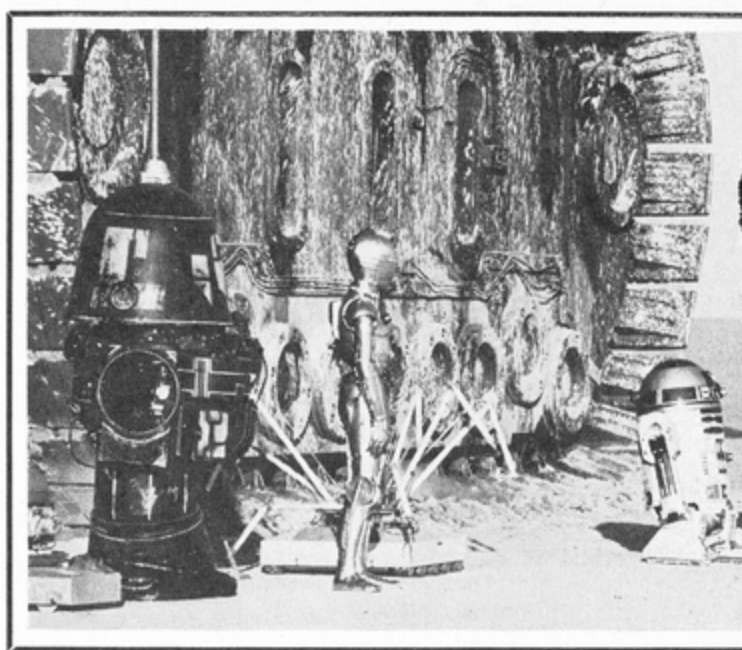
When on location all the robots had to be cleaned every day — the sand and salt got in everywhere! One problem arose with the radio control systems because of static-charged windborne sand particles present in the Sahara; an extra aerial wire had to be attached to Artoo. Also being miles from nowhere the internal batteries had to be charged from mobile generators, which also had to be maintained. Trying to keep track of up to 30 sets of batteries is guaranteed to give anyone a twitch! Artoo and company were operated by John Stears and his crew, with Dick Hewitt (of Compact Video Systems) supervising the electronics.



▲ Imperial stormtrooper (hiss) blasting after Princess Leia inside the Alliance ship.

Built from Scratch

As well as the robots and mechanical effects, Star Wars uses the most advanced optical and miniature effects — the deep space shots, laser guns, etc. In June 1975 John Dykstra was asked to supervise all the photographic special effects. There



was a slight problem — no commercial facility had either the time or even equipment to produce what was required — so John built Industrial Light and Magic Corporation, from scratch, in an empty warehouse in the San Fernando Valley.

The ILM complex included a carpentry shop and machine shop, which had to build or modify the special camera, animation equipment, editing and projection equipment needed to produce the effects. Other departments included optical printing (for putting the many different layers of film together), a rotoscope department (for matte work and general backgrounds) and a library section for keeping track of the thousands of pieces of film.

Dykstraflex

The most important part of ILM is the Dykstraflex camera, which is based on an old VistaVision camera, linked into a computer. The VistaVision camera runs 35mm film through sideways, like a 35mm still camera, whereas normal movie cameras run the film vertically — the benefit is increased resolution, which is needed when up to 12 shots are put together on one print. The computer is used to store movement with control of seven separate parameters simultaneously.

Each of the 365 special effects needed between two and 12 separate exposures of film, in all 3 838 exposures were needed. For example, in the battle sequence you see an X-wing fighter swooping and soaring over the Death Star — in fact, the model of the X-wing never moved an inch! The camera moves, creating the illusion that the fighter is moving; the Death Star is filmed separately with different camera movements. The two exposures are then printed together to create the impression of X-wing swooping over revolving Death Star — not to mention more fighters, laser flashers, stars, etc.

