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# TELEVISION CAMERA MOUNTING EQUIPMENT

WHILE THE ESSENTIAL NATURE of television must make it, technologically, a branch of electronics, entertainment TV is a creative art form and must be judged overall on this basis. Improved picture quality is a most desirable aim, yet remains a means to an end and is only one of the many factors contributing to the subjective impression created by the final picture. Composition, viewpoint, mobility, lighting and, of course, the entire audio aspect are equally important to the producer.

One of the less obvious elements in entertainment television is camera mounting equipment, which nevertheless can have a far reaching effect on the value of the complete production. This arises from the limitations on camera position and angle which are necessarily set by the mounting equipment. The ideal equipment would allow the camera always to be located in the right place at the right moment and with the picture correctly framed; and the easier it is to achieve this, the better the result.

During the pre-war and immediate post-war periods, television cameras were generally mounted on equipment designed for the motion-picture industry. This is not an unreasonable solution, at first sight, since the same requirements existed for pan and tilt, while TV and film cameras were comparable in mass and also in their need for direct control by the cameraman, who was tied to the optical viewfinder. Live television production, however, calls for methods very different from those used in film studios, where even the 'Long Take Technique', still uncommon, generally lasts not more than 10 minutes. The equivalent television sequence is quite often a complete 1-hour show.

Even where four or more cameras are available in a large studio, such a show cannot be successfully presented unless two requirements are satisfied. The camera mounting must be very versatile and manœuvrable, its mobility being limited only by the trailing camera cable; and the cameraman must be comfortably situated relative to the camera, so that he has convenient access to the controls and can 'follow' the viewfinder without strain, whatever pan and tilt angles are called for.

During the last 15 years these requirements have been met by increasingly sophisticated mounting equipment which falls broadly into two categories—the pedestal and the camera crane, both mounting the camera via a camera head offering pan and tilt motions.

The pedestal, Fig. 1, offers control of camera height over a somewhat restricted range, usually of the order of 2 or 3 feet. Generally, the pedestal is regarded as a static base for the camera and is shifted only between shots, so that camera control is restricted to pan, tilt and height variation. A skilled cameraman can combine these three movements with tracking motion; but pedestals are not normally power operated and the effort required to move the complete assembly on its wheels, and to attend to its steering, is hardly conducive to precise camera control.

The camera crane, Fig. 2, offers control over a much wider range of camera height, since the camera and cameraman are carried at the end of an arm or jib. The arm is mounted on a chassis capable of tracking motion, and may also be able to slew through a partial or complete circle. In some cases the camera column is adjustable for height, so that the assembly, local to the

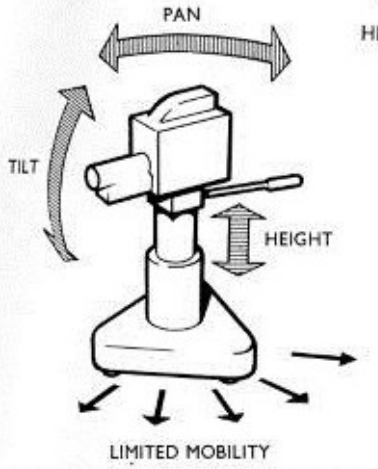



Fig. 1. Diagram showing the limits of movement of a camera pedestal.

