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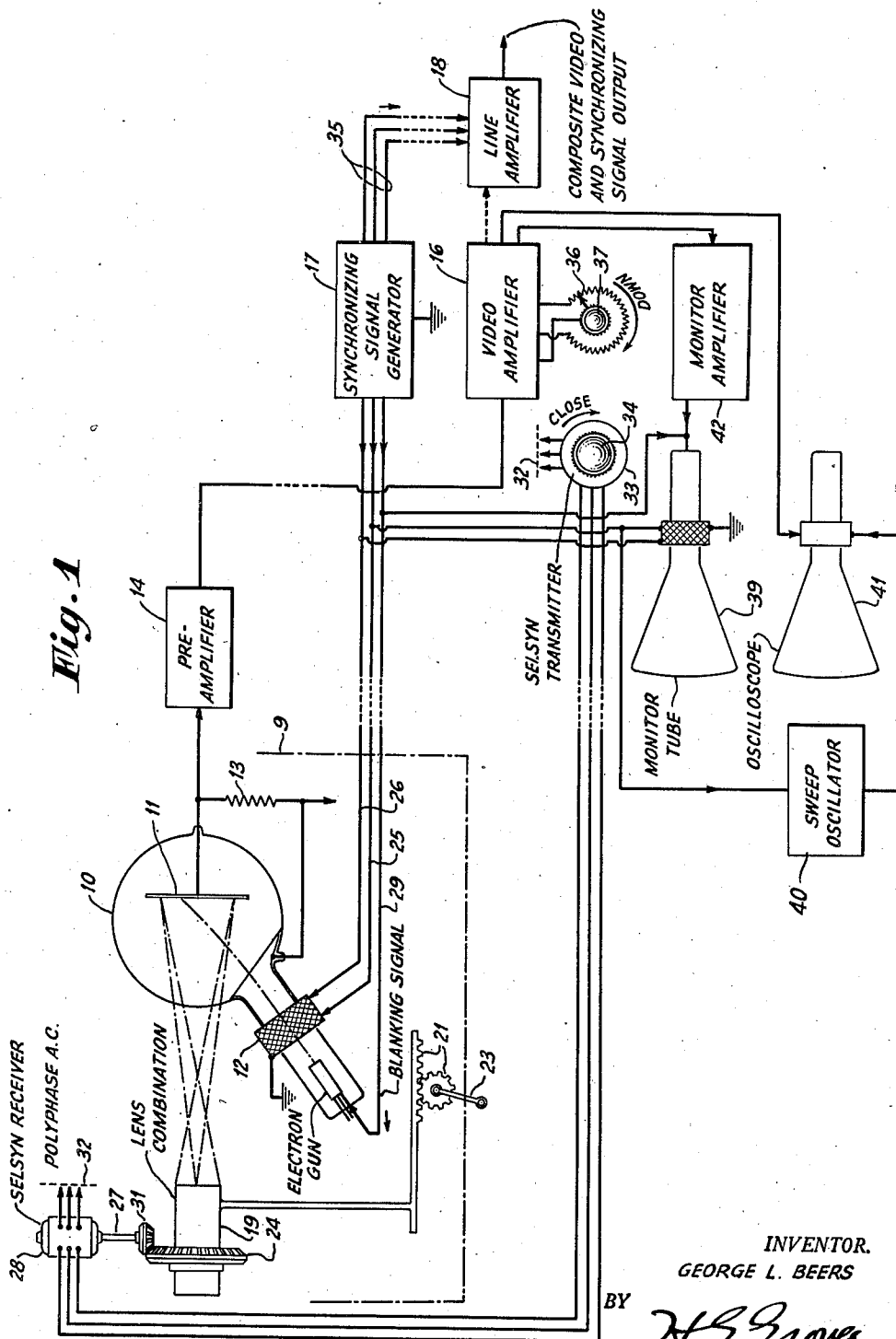
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TELEVISION PICK-UP CONTROL SYSTEM

