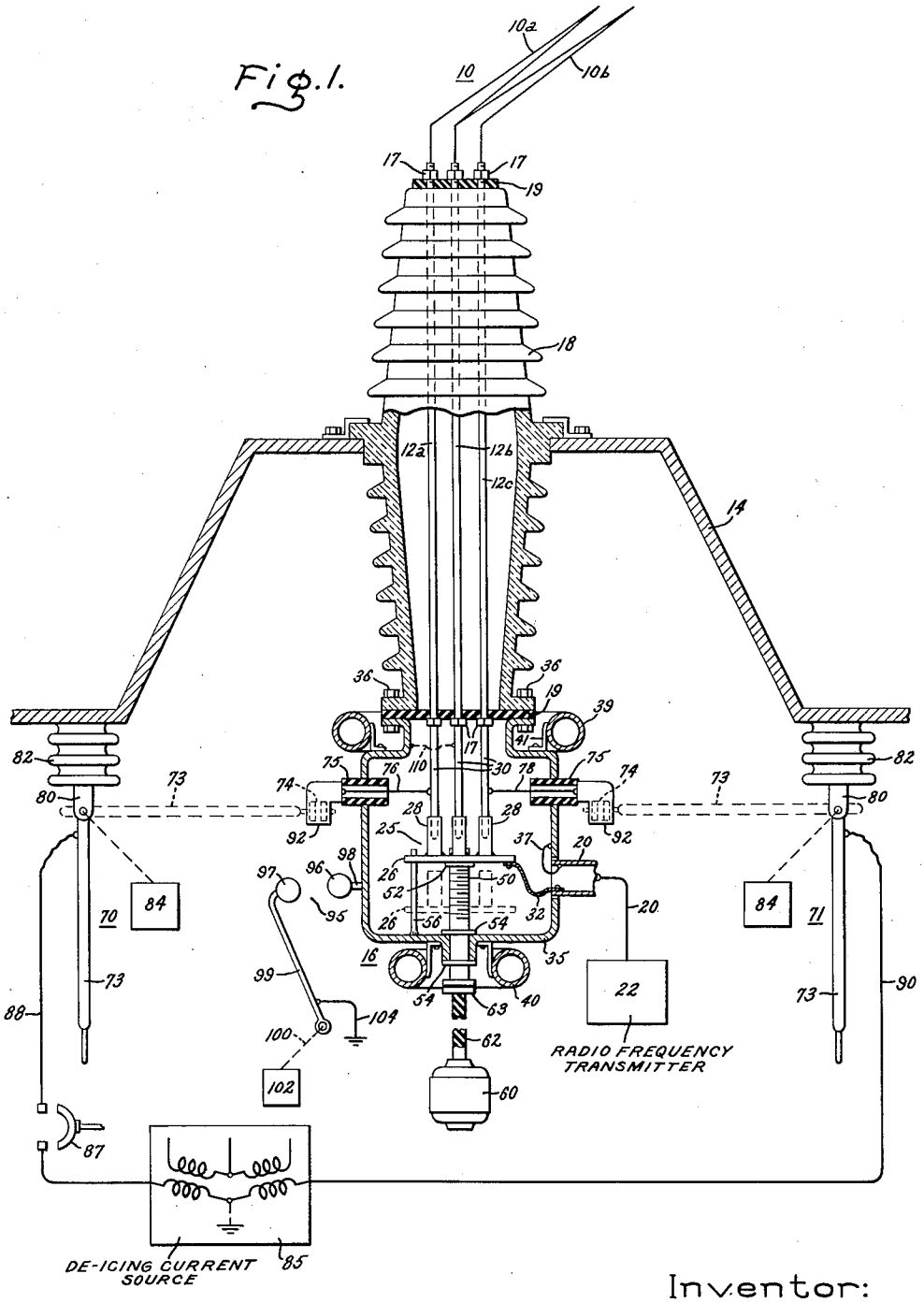
July 3, 1962 E. J. CASEY 3,042,918

ANTENNA ICE CLEARING SYSTEM

Filed Dec. 23, 1960 2 Sheets-Sheet 1

Fig. 1.



