

The wireless key of R.M.S. *Titanic*

Douglas A. Kerr

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ABSTRACT

The luxury steamship R.M.S. *Titanic*, the largest ocean-going passenger ship afloat at the time, sank on April 15, 1912, while on her maiden voyage, after striking an iceberg, resulting in the loss of over 1500 lives. But the fact that she was equipped with a (for the time) up-to-date wireless (radio) installation is credited with the saving of many lives, by bringing other ships fairly promptly to her aid.

Not surprisingly, students and aficionados of the wireless technology of that era often focus on the installation on *Titanic*. And collectors of, and experts on, antique telegraph keys often call attention to specimens of a certain type of Marconi key as being the "type used on *Titanic*".

But there are questions, yet unanswered (at least to the knowledge of the author), as to why this type of key was used with the kind of transmitter believed to have been used on *Titanic*. This article reviews this conundrum, and concludes that this belief is correct. It also discusses a related conundrum regarding the matter of the keying circuit used on *Titanic*.

In order to provide background, the article includes introductions to pivotal technical aspects of the wireless transmitters of the era.

1 CAVEAT

Various "facts" stated below are based on opinions of the author, based on his extensive analysis of the available information, and may differ from the positions of well-respected authorities.

2 THE ILL-FATED R.M.S. *TITANIC*

R.M.S. *Titanic* was a luxury steamship of the early 20th century, the pride of the fleet of the White Star Line. She sailed on her maiden voyage from Southampton, England, on April 10, 1912, with over 2200 passengers and crew aboard. She called at port at Cherbourg, France, and Queenstown, Ireland (now known as Cobh) before setting off across the Atlantic for New York, New York.

Late in the evening of April 14, 1912, traveling through the North Atlantic, she struck an iceberg, severely damaging her hull. She shortly went down, with the loss of over 1500 lives, one of the greatest marine disasters of all time.

Titanic was equipped with an up-to-date (for the time) marine wireless (radio) system, installed and operated by the Marconi company, with a powerful main transmitter. Through the use of this, *Titanic* was able to summon aid from other ships nearby at the time, and several in fact rushed to her assistance. Most notable was R.M.S *Carpathia*, which, arriving after *Titanic* had gone down, was able to rescue from the sea over 700 passengers and crew.

3 INTRODUCTION TO SPARK WIRELESS TRANSMITTERS

3.1 Introduction

Prior to the development of the vacuum tube, the most widely used type of wireless (radio) transmitter used a spark through a spark gap as a critical element in generating a radio-frequency signal.

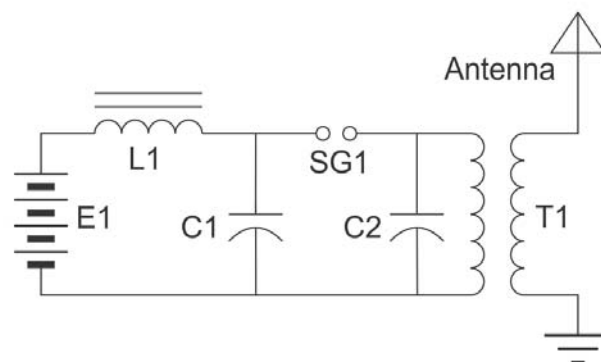


Figure 1. Simple spark gap transmitter

3.2 Basic concepts

The principle can be seen in figure 1, which shows a schematic diagram of a simple form of this creature.

The high DC supply voltage E1 charges capacitor C1 through inductor L1¹. When the voltage on C1 (and thus across spark gap SG1) reaches the “breakdown voltage” of the spark gap, a conductive arc forms across the spark gap. A significant amount of the energy from C1 passes, in a very short period, through that arc into the L-C resonant circuit made of capacitor C2 and the primary winding of radio-frequency transformer T1. That resonant circuit is tuned to the desired radio-frequency operating frequency of the transmitter.

¹ Known “in the day” as a “choke coil”, or just “choke”.

This energy pulse "excites" that resonant circuit, which oscillates at its resonant frequency. This is analogous to striking a gong with a hammer.

Inductor L1 allows the voltage across C1 to decrease as it discharges due to the current through SG1. Below a certain current value through SG1, the arc is extinguished. Then there is no ongoing path for the energy in the L-C circuit to flow back through the spark gap.

Therefore, most of the radio-frequency energy created by the oscillation in the L-C circuit goes to the antenna and is radiated as an electromagnetic wave (radio signal). Since there is (for the moment) no ongoing source of energy into the L-C system, the amplitude of this radio-frequency signal declines quickly—it is a "damped" wave. But before long capacitor C1 again charges to the breakdown voltage of the spark gap and the scenario repeats.

Figure 2 shows a typical waveform of such a signal.

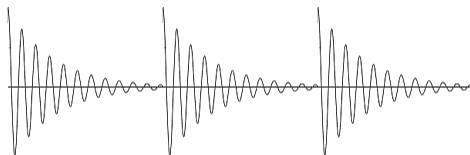


Figure 2. Damped wave

The rate of recurrence of the spark discharges (and thus the "bursts" of the waveform) varies widely over different transmitter designs, sometimes about 120 discharges/second, often in the range 500-1000 discharges/second, and in rare cases even higher.

These transmitters were in Morse code operation. The whole process I described above is started and stopped by the operator's telegraph key, by switching on and off the supply voltage to the transmitter circuit.²

Looked at from a theoretical standpoint, the signal applied to the antenna (and thus the resulting electromagnetic wave) can be thought of as a sine wave (a signal of a "pure" single frequency) modulated in its amplitude by a "waveform" that consists, repetitively, of a sudden rise followed by approximately an exponential decline.

Modulation theory teaches us that the resulting signal into the antenna (and thus the generated electromagnetic wave) does not consist only of a component at the resonant frequency of the L-C circuit, but in

² Perhaps this is actually done by a relay operated by the key, keeping high voltages and large currents away from the key. This whole matter is discussed later in this article, and is pivotal to its main topic.

addition consists of powerful components separated from that frequency by multiples of the rate at which the spark gap fires, and at frequencies near those components. Thus the transmitted signal occupies a significant "bandwidth". As a result, it is impractical, within any frequency band, to simultaneously operate a large number of independent transmitters.

