

The present invention refers to an method for the adjustment of a deflector for three aligned gun television tubes. It also refers to a device using this method. Such a method and a device using this method are already known (FR-A-2.506.105). The invention will be applied to the mass production of deflectors and to the assembly of deflectors onto television tubes for the general public.

According to methods of the prior art which are part of the practical knowledge acquired by the inventors, a manufacturing method for magnetic deflectors comprising a line winding and a field winding performing the generation sweep for a quality colour image is known. By modelling the magnetic field lines, these deflectors perform self-convergence and various image corrections which, in the past, were performed by auxiliary circuits. However, the adjustment of the deflector must be very precise. In fact, the latter comprises, on a conical separator, a ferrite bearing a toroidal field sweep winding. A saddle winding is fixed inside the separator for the line scanning. The ferrite is mounted on the separator so as to be mobile. The deflector only works if :

- both windings are correctly located in relation to each other;
- the deflector itself is correctly located on the tube neck on which it is mounted.

Usually, the adjustment of the deflector is performed in two phases of operation. The first one ensues at the end of the manufacturing process of the deflector which is then stucked so as to set this adjustment. The second one is performed by mounting the tube when assembling the different components.

The main inconvenience of this method consists in being obliged to use a test tube for the first phase of operation to display a test pattern. By using statistical sampling methods, a series of test tubes intended for the first phase of operation are taken as samples. Each test tube presents average characteristics allowing the control of the deflector according to the first phase of operation which can be transferred to another tube. It is obvious that the selection of the series of tests is not easy. Each deflector is brought, after manufacturing, to an adjustment stand for the first phase of operation. An operator places the deflector on the neck of a test tube which is mounted in a dark cabin and couples the connections of the windings of the deflector to a test pattern generator. By displaying the test patterns, four convergence errors, the so-called vertical and horizontal amplitude errors and the so-called vertical and horizontal interlacing errors, can be measured. According to the first phase of operation, he tries to minimize these pattern errors. There are many inconveniences among which we can hold up as examples :

- the problem of selecting a test tube ;
- the help of an operator for the visual evaluation of a dimensional error on an image ;
- the slowness due to the manual nature of the handling ;
- the obligation of having to maintain an important number of testing stands with the same characteristics for the adjustment of the standard deflectors ;
- the high unit costs of each testing stand.

It is an object of the present invention to avoid to have to select a television tube with complicated procedures which, in fact, bring in an error which is random

distributed over a whole manufacturing sequence.

Another object of the invention is to allow not to turn to the visual evaluation of a test pattern, since such evaluations vary with their subject.

Another object of the invention is to limit and even to eliminate the manual operations in the first adjustment step. High control rates can thus be achieved, the saving of time easily being of five times the usual time.

Another object of the invention is to propose a method and a device with subsequent costs which are considerably reduced in comparison with the above mentioned state of the art.

After the adjustment according to the first phase of operation, the adjusted deflector is sticked, i.e. the ferrite which bears the field is immobilized on its separator and is thus fixed to the line. Subject to auxiliary phases of operation, the deflector as a component is then an end product which is sent to the television tube manufacturer who must perform the second phase of operation consisting in the adaptation of the deflector to the television tube for which it is intended. Each tube comes then to a stand similar to the one described above, is taken on by an operator who also receives the deflector, mounts the deflector onto the tube neck and displays a field pattern similar to that of the first phase of operation. The operator then has to minimize again the four above mentioned errors by shifting the deflector axially along the line scanning axis or the field sweep axis. For this purpose, the deflector is fixed by its rear part and the operator

manipulates arms allowing the forward motion of the deflector along the two above mentioned axes.

The inconveniences inherent in this second phase of operation are in particular :

- that the tube intended for a given deflector may have characteristics which are quite far from those of the tube, in the extent of the statistical class for the selection of the test tube of the first phase of operation ;
- the fact that the adjustment of the four errors can only be made with two independant parameters : the shifts of the deflector along the line scanning direction and along the field sweep direction, the operator being compelled to perform a non-definable balance of the four errors.

It is an object of this invention to avoid the characteristic deviations between the test tube of the first phase of operation and the television tube on which the deflector will finally be mounted.

It is another object of the invention to allow to limit the adjustment work of the operator by reducing the possible variations of the four errors by transposing a part of the adjustments of the second phase of operation to the first phase of operation.