This is where the computer comes in. If the angle of the camera changes during a shot, the other shots change as well — hence each separate frame has to be exactly matched for each different component of the composite shot. The computer remembers everything and moves the camera accordingly — simple, but until the Dykstraflex, no camera could do it.

To create realism in the dogfight scenes, thousands of feet of World War II movies were viewed, together with storyboards. By studying the real life movements of the planes,



▲ Owen Lars (Phil Brown), uncle of Luke Skywalker, being shown the Jawa robot collection by the chief Jawa (Jack Purvis). The huge sandcrawler in the background was mistaken for a military vehicle by the Algerian army.

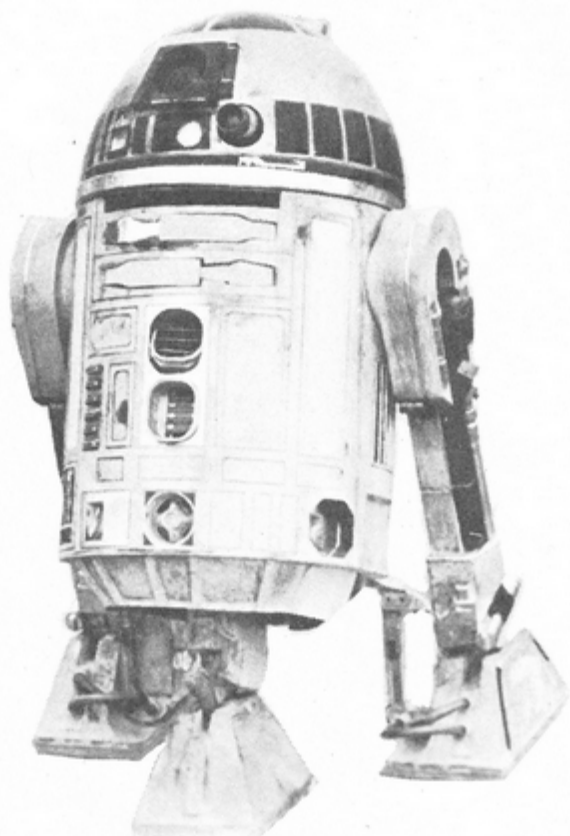
Firstly the movement had to be put down on paper, so that the camera operator could try and emulate the movement — then the operator had to teach the computer the movement, in fact he had to 'fly' the camera over the fixed model. Needless to say at the end of the filming the camera operators were all accomplished pilots!



▲ Luke Skywalker, Han Solo, Chewbacca (Peter Mayhew) and the lovely Princess Leia Organa (Carrie Fisher) trapped inside the Death Star.

the model shots were planned to be the most realistic ever made — they succeeded.

Even with the aid of the Dykstraflex the ILM crew had several problems to solve. It was easy for the director to move his hand, and say "I want the starship to move like this . . ." but to actually turn this into a finished shot was a problem.



Thanks are due to John Stears and 20th Century Fox for their help in producing this feature. All photographs are world copyright 20th Century Fox Corporation.

Contrary to some reports, most of the R2-D2 sequences were with a real robot, built by mechanical wizard John Stears — read all about the real R2-D2 here!

TWO VERSIONS of R2-D2 were made, one for Kenny Baker to fit inside and the three-legged radio controlled version. Our interest centered on the radio controlled version.

R2-D2 has three forward speeds, but no reverse, and is steerable. Provision is made for the change from two legs to three legs by radio control, also when tilted the third leg drops automatically. The reason for this is that R2 would fall over if left on only two legs!

Mechanical

In order to achieve forward motion, the two rear legs have individual traction motors which drive twin inline wheels. Steering is via the front drop leg, with a proportional self centring servo unit. The twin wheels in the steering foot remain parallel to the other wheels during turns.

