# FILM EQUIPMENT FOR COLOR TV APPLICATIONS

## RCA COLOR FILM CAMERA, TK-25A

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Films are expected to play the same important part in color programming that they do in monochrome. Moreover, because of the added impact of products shown in color, advertisers are likely to insist on color film "commercials" at an early date. Recognizing this, RCA engineers have been working for several years on the development of a suitable color film chain.

### Possible Film Systems

There are some half dozen different ways in which a color film chain could be built. In order to be sure that we were selecting the most practical for the purpose, all of these were carefully considered. The three most likely systems were tested at length, and were demonstrated for a group of broadcast consulting engineers on Oc-

(1) *A Three-Vidicon Camera With Standard Projector*

This system employs a camera which uses three Vidicons with a light-splitting optical system similar to that used in the live Studio (Image Orthicon) Camera (see Page 62). Although the sensitivity of the Vidicon is too low for studio use, it is entirely sufficient for film pickup. The great advantage of this system is that it can be used with a standard monochrome projector such as the Type 6A. Also it can be multiplexed very easily. For good results it is necessary to have three Vidicons with well-matched characteristics.

(2) *A Flying Spot Scanner With Continuous Motion Film Projector*

This system uses, as a source of illumination, a "flying spot" generated by a kinescope scanner similar to that used in the RCA Color Slide Chain (see Page 52). A special type of projector moves the film at a constant velocity and employs an optical system of rotating elements which compensate for the motion of the film in such a way that a stationary image is obtained. This system, which was developed in Europe before the war, has the advantage of being easy on the film. However, it is extremely difficult to eliminate objectionable vertical motion and image flicker due to light variations. In general it gives satisfactory quality only when provided with elaborate mechanical compensating systems (such as servo-mechanisms) to control film positioning and light output.

(3) *A Flying Spot Scanner With Fast Pull-Down Projector*

This system also uses the kinescope-type flying spot scanner, but in this case the projector is similar to the standard type used in monochrome except that it is designed to pull the film down (from frame-to-frame) in approximately 1.3 milliseconds. At this speed the whole movement is completed during the vertical blanking period. retraced its path to the top of the raster, a new frame is in place. In principle, this is the simplest of all systems, and it enables use of a very simple electronic pickup system consisting of three photo-cells. Its disadvantage is that the mechanical pull-down system must be very carefully designed to avoid film breakdown.

### Production Plans

Of the three systems described above, the combination of the fast pull-down projector and flying spot scanner is the most advanced. A model of this equipment was completed nearly a year ago, and subjected to extensive laboratory tests. Subsequently this model was sent to NBC where it has been in use for several months. Operation has been quite satisfactory. Although careful film handling is necessary, the pictures produced with this equipment have been of excellent quality. Based on this experience production was started on this type of equipment some months ago. Deliveries to stations which have already ordered color film equipment, will begin in May.

Meantime, progress on the development of the 3-Vidicon Camera has been rapid.

