

P E T I T I O N

TO THE COMMISSIONER OF PATENTS:

Your petitioner William F. Friedman and J. O. Mauborgne citizens of the United States residing at 3932 Mil. Rd. and #1 Alston Court in the ~~XXXXXX~~ XX Dist. Columbia-County, Mon. and ~~State~~ City, Washington, Red Bank, N.J and whose post-office address 3932 Mil. Rd. Washington, D. C. and No. 1 Alston Court Red Bank, New Jersey, respectively pray that Letters Patent may be granted to them without payment of fee, pursuant to the provisions of the Act of March 3, 1883, c. 143; U. S. Statutes, XXII, p. 625, as amended by the Act of April 30, 1928, for the improvement in System for Enciphering Facsimile set forth in the annexed Specification.

And they hereby irrevocably give control of their application for Letters Patent to the Secretary of War, and appoint William D. Hall whose post-office address is care of the Chief Signal Officer, Munitions Building, Washington, D. C., attorney with full power of substitution and revocation to prosecute this application, to make alterations and amendments therein, to sign their name to the drawings, to receive the Letters Patent, and to transact all business in the United States Patent Office connected therewith.

Signed at _____ in the County of _____ and State of _____ this _____ day of _____ 1943

(Sign here, _____
(first name in full) _____

S P E C I F I C A T I O N

TO ALL WHOM IT MAY CONCERN:

LET KNOWN, That William F. Friedman and J. O. Mauborgne are citizens of the United States residing at 3932 Mil. Rd. & #1 Alston Court in the District of Columbia County Monmouth State: New Jersey City Washington Red Bank have invented certain new and useful improvements in System for Enciphering Facsimile

of which the following is a specification:

The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to ~~me~~ ^{us} of any royalty thereon.

This invention relates to a system for secretly communicating by means of facsimile transmission.

In other words, by means of my invention, a message in written, printed or picture form is transmitted, under the control of a screen or camouflage element, to another station at which the transmission is received and reproduced under the control of a duplicate of said screen or camouflage element. These screens or camouflage elements interrupt the transmission in an irregular or heterogeneous manner which renders interception of the transmission by unauthorized persons difficult, if not indeed impossible.

More specifically, it is an object of my invention to provide a facsimile transmission system having a transmitting means provided with a balanced bridge circuit. The message to be transmitted causes variations in the flow of electricity in one branch of this bridge circuit. Any arbitrarily selected screen or control element causes variations in another branch of this bridge circuit. These two branches are connected together so that equal and opposite potentials are established across the circuit of an electric lamp whose output therefore varies whenever the voltages of these two branches are not substantially equal. A transmitter is mounted under the control of the output from said lamp. At the place to which it is desired to transmit the intelligence, a reception means is located, provided with a second balanced bridge circuit. A receiver in communication with said transmitter causes variations in the flow of electricity in one branch of the second bridge circuit. A duplicate of said screen or control element causes variations in another branch of this second bridge circuit. These two branches of this second bridge circuit are connected together

so that equal and opposite potentials are established across
30 the circuits of an output electric lamp whose output therefore
varies whenever the output voltages of these branches of this
second bridge circuit are not substantially equal. A light-
sensitive element, such as a photographic film or the like,
is located so as to receive and record the variations in the
35 output of said output electric lamp in the form of a facsimile
of the original message.

For a further description of my invention reference
may be had to the annexed drawings and specification, at the
end whereof the novel features of my invention will be specifi-
40 cally pointed out and claimed.

In the drawings, Figures 1 and 2 are circuit diagrams
with parts shown as blocks and designated with appropriate labels.

In that embodiment of my invention selected from
among others for illustration in the drawings and description
45 in the specification, my device is shown as comprising an
electric lamp 1 which serves as a source of light, the light
being concentrated by means of lens 2 upon the message sheet 3,
which is to be transmitted. This message may be in an opaque
form, such as on a sheet of paper, to reflect the light falling
50 thereon, or in a transparent form, such as a film, to allow the
light to pass therethrough. In either event, the reflected or
transmitted beam of light, varied in accordance with the white and
black portions of the message, falls on a light-sensitive cell
4, such as a photo-electric cell. Cell 4 is connected as part
55 of an amplifying circuit, generally indicated by block 5 since
any well-known type of amplifying circuit may be employed.