Often (especially once an alternative form emerged) this form of transmission was spoken of as "damped-wave" transmission.

3.3 AC operation

Of course, it is not that simple to provide a source of DC at a high enough voltage for this to work, so many serious transmitters (including those to be discussed in more detail here) instead operated on AC. Figure 3 shows a simple version of this.

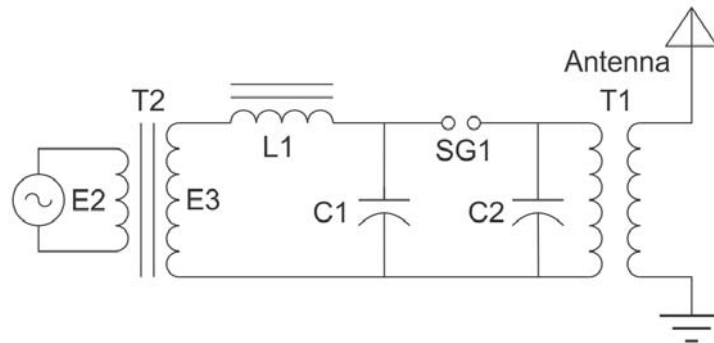


Figure 3. Simple AC-operated spark gap transmitter

The AC supply voltage, E2, is raised to a very high voltage, E3 (perhaps 10 kV RMS) by transformer T2. The rest of the operation is essentially as described just above. Of course capacitor C1 can only charge to the voltage required for a spark to initiate when the instantaneous voltage of the AC is above a certain level. Accordingly, the spacing between "bursts" of the damped wave varies continuously, and there are periods in which no bursts occur.

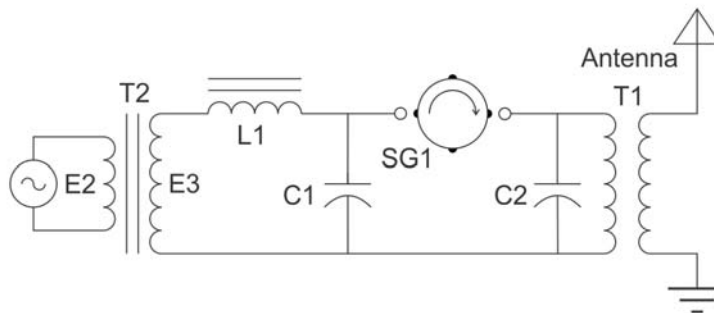


Figure 4. Synchronous rotary discharger spark gap transmitter

Operation of the transmitter can be made more consistent (and efficient) if we can force the spark gap to only discharge when the AC voltage is near its peak. One way to do this is to use a *synchronous rotary discharger* to provide the spark gap, Figure 4 shows this in simplified form.

The discharger typically consists of a rotating conducting disk with several conductive studs around its periphery. Two fixed electrodes are arranged so the tips of the studs pass close to them.

The rotation of the disk is synchronized with the AC supply waveform (the disk may for example be on the same shaft as the AC generator that creates the AC supply), and is adjusted in phase so the studs are near the electrodes when the AC wave is at its peak (positive and negative). Thus the two spark gaps in series (each between a stud and the adjacent fixed electrode) “fire” when the gap becomes small enough to no longer withstand the applied voltage. And this of course happens at the peaks of the AC waveform.

If we make the rate of spark discharge in the range of perhaps 400 1500 Hz, the detected signal will have a “musical note” sound, assisting its clear reception. But that essentially requires that the frequency of the AC supply be at half that value, substantially higher than the 50-70 Hz we might otherwise expect to be used.

This principle was used in the main transmitter of *Titanic*, although the actual circuit was a bit different.

3.4 The AC power source

In the *Titanic* main transmitter, the actual power source is taken from the ship’s 100 V DC power distribution system. Then a DC-AC motor generator set (a DC motor directly coupled to an AC generator) is used to generate the AC power from which the transmitter itself operates. The AC voltage was about 300 V, and the frequency was 420 Hz, which led to a spark repetition frequency of 840 Hz.

4 KEYING THE TRANSMITTER

4.1 Introduction

These transmitters were used for Morse code transmission, with the emission being turned on and off by the operator’s key (called the “manipulating key” in the literature of the time)—I will often say just “key” in the text.).

There are a number of ways in which this can be done. I will review four important ones. I will identify them, for later reference, with the letters A-D. The names I give them are not necessarily used in the literature.

4.2 Circuit A – The direct keying circuit

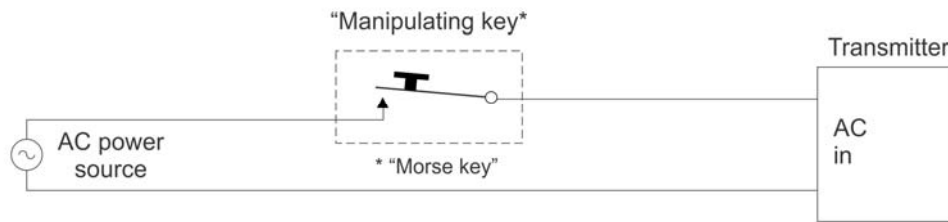


Figure 5. Keying circuit A

This is typically used for lower-power transmitters. The contacts of the manipulating key, worked by the sending operator, directly control the AC feed to the transmitter. This means that the contacts on the key must be able to make, sustain, and break the resulting current flow (the break being the most challenging, owing to the resulting arc, which can greatly erode the contacts).

But up through transmitters of modest power, it is practical to make keys with contacts robust enough to cope with this.

Nevertheless, there is the possibility that if the key is not manipulated "smartly", when closing the key there might occur a rapid series of arcs that could, in an extreme case, cause the key contacts to "weld" together.