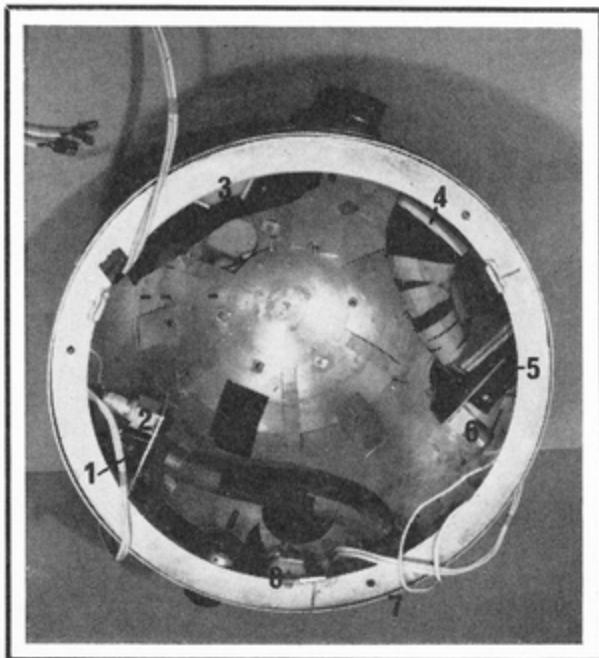
The front leg and foot can be retracted inside the body. When the front leg drops it is held at the correct distance by wires, R2-D2 can then move off at full speed.

The casings for all the R2s were specially made by a company called Petric Engineering for the modest sum of almost \$30,000, which may seem a trifle high — but they were precision pieces of engineering to the highest standard, in fact John Stears says they were excellent value.

Head Interior

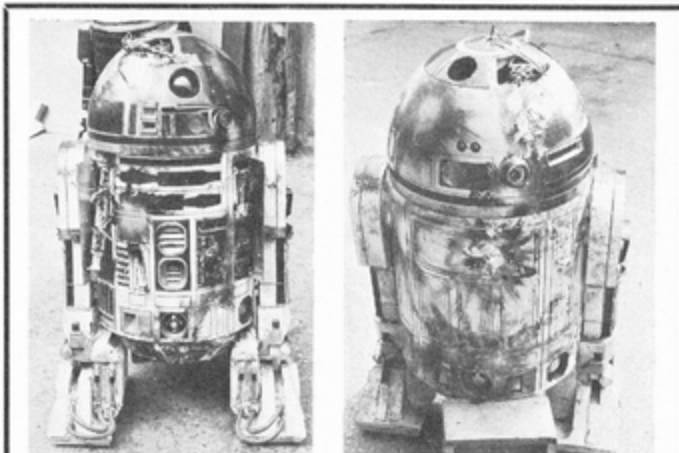


1. Q1 light source (front)
2. Coloured disc motor (front)
3. Pulsating lights (green / yellow)
4. Fibre optic display (rear)
5. Q1 light source (rear)
6. Coloured disc motor (rear)
7. Fibre optic display (front)
8. Pulsating lights (red / blue)