As a matter of fact, the invention relates to a method for the adjustment of a deflector for three aligned gun television tubes. The method of the invention consists in particular in :

1. arranging the deflector on a measuring head comprising field gradient sensors ;

2. measuring line and frame field gradients in at least one rear part and one front part of the deflector ;
3. shifting the field coil, which is mounted on a supporting ferrite, around the central axis of the measuring head so that the frame and line fields are orthogonal ;
4. simulating the alignment of the deflector with a television tube by measuring signals with the measuring head which are proportional to the angular differences between the axis of the head and each average axis of symmetry of the line and frame fields ;
5. shifting the ferrite in at least one direction of the plane orthogonal to the axis of the measuring head so as to cancel each of the proportional signals ;
6. fixing, at least temporarily, the ferrite in relation to the line winding.

The present invention also relates to an adjustment device for deflectors using the method of the invention (see claim 6).

Such a device comprises, according to the invention, supporting and centering means, firstly for the deflector itself, secondly for a coil in relation to the other. The device also comprises a field gradient measuring head, the data of which are supplied to a calculator which implements the parameters of the invention. Finally, the device according to the invention also comprises two line and field simulation feeding circuits and an automatic control of the aforesaid centering means.

Other characteristics and advantages will be clarified by the description and the annexed figures.

Fig. 1 is a view of the backside of a television tube which is provided with a deflector.

Fig. 2 is a partial section through the television receiver equipped according to fig. 1.

Fig. 3 is a block diagram of a device using the method according to the invention.

Fig. 4 represents a first test pattern used in the method according to the invention.

Fig. 5 represents a second test pattern used in the method according to the invention.

Fig. 6 to 9 are diagrams explaining the operation of the field gradient measuring head.

Fig. 10 is a diagram of an embodiment of a first circuit of the device according to the invention.

Fig. 11 is a diagram of an embodiment of a second circuit of the device according to the invention.

Fig. 12 is a diagram of an embodiment of a third circuit of the device according to the invention.

The backside of television tube is represented in fig. 1. The television tube comprises a screen 1 mounted on a flare-shaped part 2, the end of which consists of a neck 5. The neck 5 includes an assembly 6 consisting of three aligned guns, each being assigned to the successive colours red, green, blue. A deflector 3 is arranged on the neck of the tube, the main form of which modifies that of a collar which is adjusted to the connection

between the cylindrical part of the neck and the flare-shaped part 2 of the backside of the screen 1.

Looking at this figure, one makes out the problem raised in particular by the second adjustment step which has already been described. In fact, the tube is so constructed as to admit a central axis 7 corresponding to the convergence axis of the deflecting assembly 3. By mounting the deflector 3, the deflector 3 generally is arranged along its own magnetic axis 8 which forms with the axis 7 an angle referred to as angle 9 which has to be aligned. Since the mechanical methods cannot be applied for this type of adjustment, it is known from the state of the art to verify the magnetic characteristics of the tube, especially its convergence, with the test pattern distortions displayed on the screen 1. For this purpose, the four characteristic points of the screen are designated by the usual horary designations 12H, 3H, 6H, 9H. A reference trihedron x, y, z also is assigned to the axis 9, the axis z being the general propagation axis of the electron beams from the guns in the absence of deflection, the axis x reproducing approximately the line scanning direction and the axis y the field sweep direction.

A partial section through a television tube approximately according to that of fig. 1 is represented in fig. 2. The deflector is arranged on the glass 16 of the tube which is partially represented in short lines. It comprises mainly a separator 11-13 made of plastic which bears a first coil 10 and a second coil 17. The first coil 10 consists of a solenoidal or toroidal coil arranged around a ferrite core which is approximately conical. The coil 17 consists of a thermoformed coil having the form of a horse saddle and is placed in a seat of

the separator 11 in the free space 15 between the coil and the flare-shaped part of the tube. The first coil 10 is assigned to the field sweep and the second coil 17 to the line scanning. Such a deflector is called a saddle/tore type deflector. It appears in the figure that a line deflection center L and a field deflection center T can be distinguished along the axis 3. To minimize the geometry and convergence errors, both the line deflection center L and the field deflection center T should be aligned with this axis z which is also the axis 9 of the tube. For this purpose, two adjustment parameters are available in a saddle/tore type deflector: a shift of the coil 10 along the axis x and along the axis y. In fact, we notice that there is a gap 14 between the tore 10 and the separator 11 which allows shifts in the order of a millimeter. Precisely this shift along x or y allows the adjustment according to the first phase of operation described above.