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ANTENNA ICE CLEARING SYSTEM

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Fig. 2.

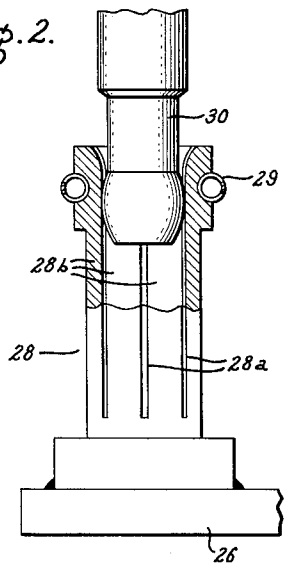
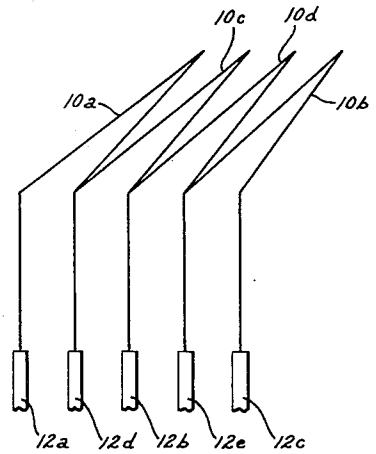


Fig. 3.



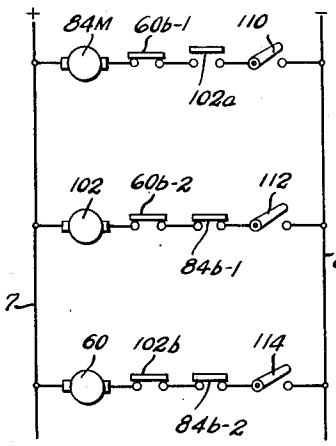


Fig. 4.

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ANTENNA ICE CLEARING SYSTEM

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12 Claims. (Cl. 343—704)

This invention relates to an antenna switching arrangement for controlling certain electrical connections in a radio transmitting system of the type that is provided with means for removing ice from the antenna of the system at desired intervals.

The usual approach to removing ice from a transmitting antenna is to circulate through the conductive sections of the antenna low frequency current capable of heating these sections sufficiently to melt the ice. As a general rule, the high voltage radio transmitter is disconnected from the antenna before the de-icing current is supplied thereto. When the ice has been melted by the de-icing current, the supply for the de-icing current is disconnected from the antenna, and the radio transmitter is reconnected to the antenna.

For performing the various switching operations involved in connecting and disconnecting the antenna and the radio transmitter and the antenna and the de-icing current supply, various switching arrangements have been proposed. But all those I am aware of have been unduly expensive and complicated and have consumed an excessive amount of space. For example, some of those proposed have required large numbers of disconnect switches mounted on insulators capable of withstanding the high voltages at which the radio transmitter is designed to operate. Such an arrangement is disadvantageous not only because of the high cost of such insulators and switches and the large amount of floor space required for such insulators and switches but also because of the complications involved in electrostatically shielding the many conductive parts of such high voltage switches to suppress corona formation that could interfere with radio transmission.

Accordingly, an object of my invention is to provide an antenna switching arrangement which is of a highly compact construction that readily lends itself to being electrostatically shielded by corona shielding of simple construction and reasonable size.

Another object is to construct the antenna switching arrangement in such a manner that it requires a near-minimum number of separate switches and high voltage insulators and consumes a near-minimum amount of floor space.

Another object is to construct the antenna switching arrangement in such a manner that, apart from the usual entrance bushing for the antenna feeder lines, it requires no supporting insulators that need be capable of withstanding the high operating voltage of the radio transmitter.