A second electric lamp 6 forms a second source of
light formed by a lens 7 into a beam directed upon a screen or
control sheet or element 8, which may be any arbitrarily selected pattern

60 having relatively light and dark portions, such as a writing,
print, drawing or random arrangement of dots.

65 Relative motion is provided between lamp 1 and message
3 and between lamp 5 and control 8 so that the beam emitted
by each of said lamps falls upon and scans the message and
the control, respectively, in a manner well-known in the art
of facsimile transmission.

The beam of light varied by control element 8 falls
on a second light-sensitive cell connected as part of an am-
plifying circuit identified by the general reference character 10.

70 The outputs of the amplifying circuits 5 and 10 are
oppositely connected as the arms or branches 11 and 12 of a
balanced bridge circuit having a diagonal or cross wire 13
connected to the terminals of a third electric lamp 14.. Am-
plifying circuits 5 and 10 have as their output a pulsating
75 direct current of constant polarity and are connected so that
equal and opposite potentials are established across lamp 14
by the signals transmitted under the control of message 3 and
control 8. Lamp 14 is sensitized by a local battery 15 regulated
by adjustable resistor 16.

80 Lens 17 concentrates the light from lamp 14 into a
beam directed upon a third light-sensitive cell 18 forming part
of a circuit including an amplifier 19, a transmitter 20, and
an output element, such as an antenna 21, as shown, or the
terminals of a wire transmission system.

85 At the location or place at which the message is to
be received, there is provided a receiving member, such as
antenna 22, as shown, or the opposite terminals of the wire
transmission system. A receiver 23 with an amplifier has its
output connected to a lamp 24 which is energized by a local
battery 25. Lens 26 concentrates the light from lamp 24 upon

15

90 light-sensitive cell 27 forming part of a circuit including a
third amplifier 27.

An electric lamp 28 emits light which is beamed by
lens 29 onto a screen or control element 30 which is a duplicate
95 of control 8. Relative movement is provided between lamp 28
and duplicate control 30 so that exact synchronism is maintained
between the scanning of controls 8 and 30. The light from source
28, reflected or transmitted by duplicate control 30, is passed
to light-sensitive cell 31 forming a part of a circuit which
100 also includes an amplifier 32. The output circuits 33 and 34
of amplifier circuits 27 and 32 are connected as arms or branches
of a second balanced bridge circuit having a diagonal or cross-
wire 35 which connects to the terminals of a third output electric
lamp 36 energized by local battery 37 under the control of ad-
105 justable resistor 38. The light output of lamp 36 is collected
by lens 39 and falls in a beam on recorder 40 which may be any
light-sensitive device such as a photographic plate or film.
Relative movement is maintained between lamp 36 and recorder 40
in exact synchronism with the relative movement between lamp 1
110 and message 3 so that recorder 40 reproduces identically the
message 3 as varied by controls 8 and 30.

The operation of my device is as follows: Message 3
is scanned by the beam of light from lamp 1 and produces variations
in this beam depending upon whether or not the portion of the
115 message which intercepts the beam is black or white. These
variations are transmitted by cell 4 and amplified in circuit 5.
Control 8 varies the beam of light from source 6 and affects
cell 9 and circuit 10 in the same way. Since the output voltages
of circuits 5 and 10 are balanced against each other there is no
120 change in the output of lamp 14 unless there is a difference be-
tween these output voltages in the arm or branch circuits 11 and

12 In other words of the four possible conditions of message
3 and control 8 two conditions cause a variation in the output
of lamp 14 and two conditions cause no variation in the output
125 of lamp 14 The conditions which cause a variation are when
the spot of message 3 on which the beam of light falls is black
or white and the simultaneously exposed spot of control 8 is
the reverse The conditions which cause no variation are when
the simultaneously exposed spots of message 3 and control 8 are
130 of the same hue The variations in the intensity of the light
emitted by lamp 14 cause pulses or oscillations in the circuit
containing amplifier 19 and transmitter 20 These pulses or
oscillations are sent to receiver 25 where they cause corres-
ponding variations in the light emitted by output lamp 4 and
135 therefore in the output of the circuit containing the third
amplifier 27 Simultaneously with the scanning of control 8
duplicate control 30 causes variations of the beam of light
from source 28 which variations actuate cell 31 and appear in
the output circuit 34 of the circuit containing the fourth
140 amplifier 32 Lamp 36 is mounted across the output circuits
33 and 34 of the circuits containing third amplifier 47 and
fourth amplifier 3 respectively Because the voltages of
output circuits 33 and 34 are equal and opposed the light
emitted by lamp 36 only varies when two of the four possible
145 conditions exist That is to say when there is present in
output circuit 33 a pulse corresponding to either a black or a
white spot in the original message 3 and there is simultaneously
present in output circuit 34 a pulse corresponding to a spot of
the opposite hue in the duplicate control 30 a variation in the
150 light output of lamp 36 occurs Conversely when the simultaneous
impulses present in the output circuits 33 and 34 correspond to
spots of like hue in message 3 and duplicate control 30 no