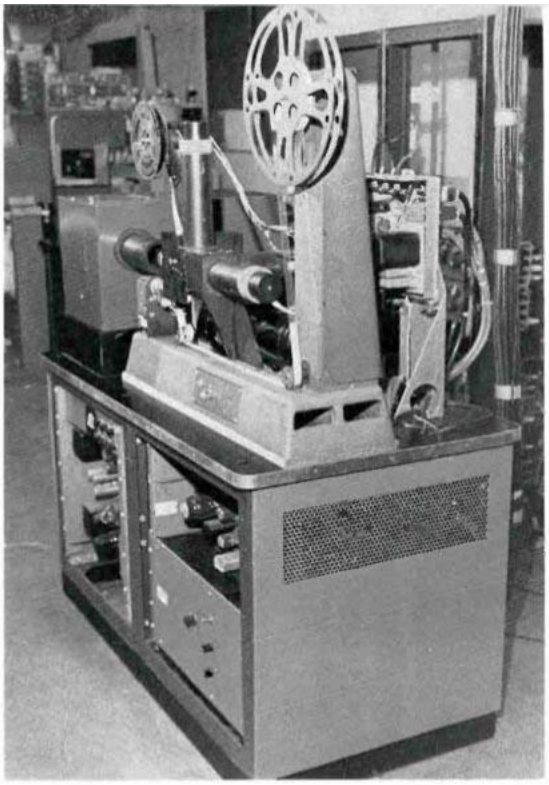


FIG. 1. The 16mm fast pull-down projector console complete with associated color flying spot scanner, video pre-amplifier, deflection amplifier, and high voltage power supply.

A very satisfactory model has been developed and demonstrated to groups of industry engineers. Without exception these engineers have been enthusiastic about the advantages of this film system. At the same time increased production of Vidicons has made it evident that obtaining matched sets of tubes will be feasible in the near future. As a result of these favorable developments production has been started on 3-V (3-Vidicon) cameras for delivery early this fall. These cameras may be used with the RCA Type 6A Professional Projector (slightly modified) which is already being used for monochrome by many stations. This combination will have the advantage of using a projector of proved design. In addition it will be easy to multiplex, so that systems using several projectors will be simpler than with the flying spot camera systems.

(Editor's Note: The color film system which is described below is the fast pull-down type which, as noted above, will be the first to be delivered. In a future issue of BROADCAST NEWS we will have an article describing the new 3-V Film Camera System.)

### Design of the Fast Pull-Down Projector

The major difference between a fast pull-down projector and a standard monochrome projector is the speed with which the film is pulled down from one frame to the next. In a conventional monochrome television film scanning system the light pulse is applied only during the vertical blanking interval and the scanning of the electron image on the sensitive surface of the pickup tube is accomplished while the surface is completely in darkness. Storage of the image is therefore an essential characteristic of this method of operation. It was recognized for years that operation in the reverse manner would have certain advantages since light could then be applied

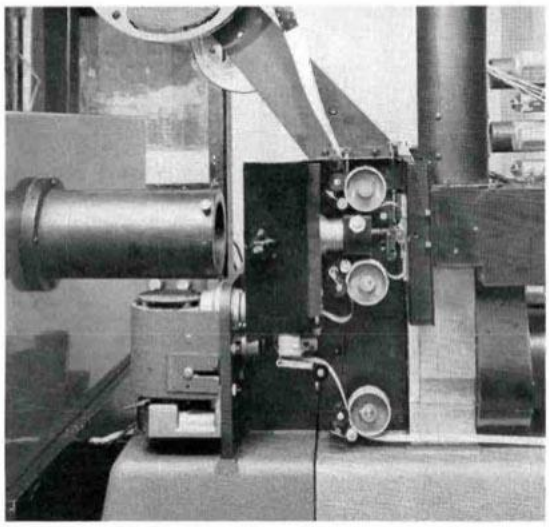


FIG. 2. Closeup of the 16mm fast pull-down projector showing details of the film path.

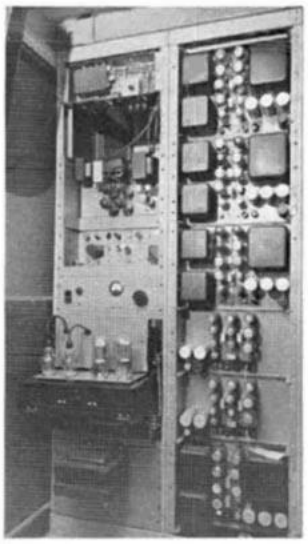


FIG. 3. View of the power supplies used for the fast pull-down projector equipment. Rack at left supplies power to the projector motor.