In carrying out my invention in one form, I provide an antenna switching arrangement comprising a plurality of spaced apart feeder lines for supplying current to an antenna and a tubular insulating housing surrounding said feeder lines. Electrically connected to one end of the respective feeder lines is a plurality of stationary disconnect contacts. A conductive casing supported on one end of the tubular insulating housing surrounds the stationary disconnect contacts. Within the casing is disposed a plurality of movable disconnect contacts for respectively mating with said stationary disconnect contacts. The movable disconnect contacts are mechanically connected together for movement in unison. Actuating means coupled to these movable contacts is provided for causing the movable contacts to move in unison into and out of engagement with the stationary disconnect contacts. A radio frequency current supply is provided for conducting radio frequency current to the switching arrangement, and the movable contacts are connected in parallel with each other and in series with this radio frequency current supply. Means is provided for supplying de-icing current to a predetermined pair of the antenna feeder lines when the disconnect contacts are out of engagement.

In a preferred form of my invention, the means for supplying de-icing current to the predetermined pair of feeder lines comprises a set of stationary de-icing contacts mounted on the exterior of said conductive casing, insulated from said conductive casing when the disconnect contacts are disengaged, and electrically connected to said predetermined pair of feeder lines, and a set of conductive switch blades for respectively engaging the stationary de-icing contacts to provide a power circuit through which de-icing current can be conducted to and from said two feeder lines.

For a better understanding of my invention, reference may be had to the following description taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is a schematic illustration of a radio transmitting system embodying one form of my invention.

FIG. 2 is an enlarged detailed view of a portion of the apparatus depicted in FIG. 1.

FIG. 3 is a schematic view of a slightly modified embodiment of my invention.

FIG. 4 shows an electrical interlock usable with the system of FIG. 1.

Referring now to the schematic illustration of FIG. 1, the radio transmitting system shown therein comprises an antenna panel **10** comprising two sections **10***a* and **10***b*. When the antenna panel is connected for transmitting, as is the case in FIG. 1, these sections **10***a* and **10***b* are connected in parallel with each other, as will soon be apparent. For conveying radio frequency energy to the antenna panel **10**, suitable feeder lines **12***a*, **12***b*, and **12***c*, which are electrically connected to the antenna panel **10** in parallel-circuit relationship during transmitting, are provided. These feeder lines extend from the antenna panel **10** through the roof **14** of a building in which the antenna switching arrangement **16** of the present invention is located. The feeder lines **12***a* and **12***c* are connected to the terminals of the antenna panel and the feeder line **12***b* is connected to the mid-point of the antenna panel.

For electrically insulating the feeder lines **12***a*, **12***b*, and **12***c* from the roof **14** through which they extend, a tubular insulating housing **18** of porcelain surrounding the feeder lines is provided. Preferably, the portion of each of the feeder lines **12***a*, **12***b*, and **12***c* extending through the porcelain housing **18** is a rigid conductive stud having nut **17** threaded on its opposite ends for clamping the porcelain **18** in compression. These clamping forces are transmitted to the opposite ends of the porcelain housing **18** through plates **19** of insulating material that are capable of locally insulating the feeder lines **12***a*, **12***b*, and **12***c* from each other.

When the antenna switching arrangement is in its solid-line, or transmitting, position of FIG. 1 the feeder lines **12***a*, **12***b*, and **12***c* are connected in parallel with each other, and this parallel combination is connected in series with a suitable transmission line **20** that conveys radio frequency energy to the feeders from a radio transmitter shown in block form at **22**. Since the feeders **12***a*, **12***b*, and **12***c* are connected in parallel with each other in FIG. 1, it will be apparent that sections **10***a* and **10***b* of the antenna panel **10** are likewise connected in parallel with each other during transmitting.

