

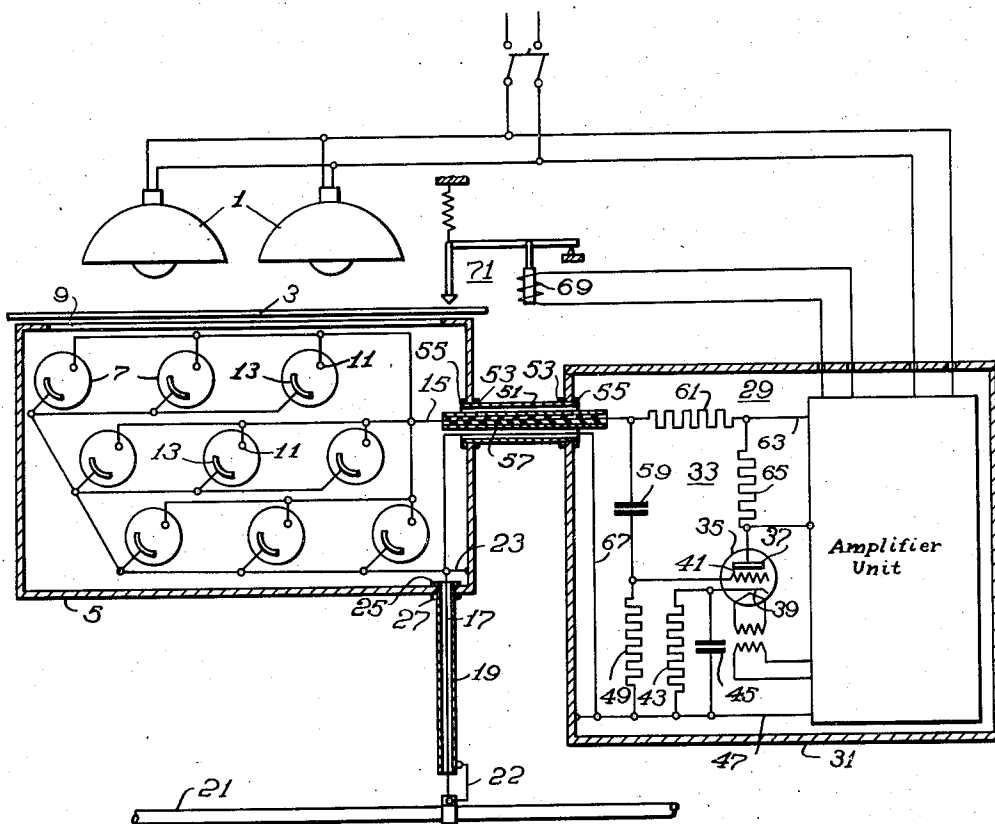
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2,193,590

ANTIMICROPHONIC PHOTOTUBE CIRCUIT

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ANTIMICROPHONIC PHOTOTUBE CIRCUIT

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5 Claims. (Cl. 250—41.5)

My invention relates to photosensitive apparatus and has particular relation to classifying apparatus used in connection with the manufacture of sheet metal in the steel industry.

5 The present invention is an outgrowth of experimental work which I have carried out in providing an arrangement for detecting small holes in sheet steel or the like. The photosensitive apparatus which is used in this work must be
10 highly sensitive, as the holes to be detected are of small dimensions, and the sheet moves at a high speed which may be of the order of 800 feet per minute or more. Moreover, the photoelectric equipment must necessarily be installed very
15 close to the sheet as it leaves a rolling mill, and, therefore, it is subjected to the mechanical vibrations engendered by steel mill operations.

In working with apparatus for detecting holes in sheet metal provided in accordance with the
20 teachings of the prior art of which I am aware, I found that substantial irregular errors in the operation are often present. An analysis of the source of these errors reveals that they arise principally from the mechanical and sonic vibrations in the region of the rolling mill. Ap-
25 parently the mechanical vibrations and the sounds cause the photosensitive tubes used in the apparatus and their component elements to vibrate. The vibration of the electrodes of the
30 photosensitive tubes, which are mounted in a relatively small metallic container, produces variations in the capacity to ground of the electrodes. A substantial number of photocells are customarily used to cover the total area of the
35 sheet to be scanned. The capacity to ground is, therefore, considerable because the cathode area is large and the variations introduced in the capacity by the vibrations are appreciable. To further aggravate this situation, the spurious variations are impressed on the multi-stage amplifier,
40 which of necessity must be used to attain the desired sensitivity, and as a result large irregular errors are produced.