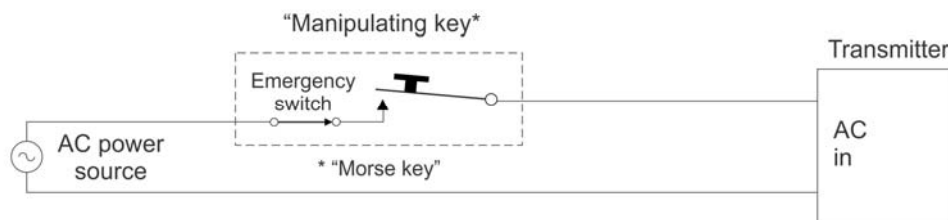


Figure 6. Keying circuit A with emergency switch

In installations where this is a serious concern, the key is often equipped with a knife-switch-like emergency switch, shown in figure 6.

If the key contacts should weld, the operator can interrupt the circuit by opening the emergency switch. Then the power to the transmitter can be shut off at the power panel so the contacts can be freed, or if needed, replaced, or in an extreme case, the key can be replaced.

As the transmitter power escalates, we reach a point that the keying contacts of a practical key cannot withstand this abuse (the break usually being the killer). So in such cases, we move up to one of the following circuits.

4.3 Circuit B—The keying relay circuit

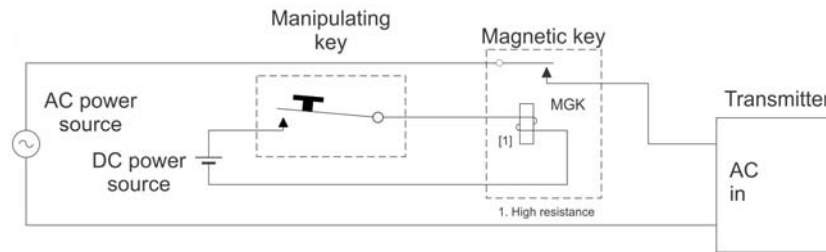


Figure 7. Keying circuit B

Here, the manipulating key controls, via a DC circuit of modest voltage and current, the electromagnet coil winding of what we can accurately call a *keying relay* (MGK). In the day, these relays were typically spoken of as “magnetic keys”, apt since indeed they were in effect a telegraph key operated by an electromagnet. But for functional clarity I will refer to it (and such things to be subsequently encountered) as a *relay*.

Of course now the contacts of the relay had to bear the brunt of making, sustaining, and (again, perhaps the most challenging) breaking the large currents involved. Still, it was usually more practical to equip this device with massive contacts (perhaps even with cooling fins) to make them up to that task than to do so on the manipulating key.

An additional benefit compared to the direct keying circuit (circuit A), in the case of higher power transmitters (where the AC operating voltage became quite high), was that this high voltage did not appear on the key (whose mechanism and terminals were open in the usual design), thus reducing the hazard to the operator.

When this circuit is used on shipboard transmitters of the class we are considering, the DC supply is typically 100 V, drawn directly from the ship’s 100 V power distribution system. The current typically drawn by the relay coil is not known to me at this time, but it is certainly “modest” (my guess is not over 100 mA).

A disadvantage of this circuit is that, were we to wish to upgrade an installation from circuit A to this circuit, additional wiring (for the DC circuit) would probably have to be installed to the operating position.

Because in this circuit the key only operates in a relatively benign circuit, there would probably be little risk of the key contacts welding. Thus there would probably not be justification for the use of a key with an emergency switch. (Hold that thought.)

Of course now the contact of the relay bears the brunt of making, sustaining and (yes, this is the worst) breaking the transmitter operating current. As the transmitter power escalates even further, it

becomes more and more challenging to provide contacts that will be up to the job. And thus we may move to the next circuit.

4.4 Circuit C—The synchronous break circuit

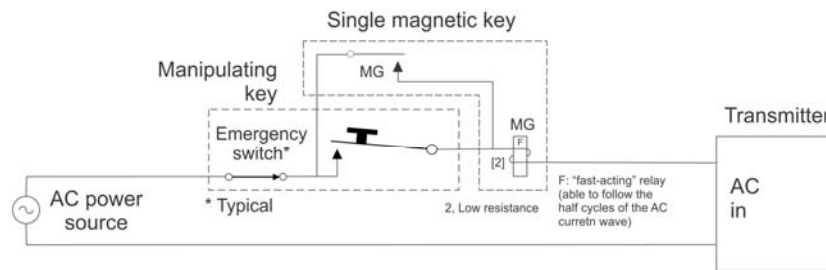


Figure 8. Keying circuit C

Here the object is to prevent any contact from having to break the large currents involved in the keying of a high-power transmitter.

When the operator depresses the manipulating key, its contact closes the path from the AC source to the transmitter input, a slightly challenging action (considering the large current that ensues) but which is feasible to support with a practical key. The current passes through the low resistance coil winding of a relay (MG), also called a “magnetic key”, although the term here is not at all as apt as it is in circuit B. The contacts of that relay close a path in parallel with the contacts of the manipulating key.

The relay is fast-operating, meaning in particular that it is able to operate and release on each half-cycle of the AC current waveform (120 times per second if the frequency of the AC source were 60 Hz, as it often was).

If the operator releases the key at a time in the AC cycle in which the current is nearly zero, the relay will be at that time released, leaving only the path through the key contacts carrying the AC to the transmitter. Thus the circuit to the transmitter is broken by the manipulating key contacts as they open. But since the current then is zero or nearly so, there is no substantial arcing to damage the key contacts.

On the other hand, if the operator releases the key at a time in the AC cycle in which the current is not nearly zero, the relay will at that time be operated. Although the key contacts will open, they are “shunted” by the contacts of the relay, and thus no current is broken by them. Shortly, as the current approaches zero, the relay releases, its contacts breaking the small current that exists at that time.

In either case, now the path to the transmitter is completely open, and no AC will flow to it until the operator next depresses the key.

A disadvantage of this circuit is that the contacts of the key must still make the heavy current, and there can be some small arcing associated with that, which can erode the contacts. And there is the possibility that if the key is not manipulated "smartly", when closing the key there might occur a rapid series of arcs that could, in an extreme case, cause the key contacts to "weld" together.