Fig. 3 represents the general diagram of a device using the invention. A device according to the invention comprises mainly centering means 22 and positioning means 23 for the stable position of the deflector 21 in relation to the measuring head 20. It also comprises positioning and centering means 27 - 29 and 33, 40. When the deflector is placed on the measuring head 20, the centering and positioning means 23, which consist, for example, of self-centering clamps, grasp the deflector at its rear part, i.e. at the smallest section of the deflector, also called input area of the electron beams. The deflector lies on a bearing area 23a of the measuring device so as to surround the measuring head 20. The deflector comprises a part 24 constituted by the field deflecting coil which is mounted on a ferrite mobile in relation to the separator and to the line deflecting

coil fixed to this separator 25. The part 24 can be displaced by a device 27 - 29 and 33, 40 for positioning and centering the field winding in relation to the line winding along a first axis x and a second axis y which may be approximately orthogonal to each other.

In the adjustment device according to the invention, mainly the first phase of adjustment must be performed in a particular way specific to the method of the invention. For this purpose, the ferrite 24 must be shifted along the axes x and y relative to its separator 25 fixed by the centering and supporting means 22, 23. The measuring head 20 is aligned with a central axis 41 which simulates the ideal magnetic axis. The axis 41 is similar to the central axis of the deflector which is the propagation direction of the electron beams not being deflected. To perform the measuring, there are two feeding circuits, the one 34, 35, 38 being associated to the field sweep, the other one 36, 37, 39 being associated to the line scanning. Each line comprises a field oscillator or a line oscillator, an amplifier and a connection to the exit wires of the field or line windings. In a preferred embodiment of the invention, sinusoidal signals have been chosen, the frequencies of which are respectively compatible with the line and field sweep frequencies which are not multiples of each other, the field sweep being simulated at 285 Hz and the line scanning at 3000 Hz.

The data 30 derived from the measuring head are supplied to a calculator 31 which calculates the coefficients which were measured according to the prior art with the test patterns displayed on the test tubes described above. These four main parameters will be described with reference to the figures 4 and 5. In the same way, the

structure of a measuring head according to the invention will be described with reference to the figures 6 to 9. The calculator gives an error signal 42 which is an analog or digital measure of the voltages proportional to the angular differences of the axes of the deflector with the axis of the head. It allows to define a shift of the axis x and a shift of the axis y which result in an optimal distribution of the four parameters. To perform this shift in a first embodiment, an operator adjusts by hand the position of the ferrite 24 with displacement screws until the error signal 42 which is read, for example by a galvanometer battery, is cancelled.

In another embodiment, the error signal 42 is given to an automatic control 32 which supplies the supply or control of a motor 29 or 33 which is responsible for the motions of a skid 27 for the axis x or 40 for the axis y. The skids 27 or 40 allow to drive back the ferrite. Thus, the motion of the ferrite on the deflector is always in the plane orthogonal to the axis 41, i.e. approximately the axis of rotation of the deflector itself. As it is known by those skilled in the art, the signals derived from the automatic control generator 32 depend on the kind of motor.

Fig. 3 represents schematically the positioning and centering means which mainly consist of a self-centering clamp 22, 23, the profile of which allows to grasp the rear collar of the deflector 21. When the clamp 22, 23 is activated, its profile assists the centering and fixing of the rear part of the deflector.

Figs. 4 and 5 represent a screen 57 on which a series of test patterns are displayed with which the deflectors

are adjusted according to the state of the art. The four characteristic parameters used by the invention will be explained with reference to these two figures.

A test pattern consisting of two crosses with the same centers placed in the center 52 of the screen 57 as represented in the inner part of the screen 57, a first red cross consisting of lines 50 and 54 and a second blue cross of lines 51 and 53. This interlacing test pattern allows to measure the horizontal and vertical interlacing parameters. The four cardinal points 3H, 6H, 9H, 12H associated to the axes x and y are defined on the screen 57. The divergences between the ends of the blue and of the red cross measure the deflecting errors caused by a bad positioning of the field in relation to the line. We can thus define the divergences DX (12), DX(6) of the vertical ends of the crosses and the divergences DY(9) and DY(3) of the horizontal end of the same two crosses. Thus, we can define a horizontal interlacing coefficient CH by the relation :

$$CH = \frac{1}{2} (DY(9) - DY(3))$$

We also can define a vertical interlacing by the relation :

$$CV = \frac{1}{2} (DX(12) - DX(6))$$

It has to be noted that the divergences considered in the calculation of CH and CV correspond to maximum deviations.