For providing a connection between the transmission line **20** and the feeders **12***a*, **12***b*, and **12***c*, a main switch

25 constituting a part of the antenna switching arrangement 16 is provided. This main switch 25 comprises a conductive cross-head 26 on which a plurality of tubular socket type contacts 28 are mounted. These socket type contacts 28 are preferably welded to the cross-head 26 to provide a good electrical connection between the cross-head and the socket contacts. Received within the socket contacts 28 are a series of plug-type contacts 30 that are electrically connected to the feeder lines 12*a*, 12*b*, and 12*c* respectively. As will soon be explained in greater detail, each of the socket contacts 28 tightly embraces its mating plug contact and thus provides a good electrical connection between the mating plug and socket contacts. A preferred construction for the mating plug and socket contacts is shown in the enlarged sectional view of FIG. 2. Here the socket contact 28 is constructed as a tube provided with slots 28*a* extending longitudinally of the tube from its outer end to define radially yieldable fingers 28*b* between the slots. These slots 28*b* are urged radially into engagement with the plug 30 by means of a suitable spring arrangement 29 encircling the tubular socket contact 28. The conductive cross-head 26 that carries the socket contacts 28 is electrically connected to the tubular transmission line 20 by means of flexible conductive braids 32 that permit the cross head 26 to be moved with respect to the transmission line 20.

The radio transmitter of the present invention is intended to operate at extremely high voltages, such as, for example, 330 kv. At such voltages, corona can, of course, be a serious problem.

For electrostatically shielding the high voltage parts of the main switch 25 in order to suppress the formation of corona therefrom, a metallic casing 35 surrounding the parts of the main switch 25, and acting as a corona shield, is provided. This casing 35 is supported on the lower end of the porcelain housing 18 of the entrance bushing and is fixed thereto by suitable means such as bolts 36. This casing 35 is electrically connected to the radio frequency transmission line 20 by means of a suitable conductive braid 37 so that the casing 35 and the transmission line 20 are at the same potential. In addition, the casing 35 is electrically connected to the conductive cross-head 26 by means of the conductive braids 32 and 37 so that the cross-head 26 and the casing 35 are always at the same potential. Thus, so long as the main switch 25 is closed, its parts are at the same potential as the surrounding casing 35, and there is therefore no dielectric stress internally of the casing 35. The electric field is disposed entirely outside of the casing 35. The casing 35 has a smooth, rounded external surface largely devoid of sharp projections, and this contributes, in a known manner, to an electric field configuration which is devoid of stress concentrations that could be a potential source of electrical breakdown. There is a region at the junction between the casing 35 and porcelain housing 18 where the electric field tends to concentrate, but this tendency is counteracted by an electrostatic shielding toroid 39 surrounding this junction region and suitably fixed to the casing 35, as by brackets 41. The smooth external configuration of this shielding toroid 39 tends to prevent the electrical field from concentrating in this junction region. There is another region at the bottom of the casing 35 which contains some sharp edges that have a tendency to distort and concentrate the electric field, but this tendency is likewise counteracted by a similar shielding toroid 40 with a smooth external configuration surrounding this region.

Since heavy formations of ice on an antenna tend to detune it and to impose excessive mechanical loads on its components, it is highly desirable that some means be provided for removing accumulated ice from the antenna. In the system of FIG. 1, ice removal is accomplished by circulating through the sections 10*a* and 10*b* of the antenna panel a low frequency current that heats the sections 10*a* and 10*b* sufficiently to melt any ice accumulated

thereon. In a preferred form of my invention, the voltage to ground the de-icing circuit is very much lower than the operating voltage of the transmitter, for example, 7.2 kv. as compared to the 330 kv. operating voltage of the transmitter. Before this relatively low voltage de-icing current is supplied to the antenna, however, it is necessary first to de-energize the radio transmitter and then to disconnect the antenna from the radio transmitter 22. De-energization of the radio transmitter is effected by means of a suitable circuit breaker (not shown) connected in a low voltage circuit of the transmitter. Disconnection of the antenna from the transmitter is then effected by opening the main switch 25.