Thus, commonly, with this circuit the key will be equipped with an emergency switch, just as was described earlier.

The relay used here is often spoken of as a "single magnetic key", to distinguish it from the "double magnetic key" apparatus we will find used in circuit D. (Of course, the relay used in circuit B is also a "single magnetic key", although its principle of operation and the nature of the relay are wholly different. Thus the description of such a keying circuit, as is often done in the literature of the day, as a "single magnetic key" circuit is quite ambiguous.

We note that with this circuit the full transmitter operating voltage appears on the key, whose mechanism and terminals are open in the usual construction. Thus, especially in the case of the higher-power transmitters, where the AC supply voltage can be quite high, there is still a substantial risk to the operator.

The key shown in figure 11 would be well suited to operation with this circuit.

I note that, if we wanted to upgrade an installation from circuit A keying to circuit D keying, no additional wiring would be required to the operating position if the relay were located near the key (as it seemingly usually was, typically just behind the key).

In this circuit, the key contacts themselves must still make the transmitter operating current. As transmitter power continues to escalate, this becomes a task that is difficult for a practical key to meet.

And, with this circuit, the fairly high transmitter operating voltage appears on the key, which is usually "open", and thus there is a substantial hazard to the operator.

Thus, for one or more of those reasons, we may move to the next circuit.

4.5 Circuit D—The double magnetic key circuit

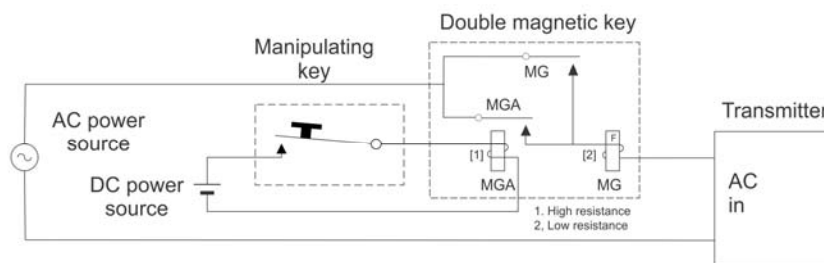


Figure 9. Keying circuit D

This circuit combines the operation and benefits of both circuits B and C. It involves two relays, typically part of a consolidated unit called a “double magnetic key”.

Here, as in circuit B, the manipulating key, operating in a DC circuit of modest voltage and current, operates the high-resistance coil of a relay (in this case labeled MGA), whose contact in turn makes the path to energize the transmitter (just as would the contact of the key itself in circuit C).

The current from the contact of MGA to the transmitter passes through the low-resistance coil of a second relay, MG. As in circuit C, MG follows the individual half-cycles of the AC current waveform.

If the operator releases the key (thus releasing relay MGA) when that current is not near zero (and thus MG is at the time operated), the contact of relay MG provides a second path to the transmitter so the contact of MGA does not actually break the current. Then, just as in circuit C, when the current reaches near zero at the end of the present half cycle, relay MG2 releases, opening the circuit so the transmitter will not be further energized until the operator next closes the key.

So, with this circuit, the contact of relay MGA must make the transmitter operating current, but it is quite practical to provide the relay with contacts that are up to that. And no contact has to break the transmitter current (that is, except when it is instantaneously almost zero); recall that making a contact able to withstand breaking a high current is more challenging than making it able to withstand making that current.

An additional advantage of this circuit is that, as with circuit B, the fact that only a relatively-small voltage is present at the key provides for decreased risk to the operator.

Because in this circuit the key only operates in a relatively benign circuit, there would probably be little risk of the key contacts welding. Thus there might not be justification for the use of a key with an emergency switch.

4.6 AC relay construction

I note that for circuits C and D, relay MG would probably need to have a laminated core and laminated armature. These relays operate on AC current. The laminated construction minimizes the degree of circulating currents (called "eddy currents") induced in the core and armature by the AC magnetic field. These currents cause the absorption of energy which can result in substantial heating of those members.

In fact we see in the photographs of relays used in that setting armatures comprising multiple bars separated by a short distance, an early way to make a laminated armature. We see one example, on a single magnetic key, in figure 10.



Figure 10. Single magnetic key

We also see this construction on the rightmost relay (MG in my notation) on a double magnetic key in figure 17.

4.7 Higher-frequency AC operation

I mentioned earlier that, especially in the case of synchronous rotary spark gap transmitters, the transmitter power supply frequency may be fairly high, perhaps 400-600 Hz. In the case of the *Titanic* main transmitter, the AC frequency is nominally 420 Hz.

In that case, keying circuits C and D are not feasible. It is not practical to make a relay that will operate perhaps 840 times per second and still have contacts large enough to be suitable for the currents involved. Thus, for such transmitters, we only have the choice of keying circuits A and B.

4.8 On *Titanic*

For the reason discussed just above, I believe that keying circuit B is that used on the main transmitter of *Titanic* (even though it might have been nice to have the advantages of circuit C or D). In fact, on a wiring diagram widely thought to represent the transmitter on *Titanic* (see figure 14), keying circuit B is clearly shown.

5 THE OBJECT OF OUR AFFECTION

It is widely said that a certain type of Marconi wireless telegraph key is the "type used on *Titanic*".



Figure 11. Marconi type 48200 key

Figure courtesy of
Tom Perera, W1TP

We see in figure 11 a nice specimen of that type of key, Marconi number 48200, from the collection of noted telegraph key expert and collector, Tom Perera, W1TP. This specimen was, by the way, found in an old house in England, in gravely deteriorated condition, and has been expertly restored.

Here we see, on the near edge of the wooden base of the key, the emergency switch, with a knob on its blade that is itself evocative of the knobs on many telegraph keys.