Filed July 31, 1943

2 Sheets-Sheet 1



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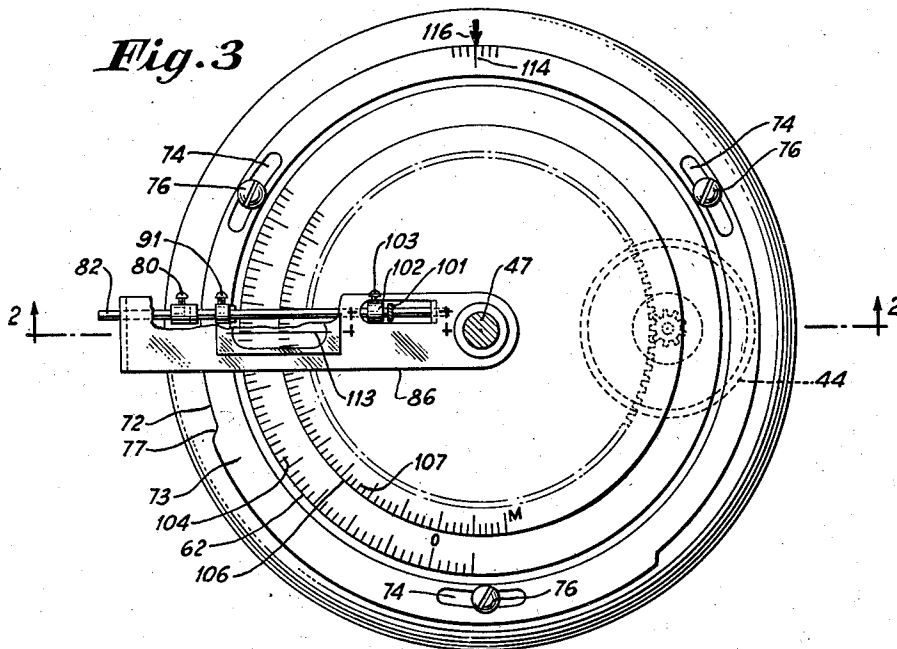
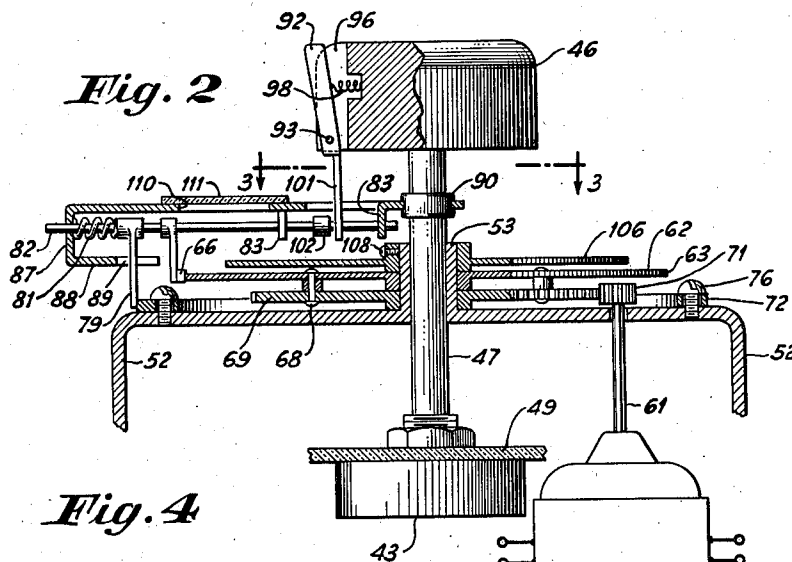
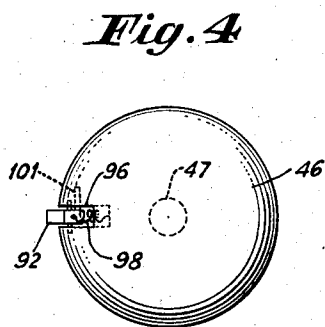
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TELEVISION PICK-UP CONTROL SYSTEM

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2 Sheets-Sheet 2



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TELEVISION PICKUP CONTROL SYSTEM

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5 Claims. (Cl. 178-7.2)

The present invention relates to a television pickup control system, and more particularly to a novel arrangement for obtaining a maximum amount of useful signal in the output of television pickup equipment under varying light conditions.