Opening of the main switch 25 is effected by driving the cross-head 26 downwardly to separate the socket contacts 28 from the plug contacts 30. For producing this downward motion of the cross-head, a lead screw 50 that is threaded into a hub portion 52 of the cross-head 26 is provided. This lead screw 50 is journaled in the casing 35 for free rotation therein but is suitably prevented from moving axially with respect to the casing 35, as by means of a pair of spaced shoulders 54 disposed on opposite sides of the casing wall. The cross-head 26 is prevented from rotating relative to the casing 35 by means of a guide pin 56 that is fixed to the casing 35 and projects through a guide opening in the cross-head 26. Thus, when the lead screw 50 is rotated in a suitable direction, its threads coact with the threads in the hub 52 to force the cross-head 26 downwardly. This downward motion of the cross-head 26 separates the socket contacts 28 from the plug contacts 30, and thus establishes the desired isolating gap between the contacts 28 and 30. The position of cross-head 26 and the socket contacts 28 at the end of this downward operating stroke are shown by the dotted lines of FIG. 1.

For rotating the lead screw 50 to effect this separation of the contacts 28 and 30, an electric motor 60, preferably at ground potential, is provided. This motor 60 is coupled to the lead screw by means of a long shaft 62 of insulating material and a suitable flexible coupling 63. The flexible coupling 63 and the lower part of lead screw 50 are all disposed within the confines of the lower shielding toroid 40 so that the toroid 40 acts as a corona shield about these parts which prevents them from acting as a potential source of dielectric breakdown. Since the motor 60 is at ground potential, the insulating shaft 62 must be long enough to withstand the full operating voltage that is present between the housing 35 and ground.

With the main switch 25 thus opened, the next step in preparing for a de-icing operation is to close a pair of disconnect switches 70 and 71 disposed at opposite sides of the metallic casing 35. These disconnect switches, which are referred to hereinafter as de-icing switches, are preferably of the type shown and claimed in Patent No. 2,741,672—Harrison, assigned to the assignee of the present invention. To facilitate an understanding of the present invention, these switches have been shown in a simplified schematic form. In the schematic form shown, each of these de-icing switches comprises a conductive blade 73 that is movable into and out of engagement with a stationary contact 74 mounted on the metallic casing 35. Each of these stationary contacts 74 is mounted on a hollow insulating bushing 75 which electrically insulates its corresponding stationary contacts from the metallic casing 35 when the contacts of the main switch 25 are disengaged. Extending through the center of each insulating bushing 75 is a conductor that electrically connects one of the stationary contacts 74 and one of the antenna feeder lines 12*a* or 12*c*. The conductor that electrically interconnects stationary contact 74 of switch 70 and the feeder line 12*a* is designated 76, and the conductor that electrically connects the other stationary contact 74 and the feeder line 12*c* is designated 78.

The blade 73 of each de-icing switch 70 or 71 is pivot-

ally mounted at one end on a stationary hinge **80** that is carried at the lower end of an insulating column **82** suitably secured at its top end to the roof structure **14**. This blade **73** has a vertically extending fully-open position that is shown in solid lines and a horizontally extending fully-closed position that is shown in dotted lines. For driving the blade **73** between its fully open position shown in solid lines and its fully closed position shown in dotted lines, a suitable operating mechanism **84**, schematically shown in block form, is provided. When the blade **73** of the two de-icing switches **70** and **71** have been operated into their dotted line fully-closed position, a power circuit is prepared for de-icing current to be supplied from a suitable source **85** of de-icing current to the antenna panel **10**. This de-icing circuit extends from one terminal of the de-icing current source **85**, through the series combination of a suitable circuit breaker **87**, conductor **88**, switchblade **73**, stationary contact **74**, conductor **76**, feeder line **12***a*, sections **10***a* and **10***b* of the antenna panel **10**, feeder line **12***c*, conductor **78**, the other stationary contact **74** and blade **73**, and conductor **90** back to the other terminal of the de-icing current source **85**. When the circuit breaker **87** is closed it completes this de-icing circuit and thus causes de-icing current to flow through the series combination of antenna sections **10***a* and **10***b* over the de-icing circuit. After this current has heated the antenna sections **10***a* and **10***b* sufficiently to melt any ice that had accumulated thereon, the circuit breaker **87** is opened to terminate the de-icing operation. The operating mechanisms **84** for the de-icing switches **70** and **71** are then energized to swing the blade **73** from their dotted-line closed positions into their solid-line open positions, so as to isolate the de-icing circuit from the high voltage radio frequency current that will be applied to the antenna feeders during subsequent transmitting.