An interesting feature is the small screw eye on the blade. Supposedly, the purpose of this is to provide a way to safely open the switch when an incident of sparking occurs that is so persistent and violent such that it is not safe for the operator to open the emergency switch directly. A cord ran from the screw eye on the emergency switch lever to an eyebolt in the ceiling of the operating room. In a case such as I have mentioned, the operator could pull that cord to the side, forcing the emergency switch to open.³

³ I have not so far ever seen such a cord in any photograph of a Marconi wireless operating room, or in any of the many careful replicas of such operating rooms where a key of this general type was used.

The observant reader may have noted that in my discussion of keying circuit B, I observed that since here the key operates in a relatively benign circuit (100 V DC at a very modest current) there might not be justification for the inclusion of an emergency switch on the key.⁴ Yet the type of key purportedly used does include an emergency switch. This conundrum was the initial motivation for the study that led to this article.

6 MUTING THE RECEIVER

In some wireless installations, a *send-receive changeover switch* was used. It would switch the antenna between the transmitter and receiver, disable the transmitter when in the receive position, and disable the receiver when in the send position (so the operator would not hear in his headset a raucous sound from the station's own transmitter).

But no such switch was needed in the Marconi transmitters of the family we will be discussing here. "Steering" of the antenna to the transmitter or receiver was done with a clever scheme using a special spark gap, essentially identical to the "arrestor" spark gap used in radio installations to discharge safely to ground dangerous currents visiting the antenna such as those from a nearby lightning strike.

But we are still left with the problem of, when the transmitter is actually sending, a raucous noise in the operator's headset. To avert this, the keys used with these transmitters have a second set of contacts, isolated from the key's main contact, which also closed when the key was depressed. They were adjusted so when the key was depressed they closed before the main contacts closed; when the key was released, they opened after the main contacts opened.

These auxiliary contacts were connected to short-circuit the operator's headset when they closed, muting it, and thus averting the "raucous noise" problem.

An advantage of this arrangement, versus the send-receive switch arrangement, is that in between the marks of the sent Morse code (*i.e.*, when the key was momentarily up), the operator could hear transmission from other stations. Then he could momentarily pause his sending to see if the other transmission was intended for his station.⁵

⁴ And the wiring diagram referred to above, which uses a highly-pictorial representation of the components, does not suggest the use of a key with an emergency switch.

⁵ Amateur radio operators will recognize this as "QSK" operation.

In figure 12, we see the key earlier seen in figure 11 from a different angle, allowing us to see the auxiliary receiver muting contacts on it:



Figure 12. Marconi 48200 key showing receiver muting contacts

Figure courtesy of
Tom Perera, W1TP

We see a fiber sleeve extending from the main lever (under the knob) which operates those contacts. (One of the two terminals of the auxiliary contacts is missing its knurled nut.)

In the case that a key with an emergency switch is not needed, but receiver muting contacts are needed, we might find the key shown in figure 13. This is a key from the collection of telegraph key maven Pete Malvasi (W2PM).



Figure 13. Marconi basic key with receiver muting contacts

Figure courtesy of
Tom Perera, W1TP

Here the receiver muting contacts are under the rear of the key lever, operated by a small insulating post (adjustable) on the lever.

Although the specifics of the locations of the receiver muting contacts may seem trivial, it will play a critical role in a forensic analysis to come later. (This is like the place in a detective movie where the camera focuses on one guy's shoes for a long time.)

7 THE TRANSMITTER WIRING DRAWING

7.1 Introduction

Figure 14 shows what is believed to basically be the circuit of the model of Marconi transmitter used as the main transmitter on *Titanic*, as found on the Internet (the actual source being unknown to me. It is not a “schematic” drawing, in that it doesn’t use “schematic” symbols, but rather pictorial presentations of the circuit items. I have added annotations for ease of reference and made a few other “improvements” to the drawing as I found it .

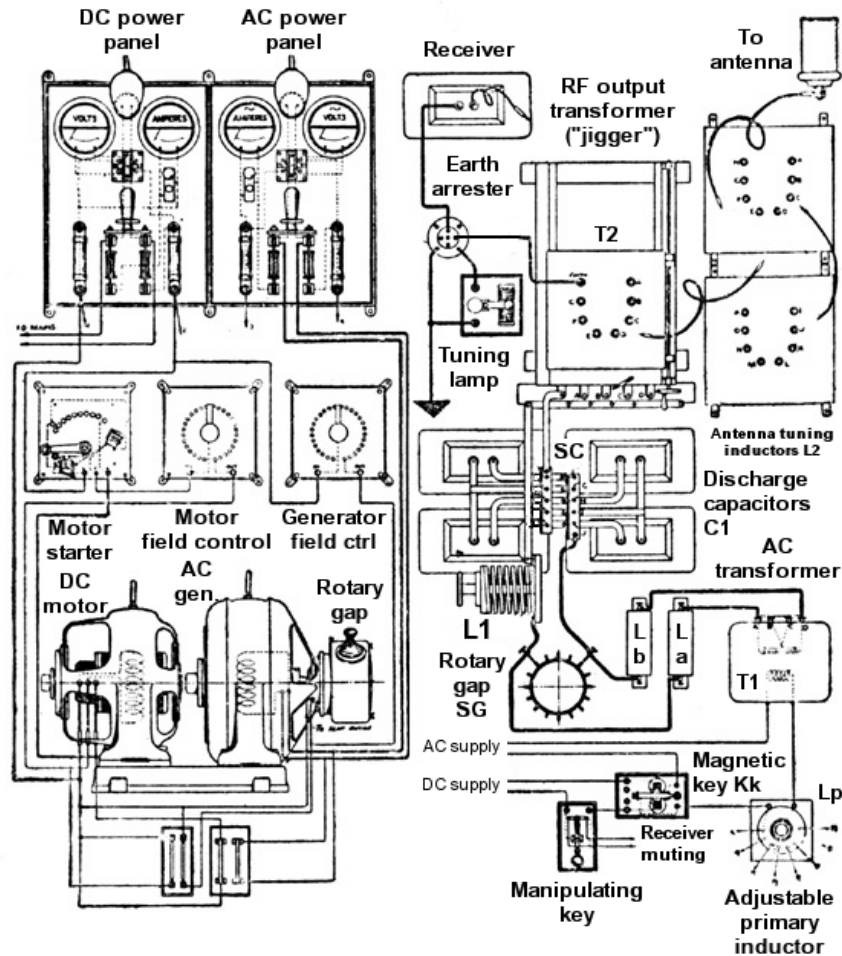


Figure 14. Circuit of *Titanic* main transmitter

It is consistent with much we “know” about that transmitter.