Certain difficulties are encountered in television pickup work because of the variation in illumination of the scene to be televised. With the usual television camera a camera operator cannot adjust the size of the stop or iris opening and fulfill his other obligations. If the iris adjustment control is made accessible to the operator when he is at his normal station in back of the camera, then it is possible for him to adjust the size of the aperture, but some indication of relative light intensity must be provided and such a device, if it gives a true indication of the effective illumination of the scene upon which the camera is trained, is complicated and expensive. The camera view finder cannot be relied upon for indicating the degree and quality of illumination on the scene which is being televised, since it is too difficult to interpret the image in the view finder in terms of the generated camera signal. Moreover, other factors affect the signal which is generated in and transmitted from the television camera, including changes in amplifier conditions, such as changing biasing and supply voltages of which the camera operator can have no knowledge. In the case of television programs which originate outdoors, such as sporting events, it is necessary that the cameraman give his individual attention to the scene in the viewfinder.

In a typical television pickup system there are two adjustable means for controlling the over all sensitivity of the system. One of these is the gain control on the video frequency amplifier and the other is the aperture control on the television camera lens. The sensitivity of the system cannot be increased beyond a certain point by increasing the gain of the video amplifier without the introduction of objectionable noise in the reproduced picture. On the other hand, the maximum sensitivity which can be obtained by increasing the aperture of the lens is in many instances limited by the depth of focus which is obtained under the wide aperture condition.

Under adverse lighting conditions it may be necessary to operate a television pickup system with the camera lens at its maximum aperture and the video frequency amplifier adjusted for high gain. If under these conditions the

light intensity should increase and a corresponding reduction in the over all sensitivity of the pickup system is desired, this decrease in sensitivity can be obtained either by reduction of the gain in the video amplifier or by a change in the iris diaphragm setting for the camera lens.

It is therefore apparent that in a television pickup system there are two independent controls for determining the over all sensitivity of the system. These are normally operated by different individuals, and under conditions where sudden and frequent variations in illumination may occur, as in outdoor pickup work, a certain amount of confusion may result through the use of these independent controls.

In order to obtain the maximum in performance from such a system, it is desirable, as the light intensity increases on the subject being televised, to first reduce the gain of the video frequency amplifier to the point where amplifier noise is not apparent in the reproduced picture and then to obtain any further reduction in sensitivity corresponding to a further increase in light by decreasing the lens aperture so that the depth of focus is correspondingly increased. This coordinated control of video gain and aperture setting cannot be obtained satisfactorily when two individuals are responsible for the setting of these two controls.

In accordance with the present invention means are provided to enable the operator at a monitoring control station to exercise coordinated control of the amplifier gain, taking into account all of the factors affecting the generated and transmitted camera signal, and selection of the most desirable lens aperture adjustment consistent with the production of a signal which can be used at a television receiver to recreate a faithful image of the televised scene. It will be apparent to those skilled in the art that when a television signal pickup and transmitting system embodying the invention is employed in televising a scene or object in a television studio, the lighting arrangement may be simplified or the lighting of the scene may be changed to obtain special effects, and the continuity of the program need not be interrupted for the purpose of making camera iris or gain control adjustments.

The principal object of the invention, therefore, is to provide means for obtaining a generated and transmitted signal from a television camera which may be employed in the reproduction of an image of the televised scene having

maximum foreground and background detail consistent with a satisfactory freedom from noise.

Another object of the invention is to provide a control arrangement whereby the camera lens aperture and the amplifier gain of a television pickup system may be correlated.

A further object of the invention is to provide a remote control means for the iris diaphragm of a television camera operable from a signal monitoring position.

A still further object of the invention is to provide a combined camera aperture and signal gain control in a television system.