Transmitting can be resumed after the de-icing switches **70** and **71** have been swung into their solid line open positions by first closing the main antenna switch **25** and then re-energizing the radio transmitter by suitable means (not shown). This closing of the main switch **25** is effected simply by operating the motor **60** in a direction reversed with respect to its opening operating direction to drive the cross-head **26** upwardly from its dotted line position into its solid line position of FIG. 1.

Suitable electrical interlocks soon to be described are provided to assure that the various operations involved in terminating transmitting, in de-icing, and in resuming transmitting are performed in the correct sequence.

During transmitting, the stationary contacts **74** of the de-icing switches **70** and **71** are at the same voltage as the lower ends of the antenna feeder lines **12***a* and **12***c* since they are connected to the lower ends of the antenna feeder lines **12***a* and **12***c* through the conductors **76** and **78**, respectively. For suppressing corona formation from these high voltage contacts during transmitting, suitable metallic corona shields **92** are provided about these contacts **74**. These corona shields are at the same potential as the contacts **74** and have a smooth rounded external configuration that suppresses corona formation in a well-known manner. The corona shields **92** are of a generally U-shaped configuration so as to permit entry of the blades **73** into engagement with the stationary contacts **74**.

It is most important that the radio frequency circuit be protected against damage from overvoltages, such as could result from possible lightning strokes to the antenna **10**. In a preferred embodiment of the present invention, the equipment for providing this protection has been incorporated directly into the antenna switching arrangement. This equipment comprises a grounding switch **95** that comprises a pair of relatively movable, large diameter, spherical electrodes **96** and **97**. Electrode **96** is a stationary electrode which is both supported on the corona casing **35** and electrically connected thereto by means of a conductive rod **98**. Electrode **97** is a movable electrode that is carried on one end of a conductive arm **99**, the other end of which is secured to a rotatably mounted shaft **100**. A suitable operating mechanism shown in block form at **102** is coupled to this shaft **100** for driving the movable electrode **97** into and out of engagement with the stationary electrode **96**. The conductive arm **99** is suitably connected to ground as shown at **104**.

In its open position depicted in FIG. 1, the grounding switch **95** provides a flashover gap between its electrodes **96**, **97** that is set to break down at a voltage slightly higher than the voltage at which the radio transmitter operates. Thus, under ordinary operating conditions the flashover gap between electrodes **96**, **97** remains intact and does not affect the transmitting operation. However, should an abnormal overvoltage condition develop due to lightning or some other possible cause, the gap will flash over and provide a low impedance bypass to ground which abruptly lowers the voltage of the radio frequency circuit and protects its parts from damage by the overvoltage.

To assure that the gap between electrodes **96** and **97** effectively protects the parts of the radio frequency circuit from overvoltage, the breakdown voltage of the gap is set at a considerably lower level than the voltage required to flash over bushing **18** or to flash over the insulating operating rod **62**. Generally speaking, the breakdown voltage of the gap is set at a value below the breakdown voltage of all the insulation to ground for the high voltage radio frequency circuit. The spherical electrodes **96** and **97** are sufficiently large that they do not constitute a source of corona during transmitting.

