PATENT SPECIFICATION

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(19)

(54) TELEVISION CAMERA TUBE

(71) We, N.V. PHILIPS' GLOEILAMPENFABRIEKEN, a limited liability Company, organised and established under the laws of the Kingdom of the Netherlands, of Emmasingel 29, Eindhoven, the Netherlands, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to a television camera tube comprising a substantially cylindrical envelope containing at one end thereof an electron gun opposite to which at the other end of the tube is a face plate having a radiation-sensitive layer, wherein a suspension member which is supported inside the tube by resilient elements comprises a ring in which a metal gauze is mounted adjacent said layer.

In such a television camera tube known from British Patent Specification 1,497,091, it has been endeavoured to prevent microphony interference by dynamic isolation. As a result of so-called stick-slip phenomena in the damping used therein, the vibration isolation is not sufficient for small vibration amplitudes. The metal gauze for a 25 mm diameter tube has a mass from 5 to 10 mg. Even a very small impact on or vibration of the tube will make the gauze vibrate and cause a smeared television image.

It has also been tried to increase the damping of the gauze vibration by making the circumferential seal of the gauze which is formed by the tensioning ring irregular with more or less sharp corners instead of the usual circular seal. The effect thereof on the damping is only small, taking into consideration that the fundamental frequency of the gauze is increased by the reduction in area.

According to the invention, a television camera tube as set forth in the opening paragraph is characterized in that the resilient elements permit the suspension member to undergo damped vibration longitudinally of the envelope with a fundamental resonant frequency f_{ms}, the vibration being damped so that the time required for the amplitude of vibration to decrease by 20 dB is less than 0.5 seconds, in that the gauze can vibrate with a fundamental resonant frequency f_g, in that the ratio of the mass of the suspension member to the mass of the gauze exceeds 30, and in that the frequencies f_{ms} and f_g differ from one another by less than 10%.

The invention is based on the recognition that the introduction of an adapted damped mass-spring system between the gauze and the envelope or collector electrode may be a simple and effective solution substantially to prevent microphony interference. The mass of the gauze, m_2, is small with respect to the mass of the mass-spring system, m_1. The mutual influencing of the two vibrating systems, namely:—

1) the gauze having a mass m_2 and resilient properties (dependent on the gauze tensioning) but substantially without damping, and
2) the damped mass-spring system having a mass m_1 and a damping coefficient k_1'', obtained by a suitable choice of the spring material and the shape and connection of the springs,

is optimum when the two natural frequencies, i.e. the fundamental frequency of the gauze and the fundamental frequency of the mass-spring system, are equal or approximately equal. If then the vibration of the mass m_1 decays as a result of the damping in less than 0.1 sec., the vibration of the mass m_2, that is the gauze, will also decay in less than 0.1 second.

The resilient elements may comprise at least three leaf springs by means of which the ring is secured to the envelope or to a collector electrode of the tube. The mass of the mass-spring system may be formed substantially by the ring alone or by the ring with an extra mass. By choosing springs having suitable damping and adapting the mass, the mass-spring system can be adapted to have a fundamental frequency near the fundamental frequency of the gauze dependent on the dimensions of the tube.

It is alternatively possible to influence the fundamental frequency f_{ms} by using longer or shorter leaf springs, by making the springs thicker or thinner, or by bending the springs; the frequency also depends on the material of the springs.

The tensioning ring usually consists of two parts. It is thus possible to manufacture a part of said tensioning ring and the leaf springs integrally, for example, by punching them from foil.

Embodiments of the invention will now be described by way of example, with reference to a Table showing a number of measured results and to the accompanying diagrammatic drawings, in which:—

Figure 1 shows a model for the mass-spring system with gauze;

Figure 2 is a longitudinal, mainly sectional view of a camera tube embodying the invention;

Figure 3 is a view on the line III—III in Figure 2 (omitting the envelope of the tube);

Figure 4 shows part of the tube of Figure 2 on an enlarged scale, and

Figures 5 to 8 show a number of alternative arrangements for the damped mass-spring system.

Referring to the Table below, the fundamental frequency of the tensioned gauze is denoted by f_{gauze} (in Hz) and the fundamental frequency of the damped mass-spring system is denoted by $f_{mass-spring}$ (in Hz). The time t_u (seconds) for a 20 dB amplitude decrease after a forced vibration level of 1*g* (10m/sec²), which is usual in standard tests of microphony phenomena, is given both for the tensioned gauze alone ($t_{u-gauze}$) and for the tensioned gauze incorporated with a damped mass-spring system ($t_{u-system}$), the mass of which was varied.