variation happens in the output of output lamp 36. These
variations of the output of the light from lamp 36 sensitise
155 the photographic element 40, spot by spot as the element is
scanned, and thus reproduce the original message 3.

We do not intend to be limited save as the scope of the attached claims may require.

We claim:

1. Means for secretly transmitting pictorial information, said means comprising, a scanner arranged to scan and reproduce a pictorial message as a series of electric impulses of varying intensity, a screen having varying portions, a second scanner
5 arranged to scan and reproduce the variations of said screen as a second series of electric impulses of varying intensity, an electric light connected across the output circuits of said scanners so that its output varies in intensity when the potentials across said output circuits are not equal, a photo-electric
10 cell mounted so as to vary in response to the output of said light, a transmitter connected to emit signals in accordance with the variations of said photo-electric cell, a receiver arranged to receive the signals emitted by said transmitter and having an output potential varying in accordance with said signals,
15 a second screen duplicating said first mentioned screen, a second receiver having an output potential varying under the control of said second screen, another electric light connected across the output circuits of said receivers so that its output varies in intensity when the potentials across said output circuits are
20 not equal, and a light-sensitive element mounted so as to be scanned and to record the variations in intensity of said other light and to thereby receive the message.

2. Means for secretly transmitting pictorial information, said means comprising, a scanner arranged to scan and reproduce a pictorial message as a series of electric impulses of varying intensity, a screen having varying portions, a second scanner
5 arranged to scan and reproduce the variations of said screen

as a second series of electric impulses of varying intensity,
an electric light connected across the output circuits of said
scanners so that its output varies in intensity when the po-
tentials across said output circuits are not equal, a photo-
10 electric cell mounted so as to vary in response to the output
of said light, a transmitter connected to emit signals in accord-
ance with the variations of said photo-electric cell, a receiver
arranged to receive the signals emitted by said transmitter,
a second electric light connected to said receiver so that its
15 output varies in intensity in accordance with the signals re-
ceived by said receiver, an amplifier circuit including a
second photo-electric cell mounted so as to vary in response to
the output potential varying in accordance with said signals,
a second screen duplicating said first mentioned screen, a
20 second receiver having an output potential varying under the
control of said second screen, a third electric light connected
across the output circuits of said receivers so that its output
varies in intensity when the potentials across said output circuits
are not equal, and a light-sensitive element mounted so as to
25 record the variations in intensity of said third light and to
thereby receive the message.

3. A transmitting and receiving system for secretly
communicating messages in pictured form in which there is pro-
vided, a first electric circuit constructed so as to emit a
direct current voltage which varies in response to the variations
5 in light transmission of a sheet on which the message is, a
control element having portions of varying light transmitting
characteristics, a second electric circuit constructed so as to
emit a direct current voltage which varies in response to the
variations in light transmission of said control element, a
10 transmitter mounted under the control of said circuits so

that the transmitter only emits a signal when the output
voltage of one of said circuits differs from that of the other,
a receiver tuned to respond to signals emitted by said trans-
mitter and to provide an output varying with said signals, *
15 second control element substantially identical to the first
mentioned control element, a third electric circuit constructed
so as to emit a direct current voltage which varies in response
to the variations in light transmission of said second control
element, a light emitter mounted under the control of said
20 receiver and of said third electric circuit and arranged so
that the light emitted thereby varies only when the voltage
output of said receiver differs from that of said third circuit,
and a recording device located so as to record the variations
of the light emitted by said emitter and thus to reproduce the
25 message.