Still another object of the invention is to provide an adjustable control mechanism for the combined control of the aperture of a television camera and the gain control means of a television system in which the camera is employed.

Still further objects of the invention will become apparent and suggest themselves to those skilled in the art to which the invention is directed upon reading the following specification and claims in connection with the drawings in which:

Fig. 1 is a schematic showing of a television pickup system, including a camera and the related output monitoring console.

Fig. 2 is a detailed sectional view sectioned on line 2—2 of Fig. 3 showing one arrangement in accordance with the invention for operating certain of the controls shown in Fig. 1.

Fig. 3 is a plan view in section on line 3—3 of Fig. 2 of the mechanism of Fig. 2.

Fig. 4 is a view in plan of the control knob of Fig. 1.

The pickup system selected for purposes of illustration is more or less conventional and comprises a camera 9 housing a pickup tube 10, shown as being of the storage type containing a light sensitive mosaic 11 and the usual auxiliary electrodes and electron emitters. These electrodes include the anode and cathode for producing the cathode ray beams. The cathode ray beam deflecting means or yoke is indicated conventionally at 12 and may comprise horizontal and vertical deflecting coils for producing a scanning movement of the beam which is directed on the mosaic 11 to release a signal output therefrom to a load circuit. The released signal output of the pickup tube 10 is applied to a pre-amplifier 14 across a load resistor 13 in most conventional devices. After initial amplification, the signal is transmitted to a video signal amplifier combination which is represented schematically at 16. Reference numeral 17 indicates a synchronizing signal generator of conventional form which generates suitable synchronizing and blanking signals, in known manner, and which is shown as being connected to the ray deflecting means 12 by way of conductors 25 and 26 to supply the horizontal and vertical beam deflection energy and by conductor 29 to the control electrode member of the electron gun (not shown) of the scanning tube 10 to provide the return line blanking. The same general types of signals are also supplied to an output amplifier 18, usually referred to as a line amplifier, by way of conductor 35. The resulting composite synchronizing and picture signal output of the amplifier 18 may be transmitted over any suitable transmission channel to a distribution point such as a radio transmitter.

The camera 9 is equipped in the usual manner with a lens combination 19 suitable for imaging the scene to be televised on the mosaic 11. A

rack and pinion 21 connected to the support for the lens combination 19 provides means for focusing the camera by rotating the hand crank 23. The lens combination 19 is equipped with the usual iris diaphragm, not shown in detail, for stopping down the lens to obtain a greater depth of focus when the televised scene is well illuminated. Reference character 24 indicates a bevel gear, which is secured to or otherwise operatively associated with the rotatable collar which adjusts the degree of opening of the iris diaphragm. The rotatable shaft 27 of the receiver 28 of a Selsyn motor system carries a bevel pinion 31 meshing with the bevel gear 24 and by this arrangement, when the shaft 27 is rotated, adjustment of the iris diaphragm will be obtained. The Selsyn motor system is shown as being the ordinary cascade arrangement of polyphase alternating current motors, the stators of which are connected to a polyphase alternating current supply source 32. Any Selsyn or equivalent system may be used. It will be understood that any other arrangement for converting motion produced at the Selsyn motor system receiver 28 into changes in the iris diaphragm opening or equivalent lens stopping means may be employed.

The movable member (not shown) of the transmitter 33 of the Selsyn motor system is provided with an operating knob 34. A gain control 36 for the amplifier 16 is provided with a suitable knob or manual control 37, and the operating knob 34 of the Selsyn motor transmitter and the knob 37 are preferably positioned so as to be conveniently accessible to a control operator stationed within viewing distance of a picture monitor tube 39 and an oscilloscope 41. The monitor tube 39 is shown as being connected through a monitor amplifier 42 to the video signal amplifier 16. The oscilloscope 41 is also connected to this amplifier and to an oscillator 40 which generates a saw tooth wave or a wave of any suitable shape for expanding the video signal or portions thereof along a coordinate axis into an observable trace in the usual manner. The oscillator 40 may be controlled from the synchronization signal generator as shown.