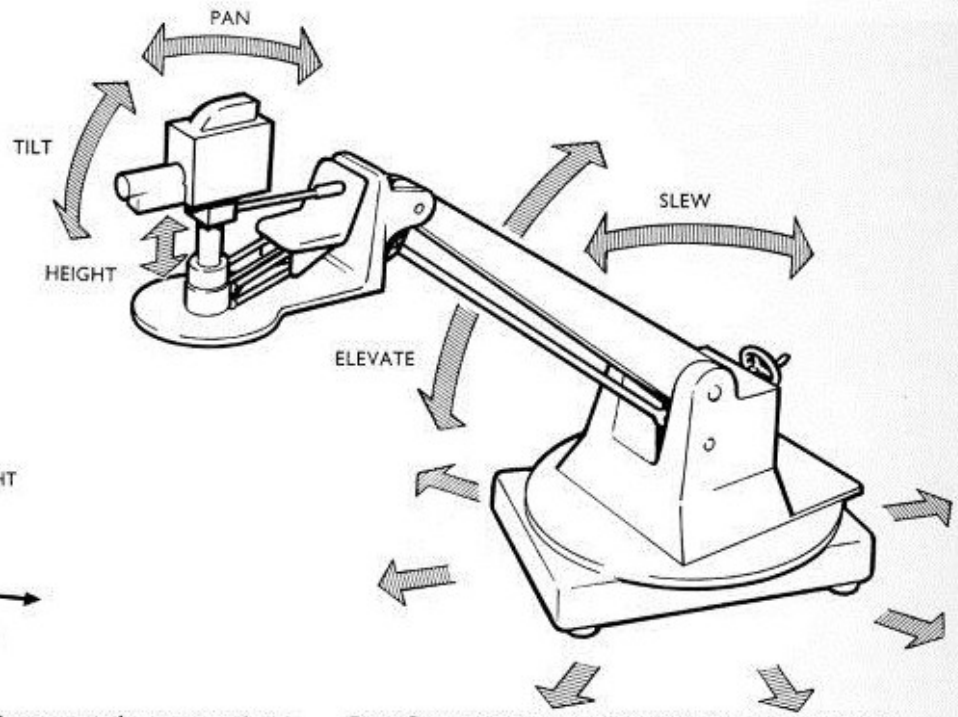



Fig. 2. Diagram crane showing the degree of mobility achieved.


Fig. 3. A Vinten Hydraulic Camera Pedestal and Pan and Tilt Head. The pedestal is in its lowest position.

cameraman, has precisely the same degrees of freedom as a pedestal, but is also capable of being shifted as a whole in three dimensions. Camera cranes have some or all motions power operated, and they require a crew of at least two men and often more. Communication between the crew to integrate their control operations into a smoothly flowing sequence is clearly a major problem, and development over the last 12 years has therefore been aimed, amongst other things, at simplifying control systems and minimizing the number of the crew.

## PEDESTALS

At least six manufacturers market pedestals, the complete range of equipment available covering many different solutions to the basic problem. Generally, a roughly triangular base is supported on three wheels, or pairs of wheels, at the corners. The wheels can all be steered as one by a large handwheel so that the pedestal can be 'crabbed' about in any direction. This mode of operation, if any, is used during shots; but it is common for two of the wheels to be capable of being locked fore and aft, when the third wheel can be steered by a towing handle for manœuvring the pedestal about the studio between shots.

A telescopic column rising from the centre of the triangular base supports the camera and contains a means of counterbalancing the camera, pan and tilt head, etc. This may be counterbalance weights or springs or the two in combination but more refined designs use pneumatic or hydraulic balance systems for the purpose (Fig. 3). Steps are taken to reduce friction to a minimum, so that, with the camera equipment balanced to within a pound or so, only very small forces are needed from the cameraman to raise or lower the viewpoint.

At present, pedestals form the major part of camera mounting equipment used in studios, and they have been developed to the point where they provide a reasonably satisfactory solution to the problem of supporting a heavy camera in a mainly static position. Their continued development is largely contingent on reducing the mass of the camera, which will open up new areas of versatility; this possibility is considered in greater detail towards the end of this article.

## CAMERA CRANES

With the post-war re-introduction of television on an ever-widening front, there was an immediate need for a camera mounting offering greater freedom than the early pedestals and tripods could provide. In 1948 Vinten, in conjunction with Marconi's, modified the Pathfinder Camera Crane (motion-picture equipment) to meet television studio requirements.

The Pathfinder Mark 11 was operated manually throughout, which necessarily limited speed of operation, and the need for a crew of three was also a decided disadvantage. In 1949, therefore, a start was made on the design of the first crane planned specifically for the television industry, which would cut the crew requirement to two and provide better mobility.

It was decided to power as many functions as possible, and electrical operation from a 100 V d.c supply was chosen as most suitable. Powered traction was provided by two $\frac{1}{4}$ h.p motors, chain driving the rear (steering) wheels. The tracker walked behind the vehicle and steered it by a tiller which also carried the forward, reverse and speed controls.

The jib was motorized by a $\frac{1}{2}$ h.p motor driving through a pinion and quadrant and controlled by a pedal at the cameraman's position. A second pedal enabled him to raise and lower the seat under power. A fourth motor was used to rotate the complete camera assembly and cameraman at the end of the jib arm, and a third pedal gave him control over speed in either clockwise or anti-clockwise rotation, as selected.