Before the de-icing circuit is placed in operation, the electrode **97** of grounding switch **95** is driven into engagement with the stationary electrode **96** thus connecting the corona casing **35** solidly to ground. This connection to ground assures that during de-icing, no high voltages will be built up on the casing **35** or the de-icing circuit due to possible inductive couplings with or leakage currents from the radio frequency circuit. It is to be understood that the electrical interlocks mentioned hereinabove assure that the grounding switch **95** is open during radio transmission and closed during the de-icing operation.

A typical interlock arrangement for assuring the correct sequence of operations is shown in FIG. 4. Here the electrical motors for operating the various switches are shown connected across a source of control power comprising a positive bus **7** and a negative bus **8**. The motor for operating the two de-icing switches is shown at **84M**; the motor for operating the grounding switch **95** is shown at **102**; and the motor for operating the main antenna switch **25** is shown at **60**.

Connected in series with the motor **84M** across the control power source **7**, **8** are switches **60***b*–**1** and **102***a*, and a manually-controlled switch **110**. The switch **60***b*–**1** is suitably coupled to a moving part of the main antenna switch **25** so that it is closed when the main antenna switch **25** is open and is open when the main antenna switch **25** is closed. The switch **102***a* is suitably coupled to a moving part of the grounding switch **95** so that it is open when the grounding switch **95** is open and is closed when the grounding switch **95** is closed.

Connected in series with the grounding switch motor **102** across the control power source **7**, **8** is another switch **60***b*–**2**, a switch **84***b*–**1**, and manually-controlled switch **112**. The switch **60***b*–**2** is suitably coupled to a moving part of the main antenna switch **25** so as to be closed when the main antenna switch **25** is open and open when the main antenna switch **25** is closed. Switch **84***b*–**1** is suitably coupled to a moving part of one of the de-icing switches **70** or **71** so as to be closed when the de-icing switches are open and open when the de-icing switches are closed.

Connected in series with the motor 60 across the control power source 7, 8 are switches 102*b*, 84*b*–2, and manually-operable switch 114. The switch 102*b* is suitably coupled to a moving part of the grounding switch 95 so as to be closed when the grounding switch 95 is open and open when the grounding switch 95 is closed. The switch 84*b*–2 is suitably coupled to a moving part of one of the de-icing switches 70 or 71 so as to be closed when the de-icing switches are open and open when the de-icing switches are closed.

The various control switches of the interlock of FIG. 4 are depicted in the position they occupy when all of the main switches are open. If it were desired to initiate a transmitting operation, manually-operable switch 114 could be closed to energize motor 60 for the main antenna switch through a circuit comprising the then-closed switches 102*b* and 84*b*–2. When the main antenna switch closed in response to energization of its operating motor 60, switches 60*b*–1 and 60*b*–5 would open. This would prevent either the de-icing switch motor 84M or the grounding switch motor 102 from operating to close their respective main switches so long as the main antenna switch 25 is closed. In order to initiate a de-icing operation, it would be necessary to open the main antenna switch 25 and to close the grounding switch 95. Opening the main antenna switch 25 would restore all the switches of FIG. 4 to their position shown in FIG. 4. With switches 60*b*–2 closed as shown in FIG. 4, the grounding switch motor 102 can be energized by closing its manually-operable switch 112. This results in closing of the grounding switch 95. Closing of the grounding switch 95 causes the contacts 102*a* to close, thus permitting the de-icing switches 70 and 71 to be closed by operation of the manually-operable switch 110. While the de-icing switches 70 and 71 are closed, the main antenna switch 25 cannot be closed because the interlock switch 84*b*–2 in series with the motor 60 is open. Similarly, while the grounding switch 95 is closed, the main antenna switch 25 cannot be closed because the switch 102*b* connected in series with the motor 60 for the main antenna switch is then open.