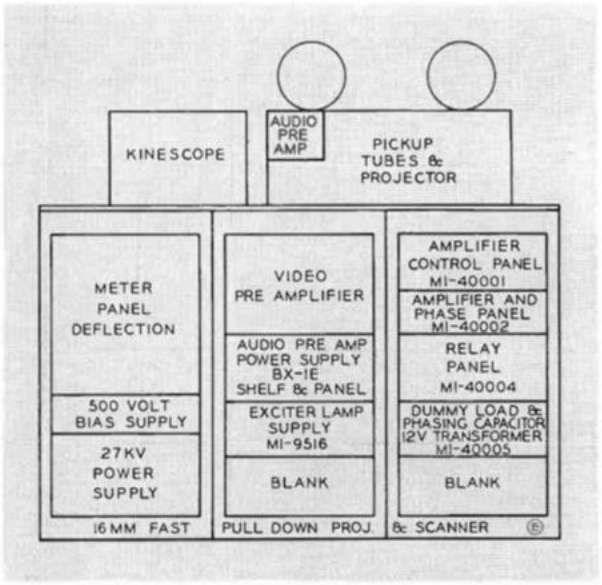



FIG. 5. Diagram of the console of the fast pull-down projector showing arrangement of the various components.

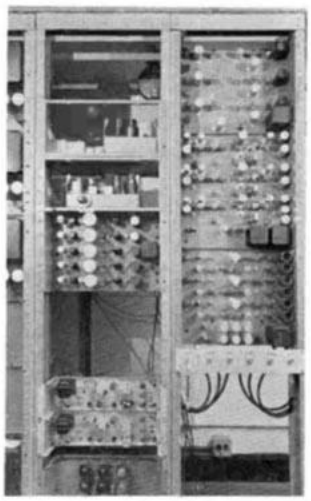


FIG. 4. View of the "rack-mounted" electronic control equipment for the fast pull-down projector. The left hand rack contains audio amplifiers and video distribution facilities, while the right hand rack contains the aperture compensator, control amplifier, and gamma corrector.

during the entire scanning period provided film pulldown from one frame to the next could be accomplished during the vertical blanking period. This arrangement is particularly suitable for use with a flying spot scanner since a given frame of film will remain stationary in the projector film gate while the beam on the flying spot tube is scanning a complete raster. The major problem involved with this system is the rapid motion required for moving the film from one frame to the next during the period allowed by the duration of vertical blanking. This period is approximately 1.3 milliseconds which is four or five times faster than the normal pulldown period associated with a 16mm machine. While this presents an extremely difficult mechanical problem, we believe that it has been solved successfully in a machine designed by our advanced development group and put into operation early last year. This machine together with the associated flying spot scanner is now in regular use at NBC in New York. Excellent results have been obtained.

The intermittent mechanism for this machine was designed with particular emphasis on obtaining an acceleration curve which would give the desired result without excessive strain on the film. While the acceleration must of necessity be very rapid the rate of range of acceleration has been carefully chosen to prevent any damage to the film under normal conditions. The deceleration of the film during the latter part of the pulldown cycle has also been designed with minimum stress on the film in mind. During the deceleration period, registration is established by using the trailing edge of the sprocket hole instead of the leading edge as is done in the usual type of projector. It has been found that this method of registration results in picture steadiness frequently better than that encountered in normal machines. The additional strain on the film because of the rapid pulldown means that special care must be exercised in making film splices. If a satisfactory splice has been made the machine will perform satisfactorily for hundreds of times without difficulty.