In practice this arrangement was less than satisfactory and was modified after studio trials. The tracker was also moved on to a suitable platform overhanging the rear of the vehicle, the tiller replaced by a steering wheel and the traction speed control re-sited forward of the wheel.

Limitations on motor power had curtailed camera manœuvrability; this motor drive was therefore eliminated, the seat assembly and the camera being free to rotate independently. A circular foot board was added, the cameraman then using his feet to swing himself and the camera in either direction. Since the cameraman's feet were then both occupied at all times, the foot control for the jib motor was replaced by a hand-operated control mounted on the pan bar.

No turntable or slewing motion was provided, transverse camera movement being obtained by use of the steering and traction controls. In its revised form, this Vinten crane proved most successful; it was widely employed and many are still in regular use in studios throughout the world. Tracking speed is 4 m.p.h while the jib takes 8 seconds to move between its limits, which give extreme camera head mounting heights of 23 and 75 in.

A different approach is evident in the Mole–Richardson camera crane, developed in the early nineteen-fifties from two M.P.R.C type Houston Fearless cranes, imported from the U.S.A for studio

trials by the BBC. The ultimate version of the crane offered a long reach and good camera height range (the camera mounting could travel between 18 and 108 in.) but needed a three-man crew with its communication and co-ordination problems. Furthermore, the platform needed for the boom operator made the chassis very long and unwieldy.

## HERON

Towards the end of 1960 Vinten delivered the prototype of an entirely new crane to the BBC. This vehicle, called the 'Heron', was a complete breakaway from earlier designs (Fig. 4).

The design aim was to retain the small size of the earlier Vinten electric crane, to achieve higher speeds and accelerations of both tracking and jib elevations and to reduce noise level—both acoustic and electrical—in operation. It was also required to provide crabbing motion, in which all wheels steer as one, which gives similar movement to the slewing jib in providing transverse camera movement and also offers many other advantages such as high-speed diagonal tracking.

The power system which was chosen to satisfy these demands is hydraulic. A hydraulic accumulator is pressurized by a sealed nitrogen system to between 800 and 1100 lb/in² and is recharged with oil as required by an electric pump. Acoustically lagged, and also damped by the mass of oil in the reservoir, the pump and motor form a very quiet prime mover. All normal use of the Heron is accommodated by running the pump at slow speed; for fast action (where ambient noise will in most cases be higher) the pump can be set to 'fast' to increase its output. Should absolute silence be needed, the Heron can be tracked over 120 ft on the energy stored in the hydraulic accumulator, with the pump switched off.

Hydraulic power is used in three independent circuits, for traction, jib elevation and camera column height control. Traction is provided by direct coupled hydraulic motors, mounted in two of the wheel hubs, the other (diagonally opposite) pair of wheels being fitted with brakes. Tracking speed is up to 6 m.p.h.

The two rear wheels can be steered, with the front wheels locked fore and aft; by operating a changeover pedal all four wheels can be linked together and steered as one, from the same steering wheel, to give a crabbing motion. The functions of steering or crabbing and of traction speed control in forward or reverse, are all operated by the tracker who stands on a rear mounted platform fitted with a 'dead man's' switch.

