

P E T I T I O N

TO THE COMMISSIONER OF PATENTS:

Your petitioner William F. Friedman, a
 citizen of the United States residing at 3932 Military Road, N.W.
 in the ~~Government~~ District of Columbia ~~suburb~~ City of Washington
 and whose post-office address 3932 Military Road, N.W., Washington, D. C.

pray a that Letters Patent may be
 granted to him without payment of fee, pursuant to the provisions
 of the Act of March 3, 1883, c. 143; U. S. Statutes, 1883, 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 he hereby irrevocably gives a control of his application
 for Letters Patent to the Secretary of War, and appoints William D. Hall,
 whose post-office address is care of the Chief Signal Officer, ~~Washington~~ Pentagon
 Building, Washington, D. C., attorney with full power of substitution and
 revocation to prosecute this application, to make alterations and amendments
 therein, to sign his 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 _____ 19 45

(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:

BE IT KNOWN, That William F. Friedman is a citizen
 of the United States residing at 3932 Military Rd. in the ~~District~~ City of Washington
 and ~~District~~ District of Columbia ^s has invented certain new and useful improve-
 ments 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 of any royalty
 thereon.

The subject matter of this invention is a system for enciphering facsimilies.

This invention relates to means for secretly communicating information by transmitting a facsimile of the message in a graphic form of any sort such as a writing, type-writing, picture, photograph or the like. Secrecy is obtained by transmitting a series of impulses caused in part by the message to be transmitted and in part by a control in graphic form such as any writing, picture or random arrangement of dots or lines. Such a control does not necessarily have any intelligibility in itself. It operates as a random key. At the receiving end, a duplicate of this control is employed. This duplicate control is moved in synchronism with the movements of the control at the transmitting end and causes a series of impulses which co-operate with the impulses received from the transmitter, the interaction between the two series of impulses serving to produce a facsimile of the original message.

It is an object, therefore, of my invention to provide apparatus comprising a transmission system including a transmitter section and a receiver section. Each of said sections has, as a part thereof, an electric circuit including the contacts of a plurality of relays interconnected in such a way as to cause a plurality of impulses to circulate in said circuit. In the transmitter section these impulses represent the combined effects due to the message to be transmitted and to a control element. An impulse can only occur in this circuit when both of the relays have not moved their contacts to the same position. In the receiver section these impulses represent those

caused by the original message, since the impulses due to the control have been removed by the use of a duplicate of the control in the receiver section.

For a further exposition 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 specifically pointed out and claimed.

In the drawings

Figure 1 is a circuit diagram of the transmitter with parts designated by blocks bearing appropriate labels.

Figure 2 is a tabulation illustrating the impulses comprising the intelligence transmitted.

Figure 3 is a circuit diagram of the receiver in block form.

In the one embodiment of my invention which has been selected from among others, my device is shown as comprising a transmitter section having a motor 1 driving shaft 2 carrying transparent drum 3 surrounded by message sheet 4 and also carrying transparent drum 5 surrounded by control sheet 6. Within drums 3 and 5 are located electric lamps 7 and 8 which serve as sources of light and which are energized from a source of electricity 9. Opposite lamps 7 and 8 so as to receive a beam of light therefrom and, respectively, under the control of message sheet 4 and control sheet 6, are located light-sensitive cells 10 and 11 which form parts of circuits including amplifiers 12 and 13 and relay coils 14 and 15. These relays also include movable contacts 16 and 17 biased in one direction by springs 18 and 19 and, in the other direction, by coils 14 and 16, respectively, when these coils are energized, and engaging one or the other of stationary contacts 20 and 21. Contacts 16, 17, 20 and 21 form parts of a circuit, including a source of current 22 and relay coil 23, which, when

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energized, attracts movable contact 24 into engagement with stationary contact 25, overcoming the pull of spring 26. Contacts 24 and 25 control a circuit including transmitter 27 having an output element 28, shown as an antenna.