In figure 15 we see the keying circuit from that drawing, enlarged.

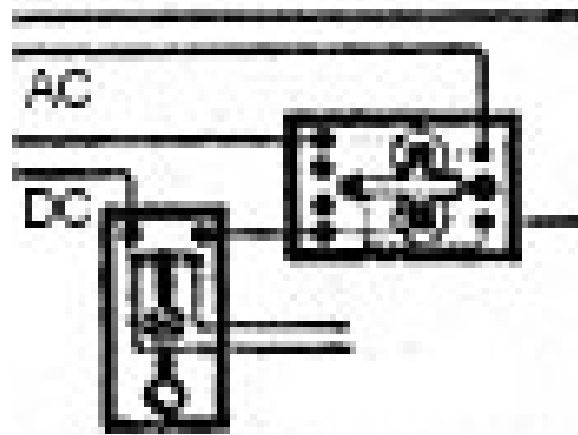


Figure 15. Keying circuit

Sadly, the resolution of the original drawing (as I was able to find it) is low, so this excerpt is rather blurry, but we can certainly see the important features to be discussed. I have taken the liberty of applying the "AC" and "DC" legends here, as the relevant legends on the full drawing were outside the battle zone.

This quite clearly seems to show keying circuit B, and in fact the "pictorial" presentation of the single magnetic key in it is very consistent with actual photographs of the same.⁶

We see no emergency switch on the key. Is this key shown here in quasi-pictorial form? Well we note that the auxiliary receiver-muting contacts are shown as if under the back of the key lever, with a terminal on each side of the lever. And if we look at figure 13, we see that this is exactly the actual arrangement on that type of key. So I conclude that indeed this is a "quasi-pictorial" portrayal of the key intended to be part of this transmitter. And we do not see the emergency switch on it.

Thus it is reasonable to believe that the design of this transmitter contemplated the use of a key such as seen in figure 13, and not a key such as seen in figure 11. (That is not to say that such a switch was in fact used on the instance of this transmitter in which we were interested!)

⁶ A well-respected paper asserts that what I call keying circuit D was used with the 5 kW Marconi transmitters both on *Titanic* and on her sister ship, *Olympic*. But those transmitters were in fact quite different, flowing from the fact that the *Titanic* transmitter used a rotary spark gap and the *Olympic* transmitter did not. In fact, circuit D could not be used with the *Titanic* version of that transmitter, owing to the higher AC frequency used there in connection with the rotary spark mode.

8 THE REALITY OF THE KEY IN *TITANIC*

8.1 Introduction

A Marconi key (number 48200), with an emergency switch, (as we saw in figure 11) is widely described on the Internet as “the type of key used on *Titanic*”. Of course, such a key is perfectly usable with keying circuit B, even though there would not be expected to be any occurrence that would call for the use of its emergency switch feature.

But clearly we cannot in a reliable way ascertain, from the drawing I discuss above, what type of key was actually used on *Titanic*. Of course, the holy grail in this inquiry would be an actual contemporaneous photo of the operating desk in the Marconi room of *Titanic*.

8.2 The “Father Browne” photo

Sadly, it is generally considered that there is only one known actual photo of the *Titanic* Marconi room, and it is not “ideal” for our purposes.

It was taken by a Jesuit postulant, Francis Patrick Mary Browne.⁷ He had booked passage on *Titanic*, on its maiden voyage, from Southampton, England to Queenstown, Ireland (today known as Cobh). It was of course fortunate for him (and us) that he debarked there rather than continuing on toward New York, which might well have cost him his life.

During an early part of the voyage, he went to the wireless room to send a radiotelegram.

While at the wireless room, he took a photo (perhaps while waiting for junior operator Harold Bride to finish his work and attend to him). Actually, he took two photos, unfortunately both on the same film frame.

So we are left with Father Browne’s double exposure of Bride at work as the only known surviving picture of the *Titanic* wireless room. We see it in figure 16.

⁷ Browne was ordained a priest in 1915, and it is the custom to refer to him today, regardless of the period of his life being discussed, as “Father Browne”.

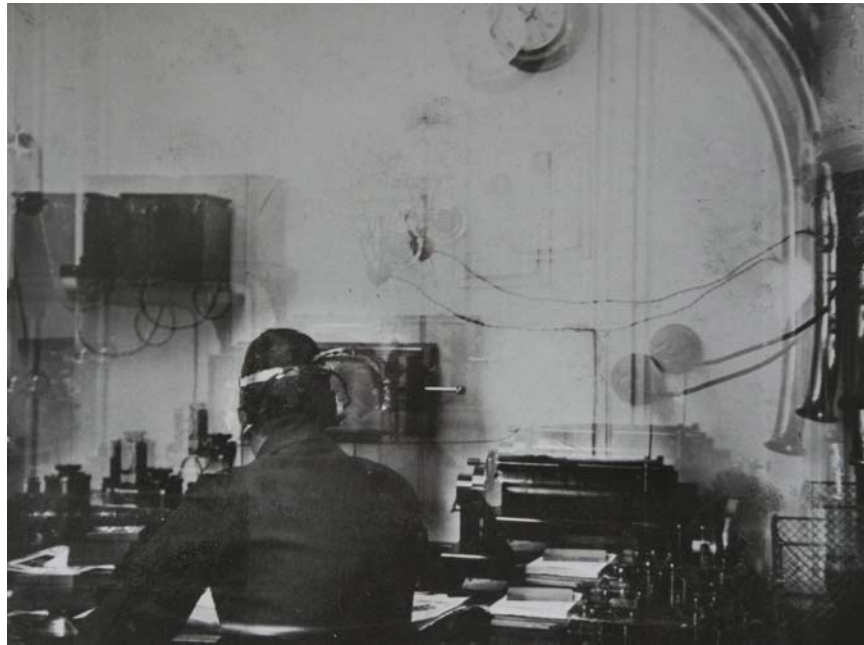


Figure 16. Operator Harold Bride in the *Titanic* wireless room

Photo by Francis Browne

Happily, the double exposure did not completely scramble a critical subject area. Careful examination of this image (in the highest-resolution form I have found) gives me a high confidence (no, not 100%) that the main transmitter key of *Titanic* was a Marconi 48200 key (or certainly something quite similar) (*cf.* figure 11).