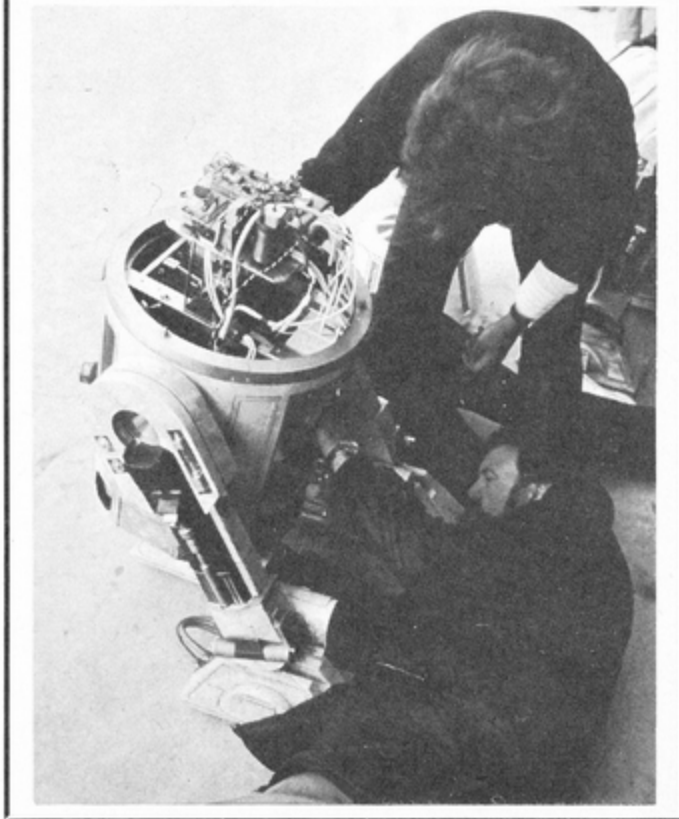


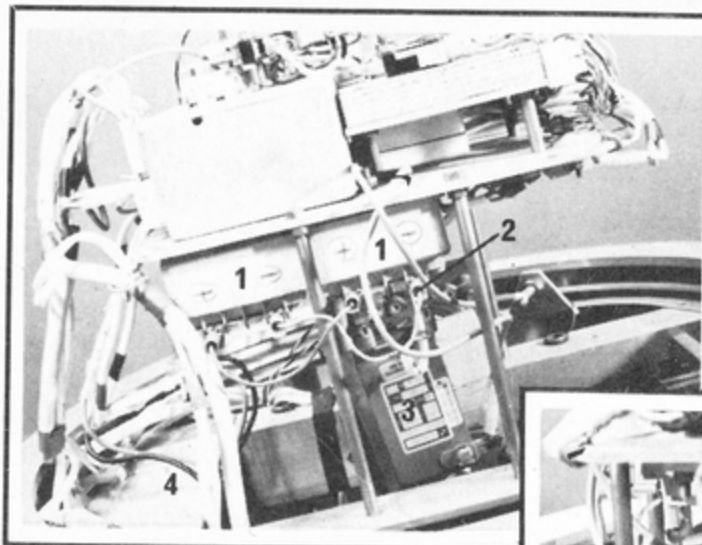
Cleaning Up

For several of the scenes R2-D2 was made to appear thoroughly blasted, or covered in grime. The only way was to virtually blast it in real life, and then clean up for the next shot. While in the Tunisian desert John Stears was also continuously cleaning real dirt and sand from R2, it got in everywhere!



- ▲ Above, R2-D2 in two stages of disorder — heart-breaking work, wrecking such a nice machine!
▼ Below, John Stears gropes under R2-D2 on location, even the best robots need repairs.