4. In a secret communication system by means of facsimile transmission, a balanced bridge circuit having an output element supplying an output varying in response to the output of an amplifying circuit controlled by the message to be sent and to the output of a second amplifying circuit controlled by a screen, the outputs of said amplifying circuits being balanced against each other so that there is no output from said bridge circuit except when there is a difference between the outputs of said amplifying circuits, a transmitter having an output element supplying an output varying in response to the output from said bridge circuit, a second balanced bridge circuit having an output element supplying an output varying in response to the output of a third amplifying circuit controlled by a receiver controlled in turn by the receipt of the output from said transmitter and to the output of a fourth amplifying circuit controlled by a duplicate of said screen, the outputs of said third and fourth amplifying circuits, being balanced against each other so that there is no output from said second bridge circuit except when there is a difference between the outputs of said third and fourth amplifying circuits, and a recorder responsive to the output of said second bridge circuit to furnish a facsimile of said message.

5. A system for secret communication comprising, a source arranged to emit a beam of light, a message located so as to vary said beam of light from said source, a light-sensitive cell arranged to receive said beam of light from said source as varied by said message, an amplifying circuit including said cell, a second source arranged to emit a beam of light, a screen located so as to vary said beam of light from said second source, a second light-sensitive cell arranged to receive said beam of light from said second source as varied by said screen, a second amplifying circuit including said second cell, a lamp connected across the outputs of said amplifying circuits so that the light emitted thereby varies when there is a difference between the outputs of said amplifying circuits, a third light-sensitive cell arranged to receive light from said lamp and to cause variations in consonance with the variations in said light, a transmitter connected in circuit under the control of said third cell so as to vary its transmission in consonance with the variations effected by said third cell, a receiver in communication with said transmitter, a second lamp connected to vary in consonance with the variations in output of said receiver, a fourth light-sensitive cell arranged to receive light from said second lamp, a third amplifying circuit including said fourth cell, a third source arranged to emit a beam of light, a duplicate screen located so as to vary said beam of light from said third source as varied by said duplicate screen, a fourth amplifying circuit including said fourth cell, a third lamp connected across the outputs of said third and fourth amplifying circuits so that the light emitted thereby varies when there is a difference between the outputs of said third and fourth amplifying circuits, and a light-sensitive device arranged to receive light from said third lamp and to record the variations of said light in the form of the original message.

IN TESTIMONY WHEREOF they affix their signature^s

(Sign here; first name in full.)

O A T H

_____) : ss

William F. Friedman and J. O. Mauborgne

the above-named petitioner^s, being duly sworn, depose and say that they are
citizen^s of the United States of America
and resident^s of 3932 Military Rd., Washington, D. C. and No. 1 Alston Court, Red Bank,
New Jersey.
that they verily believe themselves to be the original, first, and joint
inventor^s of the improvement in System for Enciphering Facsimile

described and claimed in the annexed specification; that they do not know and do
not believe that the same was ever known or used before their invention or discovery
thereof or patented or described in any printed publication in any country before their
invention or discovery thereof, or more than one year prior to this application, or in
public use or on sale in the United States for more than one year prior to this
application; that said invention has not been patented in any country foreign to the
United States on an application filed by them or their legal representatives
or assigns more than twelve months prior to this application; and that no application
for patent or said improvement has been filed by them or their representatives
or assigns in any country foreign to the United States, ~~except as follows:~~

(Sign here, first name in full)

SWORN to and subscribed before me this _____ day of _____, 1945

Notary Public

(Seal here, to be impressed
in paper.)

L I C E N S E

WHEREAS, we, William F. Friedman and J. O. Mauborgne, are employees of the Government of the United States of America, and

WHEREAS, in pursuance of said employment the undersigned ^{have} ~~was~~ invented certain improvements in System for Enciphering Facsimile

for which the undersigned ^{are} ~~is~~ about to make application for Letters Patent of the United States; and

WHEREAS, the nature of ^{our} ~~my~~ employment, and the conditions and circumstances under which said invention was made, are such as to justly and lawfully entitle the Government of the United States of America to have a non-exclusive license and right to make and use said invention, together with any and all improvements thereon and inventions relating thereto that the undersigned ^{have} ~~was~~ made or may hereafter make while employed and engaged by the United States Government;

NOW, THEREFORE, in consideration of the premises the undersigned ~~was~~ hereby give and grant unto the Government of the United States of America a non-exclusive license to make, to have made, to use and/or to sell, said invention as described in the specification executed by the undersigned on even date herewith, said non-exclusive license to extend to any and all Letters Patent which may be granted for said invention, (including all divisions, reissues, continuations, and extensions thereof) together with any and all improvements thereon and inventions relating thereto made by the undersigned while employed or engaged by the United States Government, or for which the undersigned may hereafter make application for Letters Patent while employed or engaged by the United States Government, reserving to the undersigned in each case the unrestricted possession of all other patent rights not hereby or otherwise licensed to the Government of the United States of America. Said license hereby granted or agreed to be granted shall extend throughout the United States, its territories and dependencies, and all foreign countries and shall continue in force for the full term for which said Letters Patent may be granted.