In fig. 5, the screen 57 presents a test pattern consisting of two rectangles, a blue one and a red one. The red rectangle 56 and the blue rectangle 55 allow the measurement of two amplitude coefficients : the horizontal amplitude coefficient AH and the vertical amplitude coefficient AV. As above, the divergences are defined in relation to the axes x and y with their signs DX(3), DX(9), DY(12), DY(6).

The horizontal amplitude parameter AH is defined by the relation :

$$AH = \frac{1}{2} (DX(3) - DX(9))$$

The vertical amplitude parameter AV is defined by the relation :

$$AV = \frac{1}{2} (DY(12) - DY(6))$$

By the method according to the invention, we are set free from measuring of these eight parameters which an operator must evaluate a first time during the adjustment of the deflector itself and a second time during the mounting of the deflector onto its final tube. For this purpose, the fact is used that these measures correspond to the maximum derivations in the plans including the axes x and y. Figs. 6 to 9 represent a cut deflector in which fields are measured so as to avoid the use of the test patterns described with reference to the figures 4 and 5. Only the form 60 of the deflector in the plane has been represented in each of the figs. 6 to 9. The electron beams come into the rear area of the deflector along the axis z. This rear area has a smaller

section than the end output section of the electron beams.

In the definition of the four characteristic parameters used by the invention, we may note that the geometrical elements are differences of differences. So, for each measuring point, the distance between a red trace and a blue trace which are at the deflecting ends have to be recognized, these two traces being the most distant from each other among the three beams. Therefore, probes susceptible of measuring field differences must be placed in the output area of the deflector. One merit of the invention is to have discovered that this gradient measurement allows to represent the differences which are considered for the definition of the four parameters of an adjustment operation for deflectors.

In fig. 6, a section is represented in which the measuring range of each field gradient used for the horizontal amplitude parameter AH is indicated. In the output area of the deflector, pairs of small coils 64 and 65 are placed in the plane including the axes x and z, the pair 64 being intended for measuring the field gradient modifying the two extreme beams in the direction of a point of impact 9 o'clock (9H) and the pair of small coils 65 for measuring the field gradient modifying the two red and blue extreme beams 61 and 62 towards the point 3 o'clock (3H) of the screen. It is self-evident that the absence of a tube in the measuring device implementing the method of the invention results in a simple simulation of the beams 61 and 62. There is no charge through the measuring device. To recognize more specifically the errors which the deflector brings in in its input area, a pair of small coils 63 is placed in the vicinity of the axis z by which the influence of the

rear area of the deflector can be brought back onto the gradient coefficients. Pairs of small coils 64 and 65 are placed in the plane x, z , approximately on the edge of the deflecting volume. They are located in a front area at a place the choice criterion of which will be precised below. For the measuring of the so-called horizontal amplitude parameter AH, the small coils consist of small solenoids the axis of which is parallel to the axis y .

Fig. 7 represents a diagram for the arrangement of the small coils for measuring the horizontal interlacing coefficients CH. The small coils are solenoids the axes of which are parallel to the axis x . They are placed in a plane x, z as above.

Fig. 8 represents a diagram for the arrangement of the small coils for measuring the vertical amplitude coefficient AV. The small coils are placed in a plane y, z and have axes which are parallel to the axis x . The pairs of small coils 80, 81 located in the front part of the deflector correspond to the deflecting point at 12 o'clock (12H) and to 6 o'clock (6H) on the test pattern of the prior art.

The pair of rear small coils 72 consists of the pair of small coils which is already used in fig. 7 for measuring the horizontal interlacing parameter CH.

Fig. 9 represents a diagram for the arrangement of the small coils for measuring the vertical interlacing parameter CV. The small coils are located in the plane y, z and comprise a pair of small coils 90 which measure the field gradient for the deflection at 12 o'clock and a pair of small coils 91 for the deflection at 6 o'clock.

The pair of small coils 63 consists of the small coils used for measuring the horizontal amplitude parameter of fig. 6.

In figs. 6 to 9, each pair of small coils comprises two small coils which are absolutely similar to each other and which are identified by a mark a or b depending on the small coil of the pair.

Each small coil consists of about twenty turns divided in four layers mounted on a spirale. According to the invention, the measuring head consists of a body made of a synthetic material in which the pairs of small coils are buried. In an embodiment, the small coils are arranged in the body after having been drilled with an accuracy to the hundredth. The present invention can use any other type of sensor sensitive to magnetic fields.

Thus, each parameter is measured by three pairs of small coils. This corresponds, as a matter of fact, to two samplings of the field according to the axis Oz. In an alternative embodiment, an additional pair of small coils is arranged to achieve a third sampling in an area near to the line or field deflecting centers.