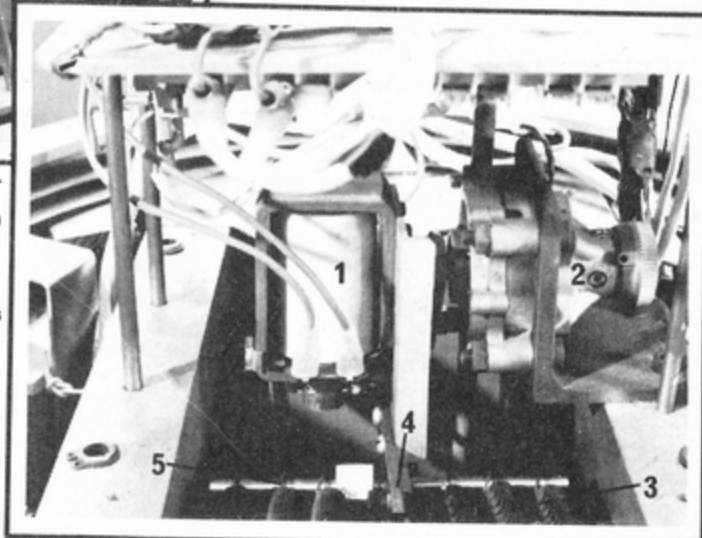


Pulsating Light Drives

1. Pulsating light control box
2. Pulsating light connections
3. Leg drop solenoid
4. Light and steering batteries.

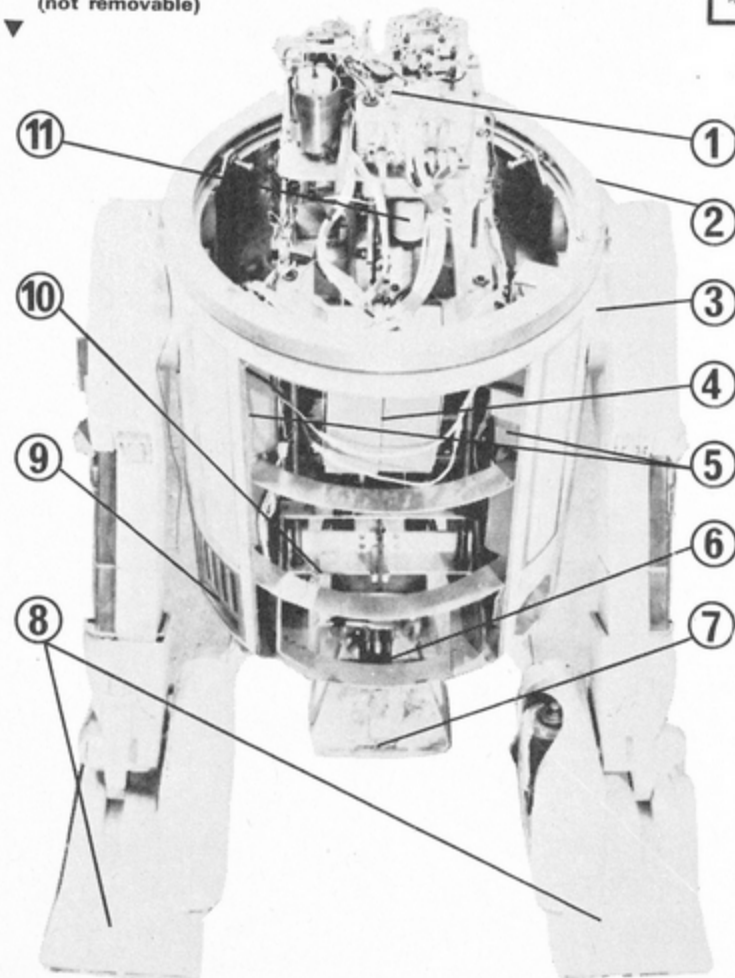
Leg Drop

1. Leg drop solenoid
2. Damper
3. Body tilt tension springs
4. Leg drop locking arm
5. Leg drop locking rod



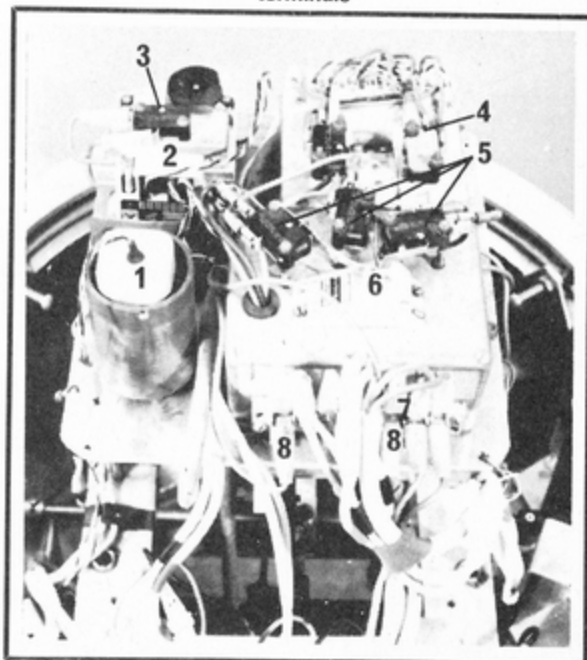
General

1. Radio control gear
2. Head ring
3. Shoulder bearing
4. Two 6V batteries for lights and steering (removable)
5. Six 6V batteries for traction (not removable)