At the place to which it is desired to transmit the intelligence, there is located a receiving system having a receiving element, indicated as an antenna 29, forming part of receiver 30 which is connected into circuit so as to control relay coil 31. This relay also includes movable contact 32 stressed away from coil 31 by spring 33 and co-operating with stationary contacts 34. Motor 35 drives shaft 36 carrying transparent drum 37 surrounded by second control sheet 38, which is a duplicate of control sheet 6. Within drum 37 is located electric lamp 39, energized by a source of electricity 40. Opposite lamp 39 so as to receive a beam of light therefrom under the control of second control sheet 38, is located light-sensitive cell 41 which forms a part of a circuit including amplifier 42 and relay coil 43. This relay also includes movable contact 44 biased in one direction by spring 45 and, in the other direction, by coil 43, when this coil is energized, so as to engage one or the other of stationary contacts 46. Contacts 34 and 46 form parts of a circuit including a source of electricity 47 and a relay coil 48. This relay includes movable contact 49 stressed away from coil 48 by spring 50 and co-operating with stationary contact 51. Contacts 49 and 51 are parts of a circuit including a source of electricity 52 and coil 53, which is the operating element of a facsimile reproducer of any convenient type.

The operation of my device is as follows: The message and the control sheets are in any graphic form such as a writing, printing, drawing, photograph or the like. They may be said to consist of pluralities of spots or elemental parts each of which

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is either black or white depending upon the part of the message which it forms. Relative movement is provided between lamp 7 and message sheet 4, between lamp 8 and control sheet 6, and between lamp 39 and second control sheet 38 in any convenient manner heretofore used in the art of facsimile transmission. This causes the beam of light emitted by each lamp to scan every spot or element of the message or control associated with it. In the transmitter this scanning thus produces a series of impulses in the amplifying circuits through the action of the light sensitive cells 10 and 11.

For convenience of description, these impulses can be said to be produced by black spots in the message or control. Thus coils 14 and 15 are energized every time an impulse occurs in the amplifying circuit associated therewith. The action of the relays controlled by these coils produces in the circuit associated with them a series of impulses distributed in time as shown in Figure 2 of the drawings in which the term "X" represents an impulse. This figure shows the four possible cases. Thus it will be seen in column 1 that energizing coil 14 by message sheet 4 without energizing coil 15 by control sheet 6, causes an impulse in the circuit containing coil 23 and labeled "Result" in Figure 2. This energizes coil 23 and causes transmitter 27 to emit an impulse. As seen in column 2, when both coils 14 and 15 are energized no impulse appears in the circuit containing coil 23. As seen in column 3, energizing coil 15 but not energizing coil 14 causes an impulse in the circuit containing coil 23. Column 4 shows that when no impulse is present in either amplifier 12 or 13 and, consequently, neither coil 14 nor 15 is energized, no impulse appears in the circuit containing coil 23. To put it another way, an impulse only appears in coil 23 and, therefore, an impulse is only sent out from transmitter 27, when coils 14 and 15 are not in the same condition, i. e., are not simultaneously energized or de-energized. This is due to the fact that simultaneous energization or de-energization

of coils 14 and 16 causes movable contacts 16 and 17 to engage stationary 20 and 21, respectively, which are connected to the same side or polarity of source 22.

The series of impulses emitted by the output element 28 of transmitter 27 is received by the input element 29 of receiver 30. Each impulse so received energized coil 31. Motor 35 produces relative movement between second control sheet 38 and light 39 so that control sheet 38 is scanned in synchronism with control sheet 6. Since second control sheet 38 is a duplicate of control sheet 6, coil 43 is energized in synchronism with the energizations of coil 15. Referring again to Figure 2, the line labeled "Result" represents the impulses which pass through receiver 30 and energize coil 31, while the line labeled "Control" represents the simultaneous impulses caused by control sheet 38 and which energize coil 43. Figure 2, column 1, shows that when there is an impulse in coil 31 and none in coil 43, an impulse is produced in coil 48, which is represented in Figure 2 by the line labeled "Message". Following through the other columns of Figure 2 shows that when coils 31 and 43 are simultaneously energized or de-energized, no impulse appears in coil 48. Likewise, ^{while} ~~when~~ either coil 31 or 43 is energized when the other is de-energized, coil 48 is energized. The energization of coil 48 causes coil 53 to be energized and coil 53 operates a stylus or other marking mechanism and thus message sheet 4 is reproduced.