In a preferred embodiment, the measuring head of the device of the invention comprises, in fact, ten pairs of small coils which are distributed as follows : two pairs of small coils in the rear area and eight pairs of small coils in the front area.

The achievement of a precise measure of the convergence asymmetry errors by measuring a field gradient in a limited number of points of the deflecting volume depends to a great extent on the positions in x, y and

especially z of these points and therefore of the sensors.

In x, y , the choice is easy. Each of the two small coils of a sensor is positioned on the crossing points of the red and white trajectories (lateral channels) respectively, for the considered value z , the trajectories being those of the points of reference $3H - 9H - 6H - 12H$.

These trajectories are predetermined once and for all by a calculation from fixed field measures made in a laboratory in the whole deflection volume of a reference deflector.

The choice of the "sampling planes" along z is more difficult and determinant.

The asymmetries of the deflecting field in relation to an axis Oz which is defined in practise by the references 22- 23 have various origins : it may be in particular a simple offset of the coils by translation and inclination in relation to Oz , or an incorrect assembly of the line coils, or field or line winding anomalies, or deformation of ferrites or of line coils; these latter types of errors can be located relatively along z .

In a first approximation, the deflecting field for each direction is constituted in each plane $xy(z)$ by :

- an uniform field referred to as $H_0(z)$;
- a component $H_2(z)$ determining the self-convergence, the cushion correction etc. ; this function $H_2(z)$ defines the nominal properties of the deflector ;
- a component $H_1(z)$ which, ideally, must be at zero because it represents the asymmetries described

above;

- higher order components of limited influence.

For each z and along the axis Ox :

$$H_y = H_0(z) + H_1(z) \cdot X + H_2(z) \cdot X^2 + \dots$$

vertically along Oy :

$$V_x = V_0(z) + V_1(z) \cdot Y_2 + V_2(z) \cdot Y^2 + \dots$$

If we consider H_y and the horizontal amplitude parameter AH , the measured field of each small coil of a gradient sensor will be :

- in red (left external gun)

$$H_R = H_0 + H_1(x-a) + H_2(x-a)^2$$

- in blue (right external gun)

$$H_B = H_0 + H_1(x+a) + H_2(x+a)^2$$

with $2a$ = distance between the blue/red trajectories,
 x = position in relation to the axis of the deflector.

If the position of the central trajectory (green) for the point 3H in relation to the ideal axis of the tube defined by 22 - 23 is X

$$x = X - d$$

d being the distance for a fixed Z between this axis and the magnetic axis of the deflector.

In this case, the gradient measured by a sensor 3H is:

$$(H_B - H_R)_3 = 2aH_1 + 4(X - d)aH_2$$

for 9H:

$$(H_B - H_R)_9 = -2aH_1 + 4(x+d)aH_2$$

The difference between the gradients 3H-9H expressing the local amplitude error in AH is :

$$AH = k(H_B - H_R)_3 - (H_B - H_R)_9 = k(4aH_1 - 8daH_2)$$

Since in the rear area the trajectories are practically not deflected, the sensor 3H merges with that corresponding to 9H so that in practice only one sensor will be used, the given signal being equal to the half and an increase supplement of 2 being applied to the corresponding amplifying line.

The expression of AH above shows that the misalignment d allows locally a compensation of the asymmetries H_1 , i.e. by shifting the parabolic component H_2 . This is locally true for a slice dz . In fact, if we integrate over z on the whole trajectory the sum $8 \int d(z) a(z) H_2(z) dz$ can just as well compensate the sum of the asymmetries $4 \int a(z)$. The function $d(z)$ is generally simple because it corresponds to an inclination or a translation of the deflector in relation to the reference axis.

$a(s)$ is very monotonic since it interprets the convergence of the beams; it varies in the area where H_2 and H_1 exist.

On the other hand, the functions $H_1(z)$ and $H_2(z)$ are not so monotonic.

$H_2(z)$ is part of the design of the product and is well known and constant (fig. 13) but changes sign twice along z . Vertically, the homologous V_2 is often more monotonic and always negative (fig. 13). A ponderation $AR - AV$ of the gains of the feeding circuits allows to take these facts into account.

The functions H_1 and V_1 which are representative of the errors described above depend on the manufacturing process and on the technology of the deflector.

For each product type, only an experimental analysis allows to determine the number of sampling planes, their positions and their eventual ponderations (relative coefficients front/back).