Radio Control Gear

1. Deac
2. Main receiver
3. Leg drop servo and microswitches
4. Steering servo and microswitches
5. Speed control microswitches
6. Speed control servo
7. Traction motor connections
8. Traction batteries charge terminals

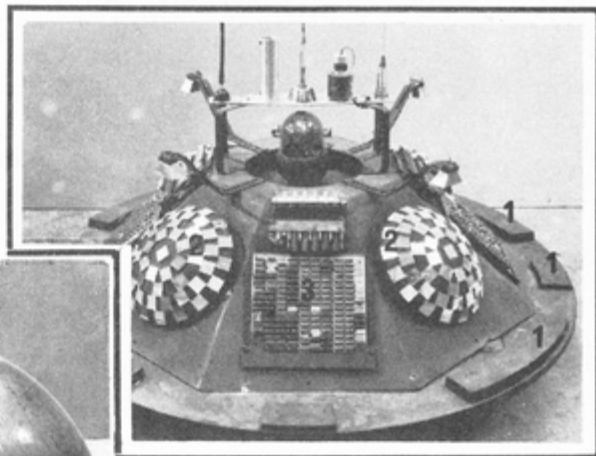
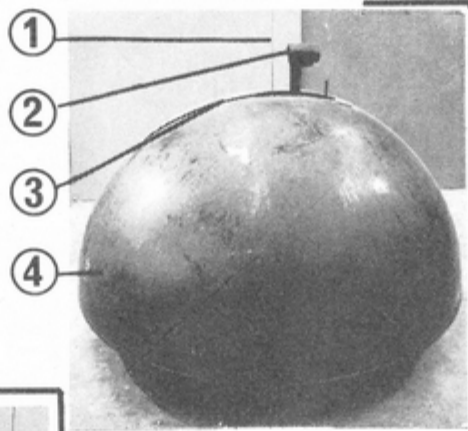