### Non-Synchronous Operation of Projectors Used with Storage Pickup Tubes

An important factor which must be considered in connection with the problem of

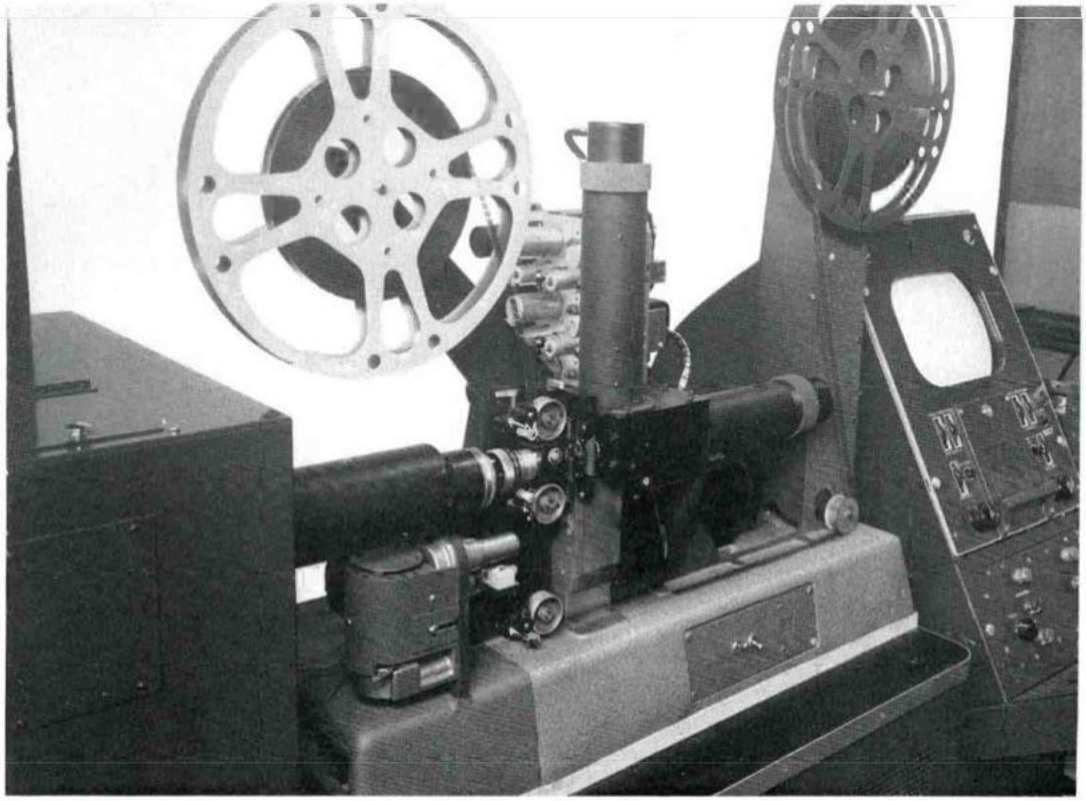
televising color film is the necessity for controlling the sync generator output signal frequencies from a crystal oscillator which establishes the correct sub-carrier frequency. With this arrangement, it is no longer possible to operate with the sync generator locked to the 60 cycle power system as is normally done in monochrome television broadcast stations. Because of this it is necessary to use a power source for the projector driving motor which is automatically kept in synchronism with the vertical scanning frequency derived from the sync generator. The method used for accomplishing this synchronization is to use a 500 watt audio amplifier as a power source for the motor. A 60 cycle wave form obtained from the synchronizing generator is used as the input voltage for the amplifier. An accurate phase relationship must also be maintained between the driving motor and the vertical blanking pulse applied to the flying spot tube so that the film motion always takes place during the vertical blanking interval. Because the time interval permitted for this motion is nearly equal to the standard vertical blanking period this phase angle must be maintained within rather close tolerances.

### The Flying Spot Scanner

The color flying spot scanner associated with the projector is essentially the same as that used in the Color Slide Chain (see Page 52). The only difference is the modification of the optical system and photocell assembly necessary because of the difference in optical requirements encountered with 16mm film. The dichroic mirrors and the filters have the same characteristics substantially as those used in the other application.

The particular advantage gained by using this method of color film scanning is that the three signals obtained from the three photocells corresponding to the three primary colors are automatically in register. For this reason, electrical operation of the equipment, its adjustment and maintenance is relatively simple.

FIG. 6. Closeup view of the 16mm fast pull-down projector equipment. A film control unit is located alongside the film equipment.





RCA Broadcast News, January, 1954