TABLE

f_{gauze} (Hz)	$t_{u\text{-}gauze}$ (sec)	$f_{mass\text{-}spring}$ (Hz)	$t_{u\text{-}system}$
2500	9		
2500		3900	5
2500		3450	3.7
2500		3000	2.2
2490		2700	0.5
2480		2500	0.1
2550		2150	0.2

The fundamental frequency of the damped mass-spring system was reduced in discrete steps from 3900 Hz to 2150 Hz by increasing the mass of the tensioning ring in a number of steps. The optimum situation in which the lowest decay time ($t_u = 0.1$ sec.) for an amplitude decrease of 20 dB is obtained is that in which the two frequencies f_{gauze} and $f_{mass-spring}$ are substantially equal. In comparison with the decay time for an amplitude decrease of 20 dB of the gauze alone, namely $t_{u-gauze} = 9$ sec., this is an excellent result. The result becomes even more favourable with a larger damping of the leaf springs which constitute the resilient elements. The remaining values in the Table are included solely for comparison.

Figure 1 is a representation of the double mass-spring system which is formed by the tensioned gauze and the resiliently supported tensioning ring. The mass of the gauze, m_2, in combination with the spring having a spring constant k_2 (which depends on the gauze tension) together determine the fundamental resonant frequency of the gauze. The tensioning ring having a mass substantially equal to m_1 and a spring with a spring constant k_1' determine the fundamental resonant frequency of the damped mass-spring system. For an optimum system it holds that

$$\frac{k_2}{m_2} = \frac{k_1'}{m_1}.$$

The damping constant k_1'' is determined by, for example, the choice of the material, the connection and the shape of the springs of the tensioning ring. The arrows denote the direction of movement of the envelope 1 and the masses m_1 and m_2.

Figure 2 is a mainly sectional view of a television camera tube embodying the invention. A tubular envelope is sealed at one end by a face plate 2 on the inside of which is a radiation-sensitive layer, in this case a photoconductive layer. An electron gun (not shown) is provided in the other end 18 of the envelope. Inside the envelope in front of said photoconductive layer is a metal gauze 5 which is clamped between two parts 4 and 7 of a tensioning ring, part 7 being integral with leaf springs 6 extending radially outwards (see also Figure 3). Said leaf springs are secured to a sleeve 8 and/or a sleeve 9. Sleeve 9 is a push-fit on V-shaped projections on the radially outer side of sleeve 8, and has an inwardly projecting flange 13; by using different sleeves to vary the distance which flange 13 extends over the leaf springs 6, it is possible to adjust the spring constant and the damping of the springs. The sleeve 8 is positioned in the envelope 1 by means of the sleeve 12 which has springs 11 engaging the inner wall of the envelope, the sleeves being mechanically connected but electrically insulated from one another by a ceramic ring 10. The mass m_1 (see Figure 1) is formed substantially by the combined masses of the parts 4 and 7 of the tensioning ring and is resiliently suspended by means of the damped leaf springs 6. The damping factor of the system is determined by the kind of material, the dimensions of the springs 6 and the connection of the springs.

Figure 3 is an end view of the part of a television camera tube where the metal gauze is mounted. The part 7 of the tensioning ring having leaf springs 6 integral therewith may be punched from one piece of metal foil. Figure 4 shows part of Figure 2 on an enlarged scale.

Figures 5 and 6 show how it is possible to make the leaf springs longer by giving them a bent shape.

Figures 7 and 8 show two further ways in which the leaf springs 6 can be secured to the sleeve 8. Figure 7 shows a bent end portion 14 of a leaf spring 6 engaging in an aperture 15 in the sleeve 8; the springs thus clamp around sleeve 8, and are locked by means of a ring 16.

Figure 8 shows a bent leaf spring welded to the outer wall of sleeve 8 by means of spot welds 17.

WHAT WE CLAIM IS:—

1. A television camera tube comprising a substantially cylindrical envelope containing at one end thereof an electron gun opposite to which at the other end of the tube is a face plate having a radiation-sensitive layer, wherein a suspension member which is supported inside the tube by resilient elements comprises a ring in which a metal gauze is mounted adjacent said layer, characterised in that the resilient elements permit the suspension member to undergo damped vibration longitudinally of the envelope with a fundamental resonant frequency f_{ms}, the vibration being damped so that the time required for the amplitude of vibration to decrease by 20 dB is less than 0.5 seconds, in that the gauze can vibrate with a fundamental resonant frequency f_g, in that the ratio of the mass of the suspension member to the mass of the gauze exceeds 30, and in that the frequencies f_{ms} and f_g differ from one another by less than 10%.

2. A television camera tube as claimed in Claim 1, characterised in that the resilient elements comprise at least three leaf springs by means of which the ring is secured to the envelope or to a collector electrode of the tube.

3. A television camera tube as claimed in Claim 2, characterised in that the leaf springs are bent.

4. A television camera tube as claimed in Claim 2 or 3, characterised in that the leaf springs have been formed integrally with at least part of the ring.

5. A television camera tube substantially as herein described with reference to Figure 2 and to Figures 3 and 4 or any of Figures 5 to 8 of the accompanying drawings.