STAR WARS

DOMES

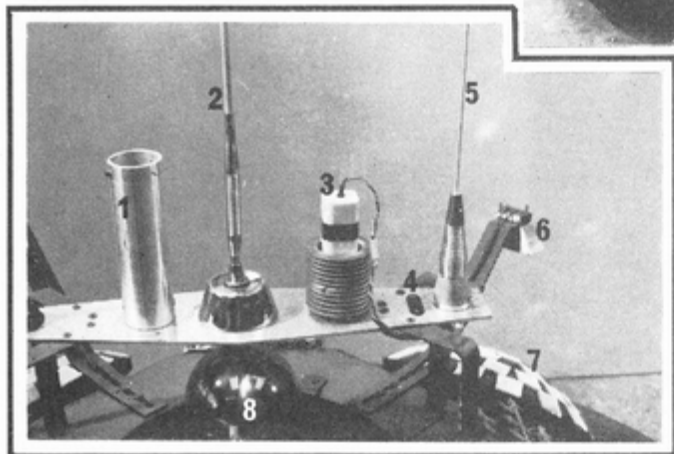
General

1. Real aerial
2. Eye
3. Slot
4. Perspex dome



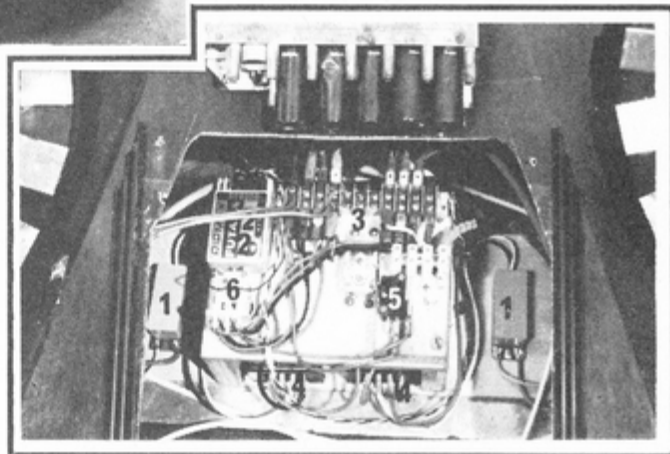
Super Structure

1. Dome locating blocks
2. Mirror domes
3. Electronics compartment



Bridge Assembly

1. Eye Socket
2. Dummy aerial
3. Deac
4. Receiver on/off
5. Real aerial
6. Oil light
7. Mirror dome
8. Flashing beacon

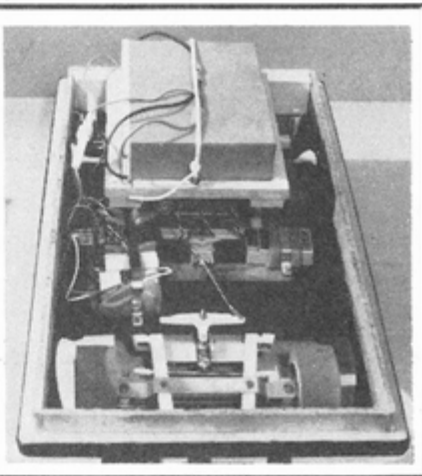
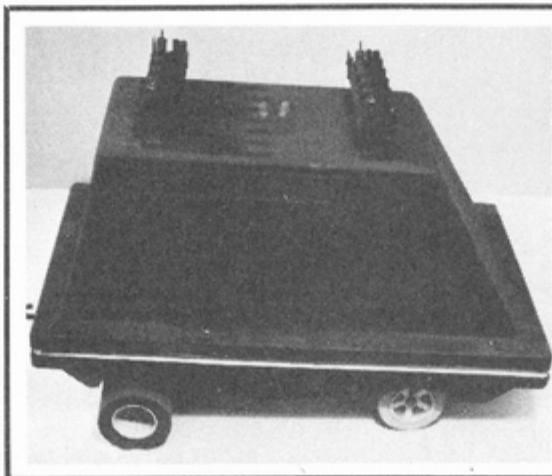


Radio Control Gear

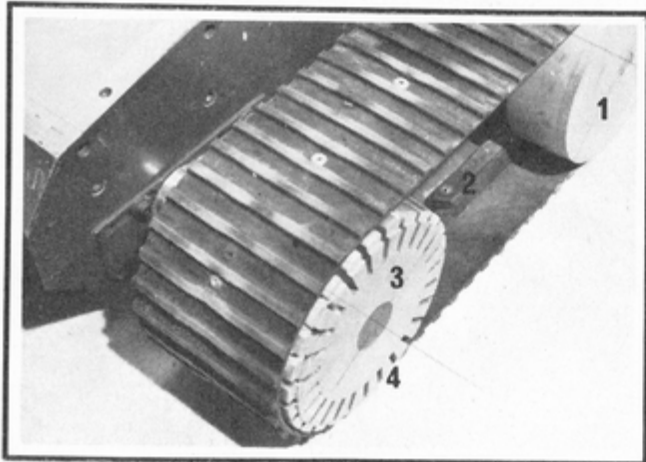
1. Suppressors
2. Receiver
3. Connecting block
4. Speed controls
5. Lighting servo
6. Lighting relay

BOX

Most people think the Box robot should have been called the Rat robot, its the one that runs around the Imperial Death Star. A Radio controlled yellow streak, makes Box robots turn and run when confronted with a Wookiee!