The cameraman sits on a seat arranged to swing

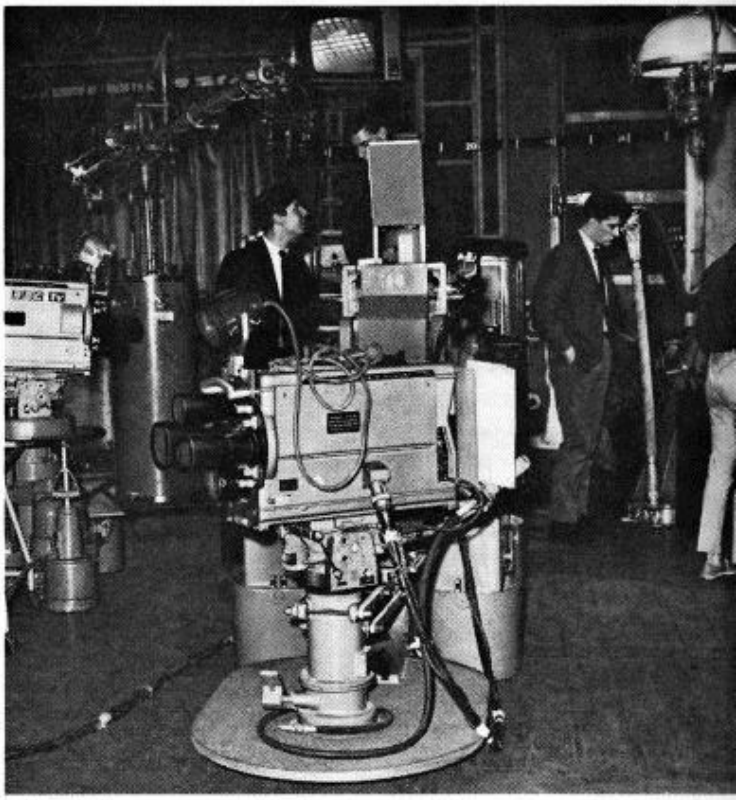
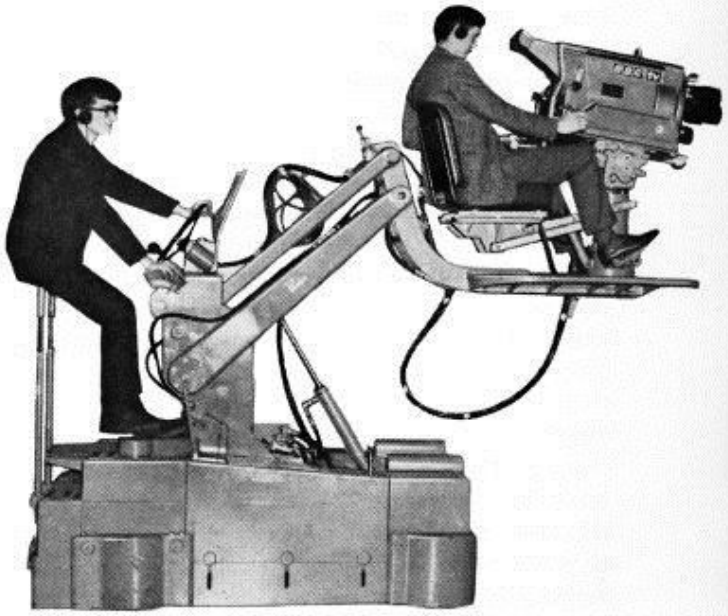


Fig. 4. A Vinten 'Heron' Camera Crane.



through 360° around a central pillar which also supports the camera mounting column. As in the Vinten electric crane, the cameraman uses his feet against the circular platform to orientate himself, and panning of the camera is quite independent. The seat is adjustable for height and distance from the pillar, and the camera mounting column is telescopically adjustable over 12 in.

Rotation of the twist grip on the pan bar gives position-proportional control over jib elevation, though other modes of operation, such as velocity-proportional, can be substituted. Elevation of the jib arm is by a direct-acting completely silent hydraulic ram. The range of heights of the camera head mounting face is from 22 to 90 inches and full travel of the jib takes just 4½ seconds.

The Heron is being widely adopted by studios in most countries for its smooth and quiet operation, freedom from electrical noise and for its versatility. It is probable that it represents the final development of equipment designed to further existing studio techniques; but a fundamental change in methods is now possible and is already in an advanced state of development.

## REMOTE CONTROL—PEREGRINE

The television camera originally borrowed some of its attributes from the motion picture camera, an important one being the use of an optical viewfinder. With the introduction of electronic viewfinding (using, in effect, a high quality picture monitor) and with the development of remote servo controls, the cameraman is no longer tied to the camera, though to date electronic viewfinders have often been fixed to their cameras in the conventional position. By separating camera and viewfinder, the problem of positioning the camera is greatly reduced, since the cameraman need no longer be the limiting factor.

Supporting a camera alone is a much easier requirement and also offers new possibilities in freedom. Pan and tilt are not limited by the physical ability of the cameraman to adopt a certain position which, at its extremes, is likely to be both uncomfortable and anything but conducive to smooth control and creative work. The weight of the cameraman—and the greater weight of his seat and platform—need no longer be a major part of the mass to be supported in space. As a result, the camera can have virtually unlimited pan and tilt, while camera movement can be extended over a far wider range of heights. Speed of movement and, particularly, acceleration can be greatly increased without adding to the mass, power requirements or potential noise of the crane as a whole.

Fig. 5. The Peregrine Camera Crane.

All these advantages are inherent in the electronic viewfinder, properly exploited, and the latest member of the Vinten camera crane family, the Peregrine, is being developed for the BBC to take advantage of this new approach (Fig. 5).