Our experience showed us that two entire planes (device described with reference to the figs. 6 and 7, i.e. three pairs of coils) were at least necessary ; in an alternative embodiment of the invention, complementary measuring points are added in the area of the deflection centers but only for one part of the parameters.

Everything that has been set out above about the horizontal amplitude parameter can identically be set out for AV, CH, CV.

So we see that four shifts according to x and y, as well field as line shifts, that is to say:

$$dx_x, dy_y, dx_x, dy_y$$

allow the adjustment respectively of:

$$AV, CV, AH, CH.$$

The object of the second phase of adjustment on a field tube is to set AV and CV to zero by shifting the whole deflector in which line and field are then independent. A simultaneous cancelling of AH and CH is then achieved if appropriate values of:

$$dx_x - dx_x \text{ and } dy_y - dy_y$$

have been obtained during the first phase on a test tube according to the state of the art or by our invention. Whereas the four motions

$$dx_x, dy_y, dx_x, dy_y$$

must be performed mechanically on the test tube of the state of the art, we have, in the case of the invention, greatly simplified the device and have only mechanized

the shift of the ferrite-field assembly (figure 3). The effect of the shifts d_{Lx} and d_{Ly} on the convergence parameters is simply calculated from measures and is not materialized by a mechanical shifting. This is made much easier by the observation that the errors AV and AH as well as CV and CH generally remain linear to each other when d_x and d_y vary:

$$AV(d_x) = \alpha \cdot AH(d_x) + G(d_{rx} - d_{Lx})$$

$$CV(d_y) = f(d_{ry} - d_{Ly}) + \beta \cdot CH(d_y)$$

The simultaneous cancelling of the amplitudes and interlacings on the final tube by d_x and d_y will be made possible by values of

$$d_{rx} - d_{Lx} \text{ and } d_{ry} - d_{Ly}$$

such as

$$AV - \alpha \cdot AH = EC \rightarrow 0$$

$$CV - \beta \cdot CH = EC \rightarrow 0$$

Thus, the combination of the measures AV and AH with a coefficient α constitutes the error signal E_a which allows an automatic control to adjust $d_{rx} - d_{Lx}$, the function G being relatively monotonic.

Furthermore, the control point Q can, in some cases, be different from zero. That is to say

$$AV - \alpha \cdot AH - Q_a \cdot E_a \rightarrow 0$$

The reasoning is identical for the interlacings, i.e.:

$$CV - \beta \cdot CH - Q_c = E_c \rightarrow 0$$

In fig. 10, a line is represented which allows to elaborate one of the parameters described above. Each pair of small coils 100, 101, 102 used to elaborate the signal 113 is represented. The pair of small coils 100 originates from the rear area and therefore corresponds to

the pairs of small coils 72, 63 of figs. 6 to 9. The small coils 100 and 102 correspond to the right or left small coils of any of figs. 6 to 9. It should be noted that all the lines connected to the pairs of small coils are identical and only the upper line of the drawing of figure 10 will be described. Each pair of small coils is connected to an amplifying circuit 103, 104. The outputs of each of these circuits are supplied to the differentiator inputs 105 - 107. The field gradients described above are obtained at the output of these differentiators. These values are supplied to integrators 108 - 110, the outputs of which are connected together to the input of a circuit producing a zero-sequence component 113 which will be used as error signal for any of the four parameters according to the allotment of the pairs of small coils 100 - 102.

The amplifier 103 comprises for each of the small coils 100a or 100b an operational amplifier 120 connected to a net of reactive resistors 121, 122 connected to the output 123 of the operational amplifier 120.

Each adapted signal coming from one of the amplifiers described above is given to the input of a differentiator consisting of an operational amplifier 130, the inputs of which are loaded through resistors 131 or 132. A condensator 133 performs a first filtering. Each differentiator is then connected to a filter 108 which performs a bandpass filtering with constant phase. Such a filter consists of an operational amplifier 140 loaded by a RC network in parallel 141 and a resistor 142 on the hot input. The outputs of the three lines from the small coils 100 - 103 are joined together at the input of the circuit 111. The input of the circuit is supplied to an adding circuit consisting

of an operational amplifier 144, the output of which gives a sum with integration by the RC network which degenerates the hot point of the amplifier 144, the sum being a linear combination of the field gradients of each pair of small coils. The coefficients which modify the gradients simulated by the different gains in each of the stages 103, 105, 108 or 104, 106, 109, or 104, 107, 110 correspond to the coefficient of the influence of the rear onto the front which has been described above. In the circuit 111, the output of the adding circuit 144 is supplied to a synchronous decoder, the second input of which is connected to the main oscillator responsible for the sweep or for the simulation of the field sweep or the line scanning. Thus the input 112 receives the line scanning frequency for the horizontal amplitude coefficient and the horizontal interlacing coefficient CH or the field sweep frequency for the vertical amplitude coefficient and the vertical interlacing coefficient. The synchronous decoding gives a detection output signal, the zero-sequence component of which is filtered by the filter cell 147 erected around the operational amplifier 146 (coefficients α, β above).