SIGNED at _____, State of _____

this _____ day of _____, 19 45

Witnesses:

Signed:

A S S I G N M E N T

WHEREAS, We, William F. Friedman and J. O. Mauborgne,
of 2032 Military Road, Washington, D.C., and No. 1 Alston Court, Red Bank, N.J.,
respectively, have invented certain improvements in
System for Enciphering Facsimile
for which the undersigned on even date herewith
executed an application for Letters Patent of the United States; and

WHEREAS, the invention was made while the undersigned ~~was~~ ^{were} in the employ
of the War Department, and pertains to a device useful in the National De-
fense, and

WHEREAS, The Government of the United States is desirous of acquiring
the entire right, title, and interest in and to the said invention and in
and to any patents that may issue thereon.

NOW, THEREFORE, in consideration of the premises and one dollar (\$1.00),
the receipt of which is hereby acknowledged, the undersigned have sold, as-
signed, and transferred, and by these presents do hereby sell, assign and
transfer unto the Government of the United States of America, as represented
by the Secretary of War, the entire right, title and interest, throughout
the United States of America, and the territories and dependencies thereof,
and not elsewhere, in and to the said invention and to the invention as de-
scribed in the specification executed by the undersigned on even date
herewith, preparatory to obtaining Letters Pat-
ent in the United States therefor, and to all Letters Patent issuing there-
on and any continuations, divisions, renewals, and reissues or extensions
of such Letters Patent; the said entire right, title and interest as well as
the control of the prosecution of the application and all continuations, re-
issues and divisions thereof to be held by the Government of the United
States of America (as represented by the Secretary of War) and all Letters
Patent including any divisions, reissues, renewals or extensions thereof
as there are or that may be granted, to be held by the Government as fully
and entirely as the same would have been held by me had this assignment and
sale not been made. The undersigned hereby gives the Government of the
United States of America the non-exclusive right to make, use, or sell the
invention for governmental purposes in all foreign countries.

Provided, however, that upon any subsequent notice of allowance of said
application or of any renewals, substitutions, divisions, continuations, or
continuations-in-part being given by the Commissioner of Patents, the entire
right, title, and interest in and to said invention and said application or
any renewals, substitutions, divisions, continuations, or continuations-in-
part, and such patents as may be issued thereon, will thereupon revert to

themselves
subject to an irrevocable, non-exclusive, and royalty-free right and license
remaining vested in the United States of America as represented by the
Secretary of War, to make, have made, to use, and to sell the subject matter
of said invention for governmental purposes only, to the full end of the
term or terms for which any Letters Patent, divisions, reissues, renewals,
extensions, continuations or continuations-in-part are or may be granted.

Witness

Before me, a notary public in and for the _____
appeared the above-named _____
_____, personally known to me, who
in my presence executed the foregoing assignment and acknowledged that his
execution thereof was his free act and deed.

Signed _____ this _____ day of _____

(Seal)

Notary Public

FIG. 1.