*See amendment of 14 Oct 46 —
additional paragraph!*

1. An apparatus for secret facsimile transmission comprising, a circuit controlled into either of two positions by the movement of the message to be transmitted, a second circuit controlled into either of two positions by the movement of a camouflage ^{facsim. message} (element), a transmitter arranged to emit a signal intermittently, an interlock provided between said circuits and said transmitter so that said transmitter only sends said signal when both of said circuits are not in the same position, a receiver in communication with said transmitter to receive signals there-
 14 Oct 46 from and to ^{control a switching element} (be controlled) into either of two positions thereby, a third
 10 circuit controlled into either of two positions by a duplicate of said
 14 Oct 46 camouflage ^{facsim. message} (element) moving in synchronism therewith, a second interlock provided between said receiver and said third circuit so that said second
 14 Oct 46 interlock only transmits a signal when said ^{switch} (receiver) and said third circuit are not in the same position, and a recorder controlled by said
 15 second interlock to reproduce the message.

2. An apparatus for secret facsimile transmission comprising, a scanner controlled by the movement of the message to be transmitted, a circuit controlled by said scanner into either of two positions, ^{(a means for}
 14 Oct 46 camouflaging a facsim. message
 camouflage element), a second scanner controlled by the movement of the
 14 Oct 46 camouflage ^{message} (element), a second circuit controlled by said second scanner
 into either of two positions, a transmitter arranged to transmit a signal
 20 Oct 47 (or none), an interlock provided between said circuits and said transmitter
 so that said transmitter only sends said signals when both of said cir-
 cuits are not in the same position, a receiver in communication with said
 10 14 Oct 46 transmitter to receive signals therefrom and to ^{control a switch} (be controlled) into either
 14 Oct 46 of two positions by a duplicate of said camouflage ^{message} (element) moving in
 20 Oct 47 synchronism therewith, a second interlock provided between said (said)
 receiver and said third circuit so that said second interlock only
 14 Oct 46 transmits a signal when said ^{switch} (receiver) and said third circuit are not
 15 in the same position, and a recorder controlled by said second interlock
 to reproduce the message.

Case 1
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Case. 5
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3. An apparatus for secret facsimile transmission comprising, a circuit controlled into either of two positions by the movement of the message to be transmitted, a second circuit controlled into either of two positions by the movement of a camouflage ^{message} (element) a transmitter ^{14 Oct. 46} arranged to emit a signal (or none) an interlock provided between said circuits and said transmitter so that said transmitter only sends said signal when both of said circuits are not in the same position, a receiver in communication with said transmitter to receive signals therefrom and ^{14 Oct. 46} to ^{control a switch} (be controlled) into either of two positions thereby, a scanner controlled ^{14 Oct. 46} by a duplicate of said camouflage ^{message} (element) moving at the same speed, a third circuit controlled by said scanner into either of two positions, a second interlock provided between said ^{switch} (receiver) and said third circuit ^{14 Oct. 46} so that said second interlock only transmits a signal when said ^{switch} (receiver) and said third circuit are not in the same position, and a recorder controlled by said second interlock to reproduce the message.

4. An apparatus for secret facsimile transmission comprising, a circuit controlled into either of two positions by the scanning of the message to be transmitted, a light-sensitive cell forming the control element of said circuit, a second circuit controlled into either of two positions by the scanning of a camouflage element, a second light-sensitive cell forming the control element of said second circuit, a transmitter ^{14 Oct. 47} arranged to emit a signal (or none) an interlock provided between said circuits and said transmitter so that said transmitter only sends said signal when one of said circuits is energized by one of said cells into a different position from the other of said circuits, a receiver in communication with said transmitter to receive signals therefrom and to ^{control a} (be controlled) ^{14 Oct. 46} into either of two positions by a duplicate of said camouflage element moving in synchronism therewith, a second interlock provided between said receiver and said third circuit so that said second interlock ^{14 Oct. 46} only transmits a signal when said ^{switch} (receiver) and said third circuit are in different positions, and a recorder controlled by said second interlock to reproduce the message.

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5. Means for secretly transmitting graphic information, said means comprising, a message in graphic form which it is desired to transmit, a scanner arranged to scan and reproduce said message as a series of electric impulses of varying intensity, a screen having varying portions, a second scanner arranged to scan and reproduce the variations of said screen as a second series of electric impulses of varying intensity, a relay connected under the control of said scanner and arranged to be moved by each of said impulses to one of two positions, a second relay connected under the control of said second scanner and arranged to be moved by each of said second impulses to one of two positions, an electric circuit including parts of said relays and adapted to be closed only when there is instantaneously an impulse in either series but not in the other, a transmitter connected under the control of said electric circuit so as to emit impulses whenever said circuit is closed, a receiver arranged to receive the impulses emitted by said transmitter and having an output comprising a third series of electrical impulses of varying intensity, a second screen duplicating said first mentioned screen, a third scanner arranged to scan synchronously with the scanning of said second scanner and reproduce the variations of said second screen as a fourth series of electric impulses of varying intensity, an ^{17/4/48} *electromechanical* (elector-mechanical) interlock connected under the control of said third and of said fourth series of impulses and arranged to be energized whenever an impulse occurs in one of said third and fourth series and no impulse occurs simultaneously in the other of said third and fourth series, and a recorder connected under the control of said interlock and arranged to operate whenever said interlock is energized and to thereby reproduce said message.