The figure doesn't allow me to confirm that the actual key had auxiliary receiver muting contacts. So on that matter I defer to the indications of the wiring drawing, which shows that it did.

8.3 So, why that key?

So, why was this key used here? As I mentioned earlier, with keying circuit B (as presumably used here), there would be little likelihood of welding of the key contacts, and thus there would probably be no need to use a key with an emergency switch. A simpler key would seemingly have done as well.

I have no idea why the key with an emergency switch was seemingly used. One possibility is that the Marconi field engineers, completing the transmitter installation, said, "The headquarters design engineers think that no emergency switch is needed with this keying circuit, but we know better."

But another possibility is that Marconi decided to use a single type of key for use in all installations of this class, for simplification of the logistics.

9 THE EMERGENCY TRANSMITTER

The wireless installation on *Titanic* included an emergency transmitter. This was a fully self-contained straight spark transmitter, operated from a 16 V storage battery, normally kept charged from the ship's 100 V DC distribution system.

It used an induction coil, with a buzzer-like interrupter (just as for the ignition coils of a Model T Ford), to generate the high voltage needed for the spark system.

This transmitter was keyed directly, the contacts of its key directly closing and opening the 16 V supply. The current would have been on the order of 17 A. Is that an environment in which there would have been a significant risk of the key contacts welding, such that an emergency switch would be required? I don't know. (The wiring drawing for a similar but lower-powered Marconi main transmitter installation includes the emergency transmitter, seemingly of the same type or similar, and the "quasi-pictorial" symbol shown there for its key implies the presence of an emergency switch.)

We see in the information about Marconi installations of this general class two arrangements with regard to the key for the emergency transmitter. In one, the emergency transmitter has its own key. In the other, there is only one key altogether, with a switch to connect it either to the main transmitter or the emergency transmitter. I can't tell from the information available to me (including the "Father Browne" photo) which was in use for *Titanic*.

If (a) a common key was used on *Titanic* for both transmitters and (b) it was considered desirable for the key for the emergency transmitter to have an emergency switch, this could have led to the use of a key with an emergency switch as the key on *Titanic*, even though that might not be needed with the keying circuit presumably used for the main transmitter.

10 CONCLUSION—THE KEY

It seems that the common wisdom—that the key type seen in figure 11 is the type of key used for the main wireless transmitter of R.M.S. *Titanic*—is likely accurate.

11 ABOUT THE DOUBLE MAGNETIC KEY

As I mentioned above, we find it often stated that *Titanic*'s main transmitter utilized a *double magnetic key*, part of what I call "keying circuit D". It is a two relay assembly. And, as I mentioned, various considerations make me uncomfortable with that thought, thinking it more likely that transmitter used what I call "keying circuit B", which

would use a single keying relay, which some would call a *single magnetic key*.⁸

It may well be that the reason we see references to the double magnetic key is that very likely the transmitter in *Titanic*'s sister ship, *Olympic*, did use keying circuit D (and thus a double magnetic key).

And, owing to the paucity of information available about the details of *Titanic*'s wireless installation, often constructors of replicas of the Titanic Marconi room have (of necessity) based their work on information about the Olympic installation.

In fact the most famous of those cases is the replica commissioned by film director James Cameron for use in his epic film, "Titanic", which most accurately reflects the Olympic installation. Ironically, in the final cut, this only appears in a very brief scene.

In figure 17 we see a lovely specimen of a double magnetic key included (I fear inappropriately) in very nice replica of the Titanic Marconi room, built over many years by a British artisan, and on display in a local museum.

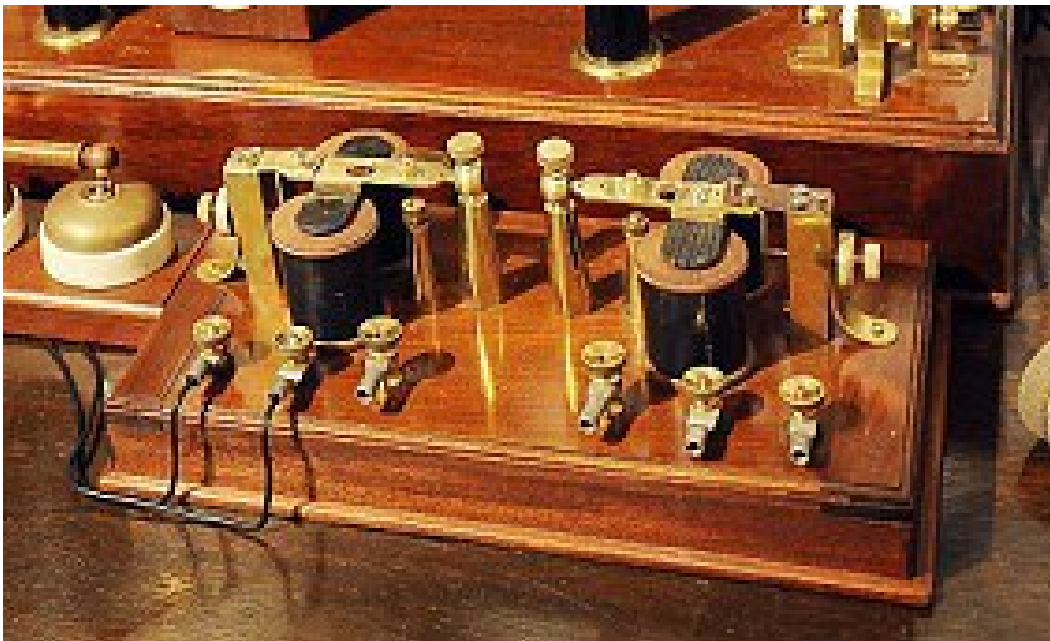


Figure 17. Double magnetic key

We see here, as we would expect, that the right hand relay (relay MG in my figure 9) has a laminated armature, as we would expect, given that it is to respond to AC (on a half cycle by half cycle basis, in fact). The left hand relay (MGA in my figure) does not appear to have a laminated armature, appropriate since it is operated by DC.