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1586887 COMPLETE SPECIFICATION

3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

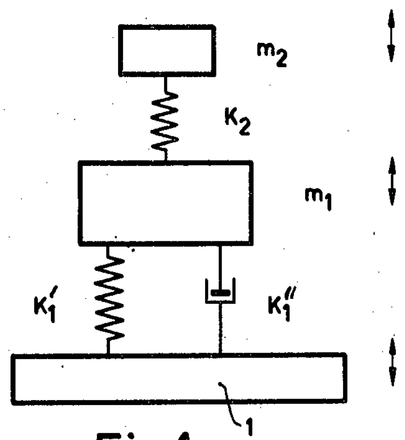

Fig.1

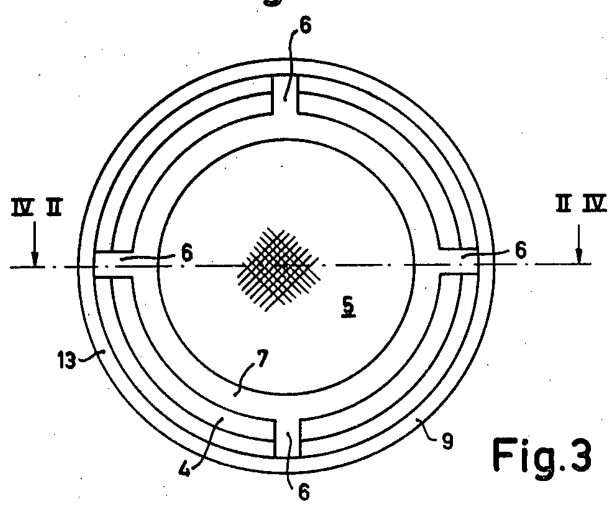

Fig.3

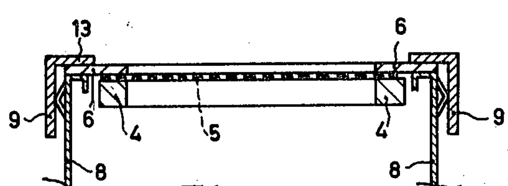

Fig.4

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3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 2

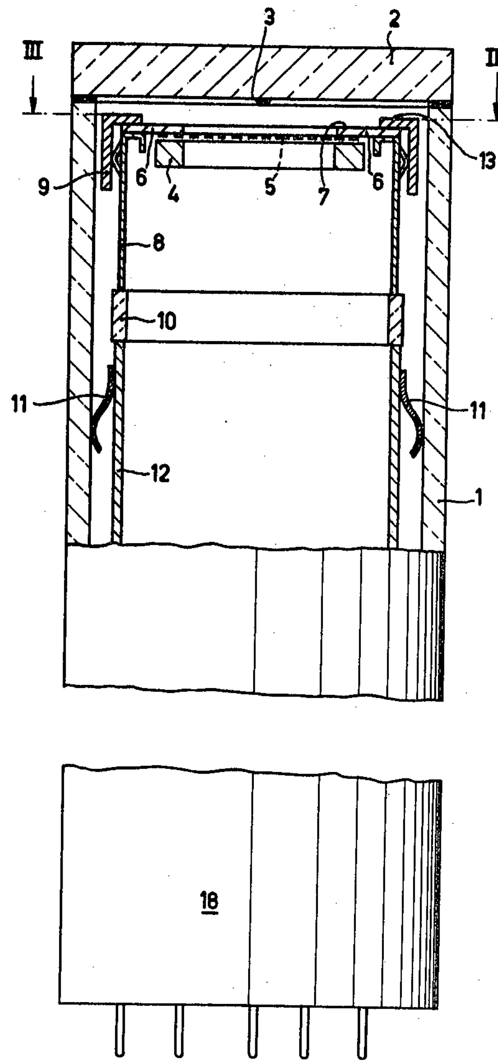

Fig. 2

1586887 COMPLETE SPECIFICATION

3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 3

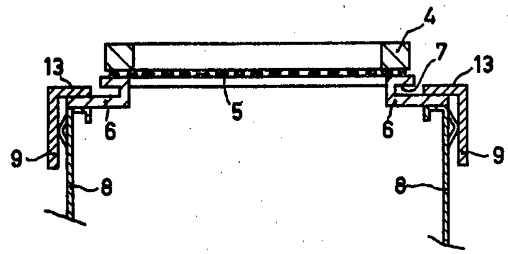

Fig. 5

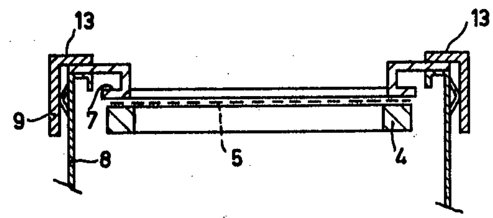

Fig. 6

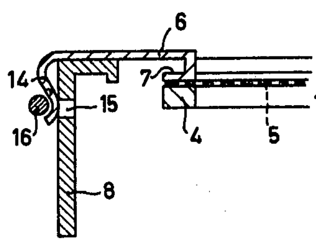

Fig. 7

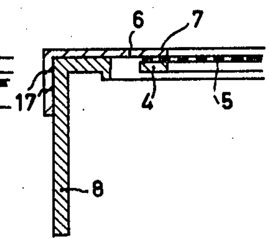

Fig. 8