In operation of the arrangement just described, the camera operator need only focus the camera on the scene to be televised by manipulating the control 23. At this time the operator at the location of the controls 34 and 37 will open the iris diaphragm so as to obtain the largest aperture or stop size of the lens combination 19. He will then manipulate the knob 37 of the gain control 36 so as to obtain an optimum signal to noise ratio, thereby providing maximum gain for the given illumination and noise conditions. The operator in doing this will be guided by the signal trace appearing in the oscilloscope 41 and the picture image which is reproduced by the monitor tube 39. This setting of the gain control will be maintained and the knob 34 may be rotated in the direction of the arrow to obtain maximum depth of focus by stopping down the lens combination 19. An indication of the smallest aperture which can be used effectively will be given by the monitor tube 39 and the oscilloscope 41 as before. The system may be operated in such a manner that there is some overlap in the functions of the gain control device 36 and the operative adjusting means 34. In the region of overlap, either control may be adjusted to obtain the desired result.

Referring to Figs. 2, 3, and 4 of the drawings,

an arrangement is shown whereby a gain control resistance unit or potentiometer 43 and a remote control transmitter 44 can be operated from a single manually operable control handle or knob 46. The potentiometer 43 and the transmitter 44 may, for example, be similar to the gain control 37 and the Selsyn transmitter 33 of Fig. 1 of the drawings. However, it will be understood that any two controls of a remote control system may be operated by the mechanism presently to be described in detail.

The knob 46 is secured at the end of the operating shaft 47 of the resistance unit or potentiometer 43. The potentiometer 43 is secured, as by a sheet of insulation 49, or in any other suitable manner, within a housing 52 which is shown fragmentarily on Fig. 2 of the drawings and in plan in Fig. 3. The top of this housing is provided with a boss 53 which is apertured to form a bearing for the shaft 47. The Selsyn transmitter 44 is also secured within the housing 52 and is provided with terminals 56 for connection with a suitable polyphase alternating current source. The transmitting terminals 56 of the transmitter are available for connection to a Selsyn receiver such as the receiver 28 of Fig. 1 of the drawings.

Driving connection from the shaft 47 to the drive shaft 61 of the Selsyn transmitter is obtained through the medium of a friction drive disc 62, the periphery 63 of which is to be frictionally engaged by a shoe member 66 of any desired friction material such as leather, a plastic, or the like. The friction disc 62 is secured as by rivets 68 to a gear 69 which is rotatably mounted on the boss 53. Preferably, the friction disc 62 is also rotatably mounted on the boss 53. The gear 69 meshes with and drives a pinion 71 secured to the Selsyn transmitter drive shaft 61. Shaft 61 may be geared down to give approximately one turn of the Selsyn rotor for one turn of the indicator if desired, or the gear 69 and pinion 71 may be interchanged.

Frictional engagement of the shoe 66 with the friction disc 62 is controlled by the cam surface 72 of a ring 73 which is slotted at angularly spaced points as indicated by reference character 74 to accommodate clamping screws 76 threadedly engaged in the housing 52. The slots 74 provide for angular adjustment of the ring 73. A complete range of adjustment may be provided by locating several sets of holes for the screws 76 around the top of the casing 52 and by elongating the slots 74. The cam surface 72 is offset as indicated at 77 to reciprocate a cam follower 79 adjustably secured, as by a set screw 80 (Fig. 3), upon a reciprocable rod 82 biased to the right as viewed in Fig. 2 by a compression spring 81. The rod 82 is slidably carried by tangs 83 formed on, or integral with, a pointer or an indicator 86 which is secured directly to the shaft 47 or to a ring 90 which may be keyed or sweated on the shaft 47. The end 87 of the indicator 86 is turned at an angle to its main portion and is apertured so as to provide an additional guide for the rod 82. The inwardly turned portion 88 of the indicator end 87 has a slot 89 which guides the follower 79 and prevents rotation of the rod 82. The spring 81 reacts between the securing portion of the cam follower 79 and the end 87 of the indicator 86. The shoe member 66 is adjustably secured, as by a set screw 91, (Fig. 3), to the rod 82.