⁸ Although of course the term *single magnetic key* is often used to refer to the relay in what I call "keying circuit C", a wholly different kind of relay.

The wiring to this unit does not seem complete, understandable since there would have been so little information available to the builder about that.

Another example is from a wonderful three-dimensional computer-generated replica of much of the *Titanic* constructed as part of the computer "game" "Titanic: Honor and Glory", being developed by Four Funnels Entertainment Company. This seems to be one of the most "credible" reconstructions of the *Titanic* Marconi room I have seen, not surprising because a major consultant on this project is Parks Stephenson, noted *Titanic* expert (his expertise includes the wireless system, on which he has written extensively).

But it does (again, perhaps inappropriately) include a double magnetic key. We see a closeup of it in figure 18, actually taken from an article by Stephenson (used here under the doctrine of fair use).

This seems to be a very credible modeling of an actual double magnetic key. I am a little disturbed, however, by the fact the both the left and right relays have "laminated" armatures—I would expect the leftmost one (presumably relay MGA in my figure 9), being operated from DC, to not have one. But this may in fact accurately represent some double magnetic relay known to Stephenson. There is no reason that both relays in such a unit cannot have laminated armatures (even though it is not **required** for relay MGA).

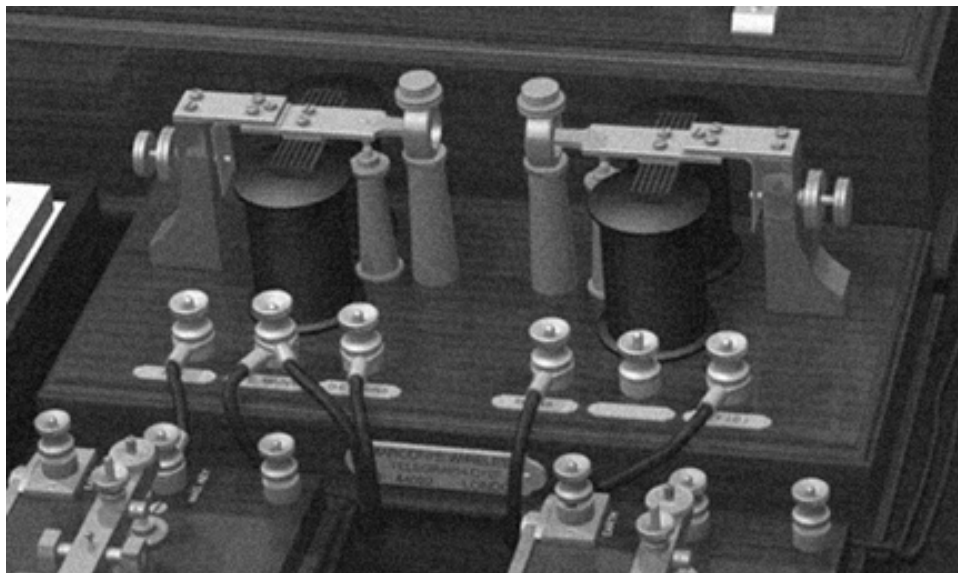


Figure 18. Double magnetic key (CGI)

From an article by
Parks Stephenson

Here, the wiring shown seems quite credible (although I had nothing authentic to check it against).

It is likely that terminals 1 and 3 (counting from the left) go to the coil of the relay I designate MGA in figure 9. Probably terminal 2 is just a

“tie point”; the 100 V DC supply is connected to terminals 2-3 and the key contacts to terminals 1-2.

Then terminals 4 and 6 are probably the “AC keying” terminals, in series with the AC feed to the transmitter itself.

But recall that, in my opinion, all that would pertain to the installation on *Olympic*, and not to that on *Titanic*.

12 ISSUE RECORD

Issue 1 (this issue), December 18, 2019—Initial issue

13 ABOUT THE AUTHOR

Douglas A. Kerr is a retired telecommunication engineer. The earliest part of his professional career was with the non-dissolved Bell Telephone system, culminating with a five year tenure with Bell Telephone Laboratories. He was also for five years president of DeVry Institute of Technology at Dallas, an accredited for-profit engineering technology college.

While with Bell Laboratories, Doug was active in the development of ASCII by an industry committee, and was a principal author and editor of the standards document for first complete version of the code (1967). He also invented and held the patent on the caps lock key.

Later in his career, Doug operated his own consulting practice, where a major activity was developing and teaching engineering seminars, some done through a major university but others done directly to telecom firms, telecom equipment manufacturers, and government agencies.

During that period Doug also from time to time gave expert testimony on telecom matters in civil suits and one criminal case.

Since his full retirement from professional practice, Doug has studied a wide range of topics and written over 125 technical articles on such diverse matters as the theory and practice of photographic exposure metering and the mechanisms of a reversible horse-drawn riding plow.

His only prior connection with *Titanic* is that when he and Carla were married (in 1999) she wore a dress closely modeled after the one worn by Kate Winslet as “Rose” in the 1997 movie, “*Titanic*”.

Doug and Carla live now in Alamogordo, New Mexico, U.S.A., “where the desert meets the mountains”.

14 ACKNOWLEDGMENTS

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Special thanks to Carla Kerr for her insightful copy editing of this difficult manuscript.

15 ISSUE RECORD

Issue 2, December 18, 2019 (this issue). Correct error in reference to HV transformer in section 3.3. Minor editorial corrections.

Issue 1, October 19, 2018. Initial Issue.

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