It is, accordingly, an object of my invention to
45 provide a photosensitive arrangement of high sensitivity that shall operate with consistency for use in a region in which there are substantial sonic vibrations.

Another object of my invention is to provide
50 photosensitive apparatus of high sensitivity which shall not operate erratically when subjected to vibrations.

More specifically stated, it is an object of my
55 invention to provide a photosensitive arrange-

ment of high sensitivity for detecting small holes in rapidly moving sheet metal.

In the practice of my invention, radiant energy of substantial intensity is projected through
any holes existing in the sheet metal and im-
pings on one or more of a plurality of photo-
electric cells connected in parallel. The number
of such cells depends in general on the width of
the sheet. In a particular installation, my in-
vention was used to detect holes in sheet metal
36 inches wide, and for this purpose nine photo-
electric cells of the usual structure were con-
nected in parallel. The anodes of the photoelec-
tric cells are coupled through a capacitor to the
control electrode of the first valve of the multi-
stage amplifier that is used in the practice of
my invention to attain the desired sensitivity.
The cathodes of the photoelectric cells are con-
nected to ground by a wire which is itself en-
closed in a tubular conductor also at ground po-
tential. The photoelectric cells are disposed in
a container to which the conductor is secured
and which is thus also maintained at ground po-
tential. The amplifier is enclosed in a grounded
container, and the cathode of the first and other
valves in the various stages of amplification are
connected to the container.

The novel features that I consider character-
istic of my invention are set forth with particu-
larity in the appended claims. The invention it-
self, however, both as to its organization and its
method of operation, together with additional
objects and advantages thereof, will best be un-
derstood from the following description of a spe-
cific embodiment when read in connection with
the accompanying drawing, in which the single
figure is a diagrammatic view showing a pre-
ferred embodiment of my invention.

The apparatus shown in the drawing comprises
a pair of sources of radiant energy 1, which may
be ordinary incandescent lamps, and which pro-
ject radiations on the surface of the sheet metal
3 that is under observation. The metal is pro-
jected in a direction perpendicular to the draw-
ing. It may be moving out of a rolling mill to
a storage reel, or it may be moving from a storage
reel to a take-up reel. In any case, the sheet
moves at a high speed, and there is considerable
mechanical vibration and noise in the vicinity in
which the observations are being made.

Directly under the sheet 3 a conducting box 5
containing a plurality of parallel connected
photoelectric cells 7 is disposed. The cells 7 are
arranged staggered in rows under a slot 9 in the
top of the box over which the sheet 3 passes in

such manner that as the sheet moves its whole area is scanned by the cells.

Each of the cells 7 has an anode 11 and a cathode 13. The anodes of the cells are connected together to a common wire 15 and the cathodes are connected to another wire 17. The wire 17 passes through a conducting tube 19 projecting from the base of the box 5 and is conductively secured to a water pipe 21, or a similar conductor, which serves for grounding purposes. The tube 19 is also grounded to the pipe 21 by a wire 22. Another wire 23 extends from the wire 17 and is connected to the right wall of the box 5. The tube 19 through which the grounding wire 17 extends is provided with a flange 25 at its upper end which engages the box 5. The flange is held in intimate engagement with the inner surface of the box by a nut 27, which is tightly screwed on the tube 19.

The output of the photoelectric cells 7 is impressed on a multi-stage amplifier 29 disposed within another metallic box 31. Only one stage 33 of the amplifier is shown in detail. The others are all of the usual structure coupled to each other and the first stage in the customary manner.

The first amplifier stage comprises a valve 35, preferably of the high vacuum type, having an anode 37, a cathode 39 and a control electrode 41. A network consisting of a resistor 43 and a capacitor 45 in parallel connect the cathode 39 to an output wire 47. The return wire 47 is connected directly to the left wall of the container 31 and to the control electrode 41 through another resistor 49. The resistor and capacitor network provide the usual self-bias for the valve 35.