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C. Means for secretly transmitting graphic information, said means comprising, a message in graphic form which it is desired to transmit, a scanner arranged to scan and reproduce said message as a series of electric impulses of varying intensity, a screen having varying portions, a second scanner arranged to scan and reproduce the variations of said screen as a second series of electric impulses of varying intensity, an ^{electromechanical} (electro-mechanical) interlock connected under the control of both of said series of impulses and arranged to be energized whenever an impulse occurs in one of said series and does not occur simultaneously in the other of said series, a transmitter connected under the control of said interlock so as to emit impulses whenever said interlock is energized, a receiver arranged to receive the impulses emitted by said transmitter and having an output comprising a third series of electrical impulses of varying intensity, a second screen duplicating said first mentioned screen, a third scanner arranged to scan synchronously with the scanning of said second scanner and reproduce the variations of said second screen as a fourth series of electric impulses of varying intensity, a second electro-mechanical interlock connected under the control of said third and of said fourth series of impulses and arranged to be energized whenever an impulse occurs in one of said third and fourth series and no impulse occurs simultaneously in the other of said third and fourth series, and a recorder connected under the control of said second interlock and arranged to operate whenever said second interlock is energized and to thereby reproduce said message.

7. Means for secretly transmitting graphic information, said means comprising, a message in graphic form which it is desired to transmit, a scanner arranged to scan and reproduce said message as a series of electric impulses of varying intensity, a screen having varying portions, a second scanner arranged to scan and reproduce the variations of said screen as a second series of electric impulses of varying intensity, a relay connected under the control of said scanner and arranged to be moved by each of said impulses to one of two positions, a second relay connected under the control of said second scanner and arranged to be moved by each of said second impulses to one of two positions, an electric circuit including parts of said relays and adapted to be closed only when there is instantaneously an impulse in either series but not in the other, a transmitter connected under the control of said electric circuit so as to emit impulses whenever said circuit is closed, a receiver arranged to receive the impulses emitted by said transmitter and having an output comprising a third series of electrical impulses of varying intensity, a second screen duplicating said first mentioned screen, a third scanner arranged to scan synchronously with the scanning of said second scanner and reproduce the variations of said second screen as a fourth series of electric impulses of varying intensity, a third relay connected under the control of said third scanner and arranged to be moved by each of said impulses of said fourth series to one of two positions, a fourth relay connected under the control of said receiver and arranged to be moved by each of said impulses of said third series to one of two positions, an electric circuit including parts of said relays and adapted to be closed only when there is instantaneously an impulse in either said third or said fourth series but not in the other, and a recorder connected under the control of said circuit and arranged to be energized whenever said circuit is closed to record the original message.

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20 Oct. 47

8. The method of ^{10/10/47 generating} (transmission which includes (sending) a facsimile ^{signal} (transmission) and ^{10/10/47} means for increasing the secrecy of the transmission, ^{10/10/47} thereby another fac. transmission, ^{10/10/47} signal before

9. The method of secret message transmission which includes taking the following steps at the transmission station: ^{10/10/47} (writing the message) scanning the ^{10/10/47} (written matter) generating a series of ^{10/10/47} impulses due to the scanning, said impulses ^{10/10/47} occurring due to ^{10/10/47} presence ^{10/10/47} of absence of written matter at the instant of the impulse at the point scanned (at

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^{9 Dec. 48} (at that instant) ^{9 Dec. 48} (interposing in and removing impulses from said series of impulses according to a predetermined plan and transmitting the resulting ^{9 Dec. 48} series) of impulses to the receiving station) and taking the following ^{9 Dec. 48} steps at the receiving station: receiving the ^{9 Dec. 48} (stream) of impulses, ^{9 Dec. 48} (moving impulses) that were interposed in the series of impulses at the ^{9 Dec. 48} transmitting station and adding impulses that were removed from the ^{9 Dec. 48} series of impulses ^{9 Dec. 48} to the transmitting station) whereby to effectively reproduce the said series of impulses that directly resulted from said scanning, and recording the last-named reproduced series of impulse.