Peregrine consists of a 3 ft 6 in. diameter circular chassis mounted on six equally spaced wheel assemblies. Three wheels are driven by integral hydraulic motors, the alternate three being braked. The traction system and the hydraulic power system generally are derived from the well-tried Heron. All six wheel

assemblies are linked by an endless chain so that tracking uses a crabbing motion at all times.

A rectangular platform is mounted on the chassis and supports seats for the two operators and their controls in front of the trunnions which carry the jib arm. The latter is counterbalanced by much of the heavier hydraulic components. Mounted at the end of the jib is a yoke assembly supporting the camera with freedom to swing in pan and tilt motions.

Controls for all functions are divided between the two operators who sit side by side, thus minimizing or eliminating communication problems.

One member of the crew may control:

Direction of tracking by a power steering system actuated by a wheel.

Speed of tracking, by a foot pedal which pivots two ways to give forward and reverse motion.

Braking, by a foot pedal.

Slewing of platform and jib, and elevation of jib, by a combined control consisting of a twist grip mounted on a lever. All these controls use hydraulic or electro-hydraulic servo systems.

The other member of the crew could then control:

Camera pan and tilt, by a miniature combined pan-tilt bar.

Focus, by a capstan.

Zoom control, by a wheel and pre-set buttons in the conventional manner. All these controls use electric servo systems.

The various controls available offer maximum mobility and freedom to the camera, and the correct integration of all motions can be assured since both members of the crew watch high-quality picture monitors, rigidly fixed in front of them.

It is clear that Peregrine represents a radically different approach from previous equipments, and equally evident that its success must be dependent on accepting the concept of all-remote control. Though more complex, Peregrine, like the simplest pedestal, is still no more than a means to an end and is justified only if it offers producer and cameraman the opportunity to create better television. The viewpoint has been expressed that a remotely-controlled unit could reduce the cameraman's close contact with camera and actors, making it more difficult to achieve subtle, flowing camera work and to anticipate moves. This is a cogent argument and there may ultimately be a place for both Peregrine and equipment offering a more traditional and intimate relationship. On the other hand, present day cameramen have developed their skills on conventional equipment which has necessarily built up an acceptance for it and a perspective geared to its limitations and advantages; anyone who had worked from the beginning with remotely controlled mountings would probably not share this feeling.

The 'disadvantage', if it be one, is the need to learn a new technique—but the benefits are considerable. Peregrine is small and compact, yet can offer higher and lower viewpoints than previous cranes. Wider angles of pan and tilt are possible without the cameraman ever moving from his optimum position, seated comfortably in front of a fixed monitor. The crew is reduced to two, communication is very easy and both men know at all times the picture they are getting. Since the crew turn with the jib and platform, both retain an instinctive sense of camera position. By eliminating steering (as distinct from crabbing) but retaining the slewing jib, all the motions possible with previous equipment have been achieved with fewer controls. The producer's work is simplified, particularly during rehearsal. During the line-up period, the producer can use the cameraman's monitor and discuss immediately with the crew the composition he wants, and he can be adjacent to the crane during rehearsal, watching the monitor if he wishes. He is close to the actors and can give them instructions, watching the monitor on the crane and immediately checking the results of his actions. These advantages of technique are implicit in remote camera control equipment and can be realized in Peregrine provided resistance to remote control can be overcome. Remote control of pan and tilt is already in use in studios, and every other remote control in Peregrine is already in current use in some form. The refinement of modern servo mechanisms, highly developed for aircraft and industrial applications, is thought to offer more than adequate sensitivity for this demanding situation.

## THE FUTURE

It is dangerous to speculate beyond that state of the art proved by actual experiment, but one development likely to have important repercussions, is reduction in camera size. New developments in camera tubes are likely to enable camera size and weight to be reduced significantly, and there may well be other such developments to the same end. Coupled with the concept of remote viewing, the way is now open for the succinctly termed 'eyeball on the end of a billiard cue'.