STICK



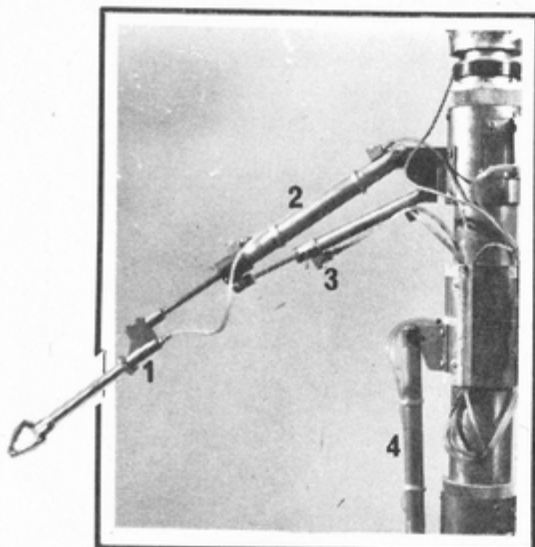
▲ Track

1. Idler wheel
2. Track guide
3. Drive wheel
4. Sand escape vents



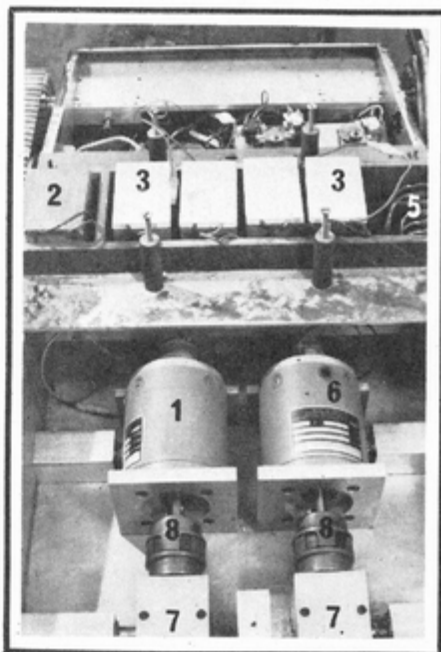
▲ Head

1. Eyes
2. Pivot
3. Slipping
4. Brush
5. Eyes up/down crank
6. Counter balance spring
7. Eyes up/down motor
8. Slip ring feed



Arm

1. Claw ram
2. In/out ram
3. Up/down ram
4. Dummy ram

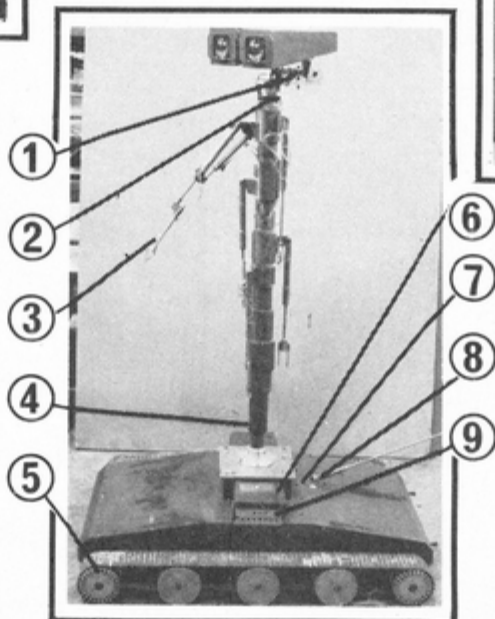


▲ Base

1. Right traction motor
2. Auxiliary battery
3. Traction batteries
4. Receiver
5. Pneumatic connections
6. Left traction motor
7. Gearboxes
8. Flexible couplings

General ▶

1. Eyes pivot
2. Head swivel
3. Practical arm
4. Stick
5. Drive wheels
6. Battery compartment
7. Receiver on/off
8. Real aerial
9. Pneumatic connections



**STAR
WARS**