10. In a system of secret facsimile transmission, a transmitting station comprising first and second elements of which each element is adapted for operation to a plurality of positions, scanning means for operating the first of said elements to control its position, means for controlling the position of the second element in an irregular manner according to a predetermined law; and a receiving station comprising third and fourth elements of which each element is adapted for operation to a plurality of positions, means whereby the position of the third element is controlled according to the conjoint action and in dependance on the relative position of the first and second elements, means for controlling the fourth element in the same irregular manner that the second element is controlled, and means responsive to the conjoint action and acting in dependance on the relative positions of the third and fourth elements for reproducing the original message.

14 Oct. 46

10. In a system of secret facsimile transmission, a transmitting station comprising first and second elements of which each element is adapted for operation to a plurality of positions, scanning means for operating the first of said elements to control its position, means for controlling the position of the second element in an irregular manner according to a predetermined law; and a receiving station comprising third and fourth elements of which each element is adapted for operation to a plurality of positions, means whereby the position of the third element is controlled according to the conjoint action and in dependance on the relative position of the first and second elements, means for controlling the fourth element in the same irregular manner that the second element is controlled, and means responsive to the conjoint action and acting in dependance on the relative positions of the third and fourth elements for reproducing the original message.

9 Dec. 48 ~~Claims 11 and 12 added by amendment of 20 Oct. 1947.~~
Claims 13, 14, and 15 added by amendment of 9 Dec. 1948.

IN TESTIMONY WHEREOF I affix my signature _____

(Sign here, first name in full.)

O A T H

): ss
_____)

William F. Friedman

the above-named petitioner _____, being duly sworn, depose^s and say^s that he is a
citizen _____ of the United States of America
and resident _____ of 3032 Military Road, N. W., Washington, D. C.
that he verily believe^s himself to be the original, first, and sole
inventor _____ of the improvement _____ in System for Enciphering Facsimile

described and claimed in the annexed specification; that he do^{es} not know and do^{es}
not believe that the same was ever known or used before his invention or discovery
thereof or patented or described in any printed publication in any country before his
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 him or his 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 him or his 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 _____, 1943

Notary Public

(Seal here, to be impressed
in paper.)

WHEREAS, I, William F. Friedman,
of 3982 Military Road, N. W., Washington, D. C.,
have invented certain improvements in

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 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
myself

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.