From the parts thus far described, it will be seen that as the knob 46 is turned, the indicator

86, which is secured to the shaft 47, will turn and by reason of frictional engagement of the shoe 66 with the friction disc 62, the gear 69 will be rotated causing the Selsyn transmitter shaft 61 to be rotated. Concurrently with this, the potentiometer 43 is adjusted. The shaft 47 will continue to drive the gear 69 in the manner just described until a raised portion in the cam track such as the offset 77 is reached, whereupon the rod 82 will be moved toward the left by the cam follower 79 to cause disengagement of the shoe 66 from the friction disc 62. This point of disengagement, which is also the point of engagement when the knob 46 is turned in a clockwise direction to decrease the gain, may be chosen so that when the gain is decreased to a given point, the iris diaphragm control will be operated along with the potentiometer 43. The slots 74 in conjunction with the set screws 76 permit selection of the point of engagement of the Selsyn drive.

In order to provide for conveniently releasing the Selsyn transmitter drive at any time, irrespective of the cam track 72 so that the potentiometer 43 may be separately adjusted, a member 92 is pivotally mounted at 93 in a slot 96 in the knob 46. A compression spring 98 may be provided to keep the member 92 in its inoperative position when it is not deliberately grasped by the hand of an operator when rotating the knob 46. An extension 101 on the member 92 extends downwardly to engage a stop member 102 adjustably secured, as by a set screw 103 (Fig. 3), on the rod 82.

When the knob 46 is turned with the member 92 pressed inwardly, it will be seen that the rod 82 will be moved to the left, releasing the shoe 66 from engagement with the friction disc 62.

The disc 62 is provided with graduations 104 (Fig. 3), and a stationary disc 106 is provided with a scale of graduations 107. The stationary disc 106 is secured in any suitable manner, as by a set screw 108, to the upper portion of the boss 53 which projects beyond the disc 62.

The indicator 86 is provided with an aperture 110 which is covered by a window 111 of suitable transparent material, such as glass or a transparent plastic, secured in any suitable manner to the indicator. A cross hair 113 is provided on the window 111 so that it will cooperate with the scales 104 and 107 of the friction disc 62 and the stationary disc 106, respectively.

The cam ring 73 is provided with graduations 114 which cooperate with a mark 116 on the housing 52 to assist in adjusting the ring 73 angularly with respect to the top of the housing 52 so that the desired point of engagement and disengagement of the shoe 66 with the periphery 63 of the friction disc 62 may be oriented with respect to any point on the stationary scale 107.

Briefly, the combined control mechanism of Figs. 2 to 4 in the drawings is operated in the following manner.

When the knob 46 is manipulated to move the indicator 86 in a clockwise direction as viewed in Fig. 3, the gain of the amplifier controlled by potentiometer 43 is reduced. The maximum gain setting may be indicated by the letter M on the scale 107 as shown. The mechanism is arranged so that rotation of the disc 62 in a clockwise direction reduces the aperture of the lens of the associated television camera, for example, by an arrangement similar to that shown in Fig. 1 of the drawings.

The angular position of the disc 62 which corresponds to the maximum opening of the camera iris may be indicated by a O or other suitable mark on the scale 107 coming into register with any desired indicating mark on the stationary disk 106. If the mark M on the scale 107 is chosen, the O and M will be in about the relative positions shown on Fig. 3 after turning the indicator to the position shown, since the offset 77 will have caused the disc 62 to be displaced clockwise angularly by approximately the amount shown. The relative position of the parts shown by Fig. 3 is to be taken as illustrative only and not as showing an absolute mode of operation.

Under typical operating conditions of a television system, the cam ring 73 is locked by the screws 76 in an angular position such that the cam offset 77 is effective when the indicator 86 is turned clockwise to the point where the noise level may be tolerated.