A really small camera weighing perhaps 30 lb, such as is now feasible, enables the advantages embodied in Peregrine to be carried to the limit. A logical development of Peregrine may thus be a basic chassis

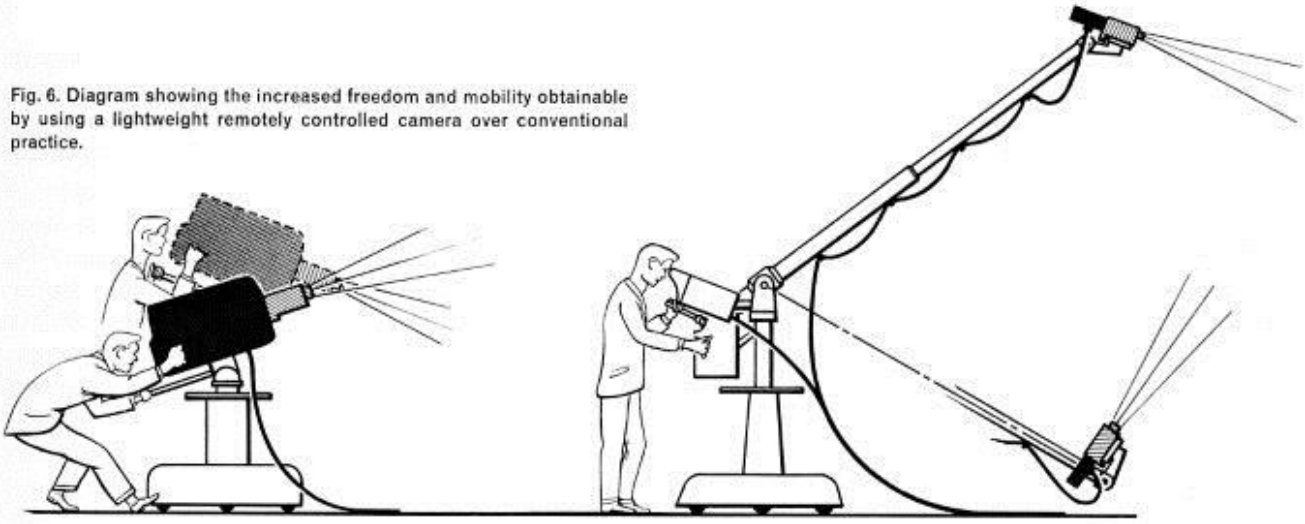


Fig. 6. Diagram showing the increased freedom and mobility obtainable by using a lightweight remotely controlled camera over conventional practice.

unit complete with hydraulic system, traction, slewing and elevating mechanisms, complete and standard, as far as the jib arm trunnions; different arms could then be fitted quite rapidly, adapted to different duties and different camera sizes. The smaller the camera, the longer the arm, if required, though the reduced mass could also be exploited to increase acceleration. It is probable that, in such an equipment, the pan and tilt mounting would support the zoom lens directly, the camera itself (as the lighter item) being attached to the back of the lens by quick release mountings.

Together, remote control, electronic viewing and small cameras will fundamentally change the design of studio camera cranes, and they will also undoubtedly give a new look to the pedestal. At present, the camera lens height range, given by a typical pedestal, is from about 3 to 5 ft with little or no camera mobility. Future pedestals may well improve their versatility by acquiring some of the attributes of the microphone boom. The basic pedestal with, or without, a centre height adjustment may support an arm swung manually, and directly, in elevation and azimuth, and lockable in any position. The small camera at the tip of the arm could be remotely controlled for pan and tilt by a very simple system involving nothing more complicated than pulleys and cables. Fig. 6 compares the freedom and mobility of such a mounting with the conventional pedestal.

Camera mountings have come a long way from the simple tripods and improvised trucks based on motor cycle wheels, which first gave television cameras mobility. Most of the development has been in Britain where the lead given by the BBC has consistently provided a favourable climate for advanced design, and has resulted in British equipment being more widely used in studios throughout the world than any other.

# New Marconi Camera Pedestal

Marconi's have introduced a new lightweight camera pedestal, designed for both studio and outside broadcast use. Being collapsible, it is extremely easy to transport, and being little over 2 ft in width it is particularly useful for manœuvring in restricted areas in crowded studios or through doorways, etc. The centre pedestal, which is raised and lowered hydraulically, can be lifted to 5 ft above the floor. For low-angle shots, the centre pedestal can be removed and the camera head fitted on top of the spider. In this case the friction head is only 12 in. above floor level.

Despite the fact that it weighs only 80 lb (36 kg) the whole assembly is very strong and rigid. The centre pedestal itself is mounted on a strong steel spider with three adjustable legs.

This new pedestal has undergone a long period of test with the Marconi Demonstration Unit, and has been used for several outside broadcast events, where it has proved extremely successful. Five pedestals have recently been ordered for Radio Caracas in Venezuela.