MESSAGE

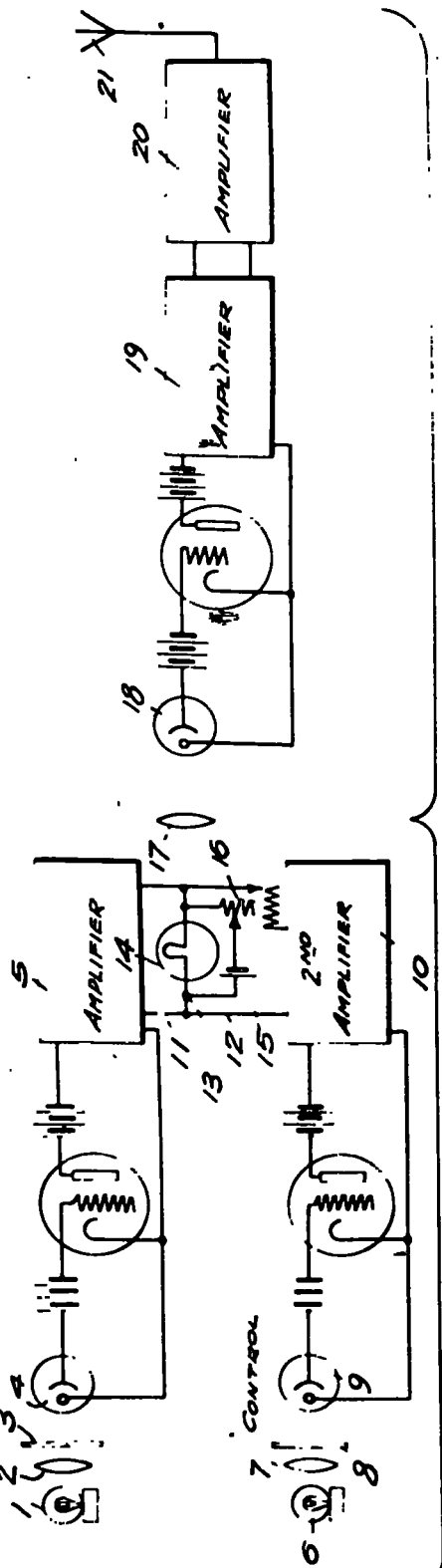
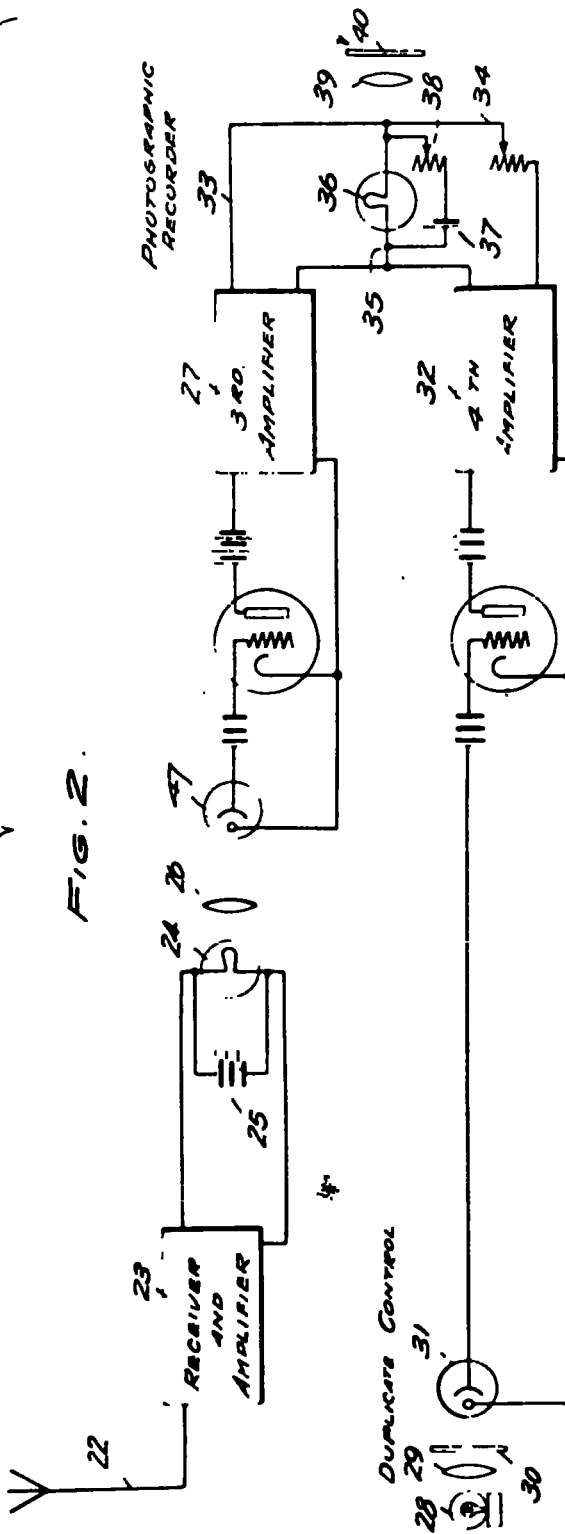


FIG. 2.



INVENTORS
 WILLIAM F. FRIEDMAN
 JOSEPH O. MAUBORGNE

BY *William D. Hall*
 ATTORNEY