It will be understood that lighting conditions on the scene to be televised will govern the setting of the adjustable parts of the combined mechanism disclosed herein so that only a general outline of the mode of operation can be given. Those skilled in the art, to which this disclosure is addressed, will be able to operate the mechanism provided by this invention in such a manner as to obtain best results under varying conditions of lighting on the scene to be televised and varying noise conditions which are present in the electrical portion of the television system.

For example, under a given light condition, the disc 62 may be set initially to the point corresponding to the full open setting of the camera iris. The knob 66 will be rotated clockwise from a position near the counterclockwise end of its range of movement to reduce the video gain until noise disappears, or can just be tolerated as shown by the oscillograph or the video monitor tube, and at this point the setting of the cam ring 73 is chosen so that the indicator 86 will engage the disc 62 through the medium of the friction shoe 88 and cause the disc to rotate with the indicator 86. From this point the camera aperture will be decreased to sharpen up the detail of the picture, and the gain will be further reduced. Gain reduction from this point may be at a decreased rate if desired, by selecting a potentiometer having a non-uniform resistance unit. This suggested mode of operation described by way of example is suitable for conditions where the light is a minimum and maximum gain must be employed.

The potentiometer 48 may be of the type which has a tapering resistance unit so that the reduction in the gain will be slight during a portion of the range of movement of the indicator 86, or if desired, the potentiometer may be so arranged that no further reduction in gain occurs after the friction shoe 88 comes in contact with the cam surface 63 of the disc 62.

From the foregoing it will be seen that the arrangements described herein provide the maximum depth of focus for any given light condition and also that it is not susceptible of interference on the part of the camera operator. Also, these arrangements permit a convenient balancing of the noise factor against the iris opening under extremely adverse conditions so that a picture may be obtained in preference to

no picture at all by disregarding a certain amount of noise.

Having now described the invention, what is claimed and desired to be secured by Letters Patent is the following:

1. A television pickup control system comprising a television camera having a picture scanning tube, a lens, means for providing relative movement between said tube and said lens for focussing purposes, an amplifier, a transmission line connecting said tube with said amplifier, an adjustable gain control for said amplifier, a stop adjustment for said lens, remote control means for said stop adjustment means located adjacent to said gain control, an oscilloscope, and means to supply said oscilloscope with signals produced by said picture scanning tube, said remote control means and said adjustable gain control being accessible to and having a combined control for manipulation by an operator stationed within viewing distance of said oscilloscope whereby the aperture of said lens and the gain of said amplifier may be correlated to produce a signal having an optimum value of signal to noise ratio and signal components representing maximum depth of focus of said camera.

2. A television system comprising a camera having a picture scanning tube, a lens to image a scene on said scanning tube, an adjustable aperture for said lens, power driven means for effecting adjustment of said aperture, an amplifier connected to amplify the signal output of said camera, an adjustable gain control for said amplifier, manually operable adjusting means for said gain control, and means adapted for control by said manually operable adjusting means and situated adjacent said gain control adjusting means for controlling the operation of said power driven means.

3. A television system comprising a camera having a picture scanning tube, a lens to image a scene on said scanning tube, an adjustable aperture for said lens, remotely operable means for effecting adjustment of said aperture, an amplifier connected to amplify the signal output of said camera, an adjustable gain control for said amplifier, manually operable adjusting means for said gain control, and means adapted for control by said manually operable adjusting means and situated adjacent said gain control adjusting means for controlling the operation of said aperture adjusting means.

4. A television system comprising a camera having a picture scanning tube, a lens to image a scene on said scanning tube, an adjustable aperture for said lens, means for effecting adjustment of said aperture, an amplifier connected to amplify the signal output of said camera, an adjustable gain control for said amplifier, and a combined control for said adjustable gain control and said aperture adjusting means.

5. A television system comprising a camera having a picture scanning tube, a lens to image a scene on said scanning tube, an adjustable aperture for said lens, power driven means for effecting adjustment of said aperture, an amplifier connected to amplify the signal output of said camera, an adjustable gain control for said amplifier, and a combined control for said adjustable gain control and said power driven aperture adjusting means.

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