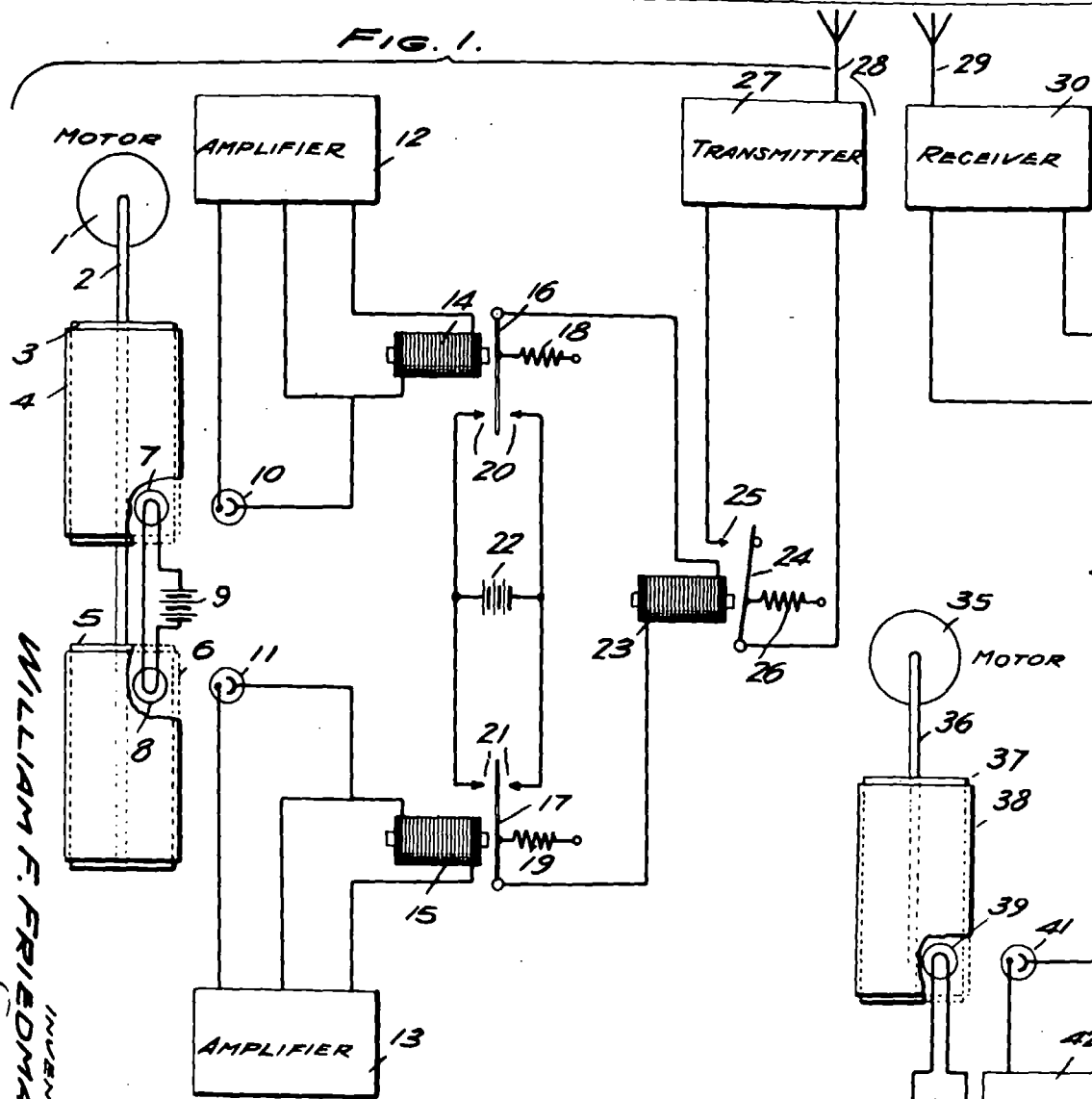


FIG. 2.

	1	2	3	4
MESSAGE	X	X		
CONTROL		X	X	
RESULT	X		X	

→ TIME

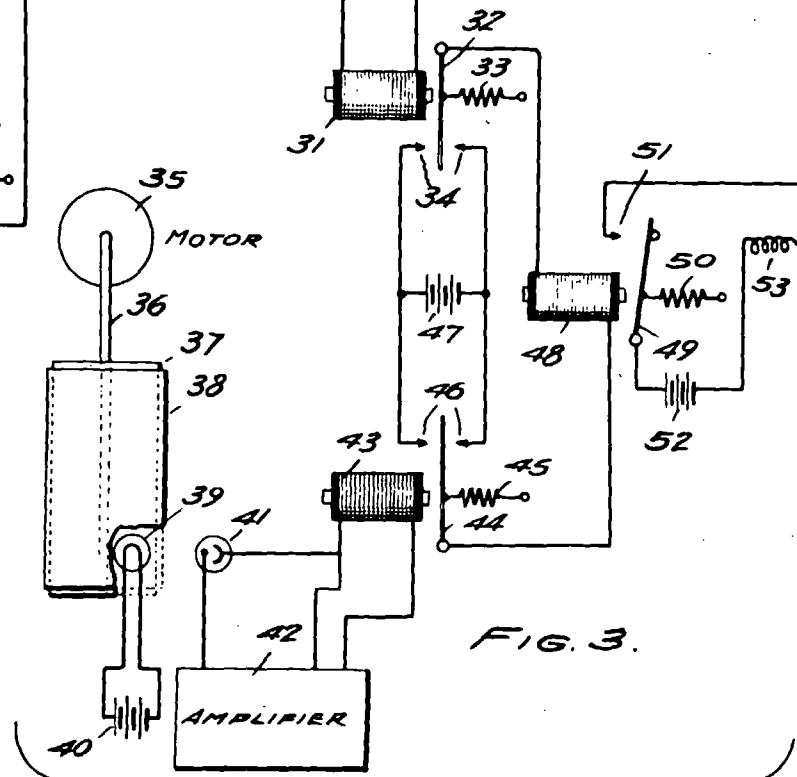


FIG. 3.

WILLIAM F. FRIEDMAN
INVENTOR
William F. Friedman
Attorney