The circuit of fig. 10 corresponds to the calculator 31 of fig. 3. This calculator is an analog calculator. In another embodiment, the signals from the sensors 100, 101, 102 are digitalized and given by an appropriate interface to a digital processor which can elaborate a digital signal 42 according to the fig. 3 which is able to give the error signals similar to those described with reference to the fig. 10. Thus, the calculator 31 of fig. 3 comprises four circuits similar to those of fig. 10, in the case of an analog calculator. In fig. 11, a circuit is represented which is able to be used to

generate two signals 156, 157 for the automatic control of the motors 33 or 29 of the embodiment of fig. 3. Each of the four parameters calculated, for example according to the circuits of fig. 10 is supplied to the inputs 152, 155 of the circuit of fig. 11. They are associated with each other by addition in a linear combination which simulates electrically the conditions so that the deflector is optimally adjusted according to the invention.

The circuit of fig. 11 comprises two independent distinct branches 150 and 151. The branch 150 comprises two inputs : 152 which receives the horizontal amplitude signal AH and 153 which receives the vertical amplitude signal AV. In the same way, the branch 151 receives from the input 154 the vertical interlacing signal CV and from the input 155 the horizontal interlacing signal CH. Since both branches are identical, we now describe the branch 150. The input 152 which receives the horizontal amplitude signal is supplied to a unit gain inverting amplifier. The output of this amplifier as well as the input 153 are supplied to an adder consisting of the operational amplifier 166. The output signal 156 is a linear combination of the two inputs 152, 153, the coefficients of which depend on the ratios of the resistors 163 to 165 and 164 to 165. The so formed signal can drive an interface to supply the motors 29 or 33 of fig.3.

Fig. 12 represents a secondary circuit of the calculator 31 of fig. 3 which is also an analog circuit. Before performing the operations of the method of the invention which have been described, it is necessary to adjust the orthogonality of the line and field coils so that the

line and frame fields are really orthogonal or approximately orthogonal. For this purpose, the field coil is used as sensor for the line field. The field amplifier 34 supplied by the circuit 202 is switched off by the connector 201. The field winding 200 is set to the input of a transformer 203 which has a turn ratio of 250 in a preferred embodiment. The output of the transformer 203 is supplied to a higher gain amplifier 204. The output of this amplifier is supplied to a synchronous detector 205, the other input of which is connected to the line oscillator 37. We use - as mentioned with reference to fig. 11 - a filter cell of the zero-sequence component 206 which gives an error signal 207 which must be cancelled by rotating the field 24 in relation to the separator 25. Those skilled in the art can easily embody the automatic control, which has not been represented in fig. 3.

After the adjustment has been done, the ferrite 24 is immobilized on the separator, at least temporarily, so as to keep the adjustment. In the embodiment, the ferrite is stuck onto the separator with a hot-setting glue.



Claims

1. Method for the adjustment of a deflector for a three aligned gun television tube, characterized in that it consists in:
 1. arranging the deflector (21) on a measuring head comprising field gradient sensors (20 ;
 2. measuring line and frame field gradients in at least one rear part and one front part of the deflector ;
 3. shifting the field coil, which is mounted on a supporting ferrite (24), in relation to the line deflecting coil, around the central axis (41) of the measuring head so that the frame and line fields are orthogonal ;
 4. simulating the alignment of the deflector with a television tube by measuring signals with the measuring head which are proportional to the angular differences between the axis (41) of the head and each average axis of symmetry of the line and frame fields;
 5. shifting the ferrite in at least one direction (x and/or y) of the plane orthogonal to the axis (41) of the measuring head so as to cancel each of the proportional signals;
 6. fixing, at least temporarily, the ferrite in relation to the line winding.
2. Method according to claim 1, characterized in that the adjustment of the orthogonality of the line and frame fields is first performed by measuring the current induced in the field winding by the line coil (26) connected to a sweep generator (36, 37) and that this current is cancelled by rotation of the ferrite (24) which bears the field coil.
3. Method according to claim 1, characterized in that for each of the horizontal amplitude (AH), vertical ampli-