A metallic conductor 51 provided with flanges 53 at its ends interconnects the boxes 5 and 31. Each of the flanges 53 is brought into intimate engagement with its adjacent wall by an associated nut 55 which is screwed on the conductor. The wire 15 to which the anodes 11 of the photoelectric cells 7 are connected extends through an insulating tube 57 disposed within the conductor 51 between the two boxes. When the amplifier box 31 is connected to the junction point of a coupling capacitor 59 and a resistor 61 which is in turn connected to the positive anode supply conductor 63, the coupling capacitor 59 is at its other terminal connected to the control electrode 41. The anode 37 of the valve 35 is connected through a resistor 65 to the output conductor 61. A wire 67 passing through the tube 35 through which the boxes 5 and 31 communicate, connects the output conductor 31 on the cathode side to the grounded wire 17. The boxes 5 and 31 are thus completely grounded.

The output of the multi-stage amplifier 29 supplies a solenoid 69 whereby a marking device 71 is actuated. When the sheet metal is perforated, radiant energy penetrates to one or the other of the photo-electric cells 7, and current is supplied from the amplifier 29 to the solenoid 69. The marking device 71 is then actuated and indicates the presence of the hole. Because of the complete grounding of the containers 5 and 31 and the cathodes 13 erratic operation by reason of vibration of the cells 7 or their electrodes 11 and 13 is prevented.

Although I have shown and described certain specific embodiments of my invention, I am fully aware that many modifications thereof are possible. My invention, therefore, is not to be restricted except insofar as is necessitated by the

prior art and by the spirit of the appended claims.

I claim as my invention:

1. For use in an establishment, such as a steel mill, in which mechanical and sonic vibrations of substantial amplitude are present, the combination comprising a plurality of photosensitive devices each having an anode and a cathode, amplifying means for said devices including an electric discharge valve having a control electrode, the factor of amplification of said means being such that substantial errors would be produced in the output thereof by reason of the effect of the mechanical and sonic vibrations on said photosensitive devices, means including a capacitor for coupling said anodes to said control electrode, and means for connecting said cathodes to ground.

2. For use in an establishment, such as a steel mill, in which mechanical and sonic vibrations of substantial amplitude are present, the combination comprising a plurality of photosensitive devices each having an anode and a cathode, amplifying means for said devices including an electric discharge valve having a control electrode, the factor of amplification of said means being such that substantial errors would be present in the output thereof by reason of the effect of the mechanical and sonic vibrations on said photosensitive devices, means including a capacitor for coupling said anodes to said control electrode, and means for connecting said cathodes to ground, said connecting means including a wire which is connected directly to ground and a conducting shield enclosing said wire which is also connected to ground.

3. For use in an establishment, such as a steel mill, in which mechanical or sonic vibrations of substantial amplitude are present, the combination comprising a plurality of photosensitive devices each having an anode and a cathode, multi-stage amplifying means for said devices including an electric discharge valve having a control electrode, the factor of amplification of said means being such that substantial errors would be present in the output thereof by reason of the effect of the sonic vibrations on said photosensitive devices, means including a capacitor for coupling said anodes to said control electrode, and means for connecting said cathodes to ground, said connecting means including a wire which is connected directly to ground and a conducting shield enclosing said wire which is also connected to ground.

4. For use in an establishment, such as a steel mill, in which sonic vibrations of substantial amplitude are present, the combination comprising a plurality of photosensitive devices each having an anode and a cathode, multi-stage amplifying means for said devices including an electric discharge valve having a control electrode and a principal electrode, the factor of amplification of said means being such that substantial errors would be present in the output thereof by reason of the effect of the sonic vibrations on said photosensitive devices, means including a capacitor for coupling said anodes to said control electrode, means for connecting said principal electrode to ground, and means for connecting said cathodes to ground, said connecting means including a wire which is connected directly to ground and a conducting shield enclosing said wire which is also connected to ground.

5. For use in an establishment, such as a steel

mill, in which sonic vibrations of substantial amplitude are present, the combination comprising a plurality of photosensitive devices each having an anode and a cathode disposed within
5 a conducting container, multi-stage amplifying means for said devices disposed within another conducting container and including an electric discharge valve having a control electrode and a principal electrode, the factor of amplification
10 of said means being such that substantial errors would be present in the output thereof by reason of the effect of the sonic vibrations on said photosensitive devices, means including a capacitor in said other container and a wire passing
between said containers for coupling said anodes to said control electrode, said wire passing through a conducting tube interconnecting said containers and being insulated therefrom, means
for connecting said principal electrode to the 5 wall of said other container, means for connecting said cathodes to said first-mentioned container, and means for connecting said cathodes to ground, said connecting means including an-
other wire which is connected directly to ground 10 and a conducting shield enclosing said wire which is conductively secured to said first-mentioned container.

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