tude (AV), horizontal interlacing (CH) or vertical interlacing (CV) parameters a field gradient at the rear part of the deflector and two field gradients at the front part of the deflector, symmetrically on each side of the central axis (41) are measured and in that each of the parameters is measured by linear combination of the three gradients, the coefficients of the linear combination being measures of the relative influences of the rear and front areas of the deflector, the parameters AH, AV, CH, CV being determined respectively by the relations :

$$\begin{aligned} \text{AH} &= 1/2 \langle \text{DX}(3) - \text{DX}(9) \rangle & \text{AV} &= 1/2 \langle \text{DY}(12) - \text{DY}(6) \rangle \\ \text{CH} &= 1/2 \langle \text{DY}(9) - \text{DY}(3) \rangle & \text{CV} &= 1/2 \langle \text{DX}(12) - \text{DX}(6) \rangle \end{aligned}$$

DX(6), DY(12) and DY(9), DY(3) being respectively the distances between the vertical and horizontal end of blue and red crosses passing through the center of the screen and DX(3), DX(9), DY(12), DY(6) being respectively the distances, at the cardinal points West, East, North and South, between the sides of a blue rectangle and of a red rectangle formed along the edges of the screen of the measured cathode tube.

4. Method according to claim 3 characterized in that the shift of the ferrite (24) along the axis x is controlled so that to cancel an error signal consisting of a linear combination of the horizontal amplitude (AH) and vertical amplitude parameters.
5. Method according to claim 3 characterized in that the shift of the ferrite (24) along the axis y is controlled so that to cancel an error signal consisting of a linear combination of the horizontal amplitude (AH) and vertical amplitude parameters.



6. Device implementing the method according to any of the claims 1 to 5, characterized in that it comprises
- supporting and centering means (22, 23) for the deflector (21) ;
 - a measuring head (20) comprising field gradient sensors on the one hand in the front part of the deflector and on the other hand in the rear part of the deflector ;
 - two line and frame sweep feeding circuits (36, 37), connected to said coils ;
 - a calculator (31) for the four vertical (AV) and horizontal amplitude (AH) and vertical (CV) and horizontal interlacing (CH) parameters;
 - a circuit (32) which elaborates from the four signals (42) which simulate the four parameters an automatic control signal for the shifts x and/or y of the ferrite (24) on the separator (25) in a plane which is orthogonal to a central axis of the device so as to annulate error signals.
7. Device according to claim 6, characterized in that the sensors consist of pairs of small coils (110a, 100b).
8. Device according to claim 6, characterized in that the measuring head (21) comprises two sensors (72, 63) in the rear area of the deflector in the vicinity of an axis (41) of the device and eight sensors (64, 65, 70, 71, 80, 81, 90, 91) in the front area in the two planes including the axes x of line scanning or the axis y of field sweep, orthogonal to the axis z (41), the sensors being intended for detecting fields which are orthogonal two by two.
9. Device according to claim 6, characterized in that the calculator (31) comprises for each of the four



parameters to be simulated:

- a circuit (103, 105) calculating the field gradient of each sensor (100);
- a bandpass filter (108) for each circuit (103, 105) with constant phase;
- an adder (144) which performs a linear combination of the gradients from a sensor of the rear area (100) and from two sensors of the front area (101, 102) reserved for the calculation of said parameters;
- a synchronous decoder (145) at line or field frequency according to the simulated parameters;
- a filter (146) supplying a zero-sequence component (113) simulating said parameters.

10. Device according to claim 6, characterized in that the circuit (32) comprises two branches, one (150) associated to the shift x and the other (151) to the shift y, the branch (150) performing a linear combination of the signals simulating the vertical amplitude (AV) and the horizontal amplitude parameters, the branch (151) performing a linear combination of the signals simulating the vertical interlacing (CV) and the horizontal interlacing parameter (CH).
11. Device according to claim 10, characterized in that each branch (150, 151) performs an addition of its two inputs (152, 153) with coefficients which are determined by the ratio of the resistors (163, 165 and 164, 165).
12. Device according to claim 10, characterized in that the automatic control by motors (33, 29) performing the shifts of the ferrite (24) with skids (27, 40) tends to cancel the automatic control signals existing at the outputs (156, 157) of the circuit (32).



13. Device according to claim 6, characterized in that the deflector lies on a horizontal bearing surface (23a).
14. Device according to claim 6, characterized in that the supporting and centering means (22, 23) comprise a self-centering clamp grasping the rear collar of the deflector.