A particular advantage of my antenna switching arrangement is that, apart from the entrance bushing 18 for the antenna feeder lines, it requires no supporting insulators that need be capable of withstanding the high operating voltages of the radio transmitter. This, of course, is of considerable importance from a cost viewpoint since insulators rated for 330 kv. voltages are quite expensive. Since the entrance bushing 18 is required whether or not any switching arrangement is included in the radio transmitting system, it will be apparent that the expense of even this insulator cannot be attributed to the antenna switching arrangement.

One particular switching arrangement that has been proposed for the general type of application described hereinabove has required separate disconnect switches for each of the feeder lines 12*a*, 12*b*, and 12*c*. This arrangement required at least two 330 kv. supporting insulators for each of these switches. The present arrangement not only makes it possible to eliminate all of these 330 kv. supporting insulators but allows all of the separate switches to be replaced by a single contact structure 25 that can readily be housed within a corona shield 35 of reasonable size and simple construction. Had three separate switches been utilized, the space consumed would have been much larger and separate corona shielding would have been required for the high voltage parts of each switch, thus greatly complicating the shielding problems. Had five antenna feeder lines been employed (as in FIG. 3) and hence five separate disconnect switches been relied upon, the space consumed would have been still greater and the shielding problems would have been even more complicated. The present arrangement lends itself to still greater numbers of feeder lines since these

can be accommodated simply by adding more socket contacts 28 to the cross-head 26.

It will be apparent that the antenna switching arrangement of the present invention requires very little floor space inasmuch as the major parts of the main antenna switch 25 are all suspended from an insulator mounted on the roof 14 of the building containing the switching arrangement. The fact that the stationary contact of each de-icing switch 70 or 71 is supported on the entrance bushing 18 and the fact that the other end of the de-icing switch is suspended from an insulator secured to the roof structure 14 also contribute toward reducing the amount of floor space required by my antenna switching arrangement.

By supporting the stationary electrode of the grounding switch 33 on the corona casing 35 and thus using the entrance bushing 18 as its insulating support, I have obviated the need for separate insulators to support the components of this switch. Also by using the grounding switch as a combined grounding switch and an insulation coordinating gap, I have eliminated the need for a separate protective gap to provide insulation coordination and overvoltage protection.

Although FIG. 1 shows only three feeder lines leading to the antenna panel 10, it is to be understood that more of these feeder lines could be supported within the insulating housing 18 and suitably connected to an antenna panel, if necessary or desirable. For example, in FIG. 3, there are shown five feeder lines leading to the antenna panel 10 and appropriately connected thereto. The outer two feeder lines 12*a* and 12*c* correspond to identically designated feeder lines in FIG. 1 and serve during de-icing to conduct de-icing current to and from the panel 10, as in FIG. 1. This de-icing current would flow through the series combination of panel sections 10*a*, 10*c*, 10*d*, and 10*b* since the intermediate feeder lines 12*b*, 12*d*, and 12*e* would not be connected to the de-icing current source during de-icing, as is the case with the intermediate feeder line 12*b* in FIG. 1. During radio transmission, however, all of the feeder lines are connected in parallel as in FIG. 1 since each feeder line is provided with a plug and socket contact corresponding to the plug 30 and socket contact 28 of FIG. 1.

Although I have shown center feeder line 12*b* of my antenna switching arrangement isolated from the casing 35 during de-icing, it is to be understood that for certain types of de-icing current sources, this center feeder line could desirably be connected to the casing, as indicated by the dotted lines 110 of FIG. 1. For example, when the source of de-icing current is two phases of a polyphase transformer with a grounded neutral, as is indicated inside the block 85, it is desirable during de-icing to connect the center feeder line 12*b* to ground through connection 110, the casing 35 and the grounding switch 95.

While I have shown and described a particular embodiment of my invention, it will be obvious to those skilled in the art that various changes and modifications may be made without departing from my invention in its broader aspects and I, therefore, intend in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. An antenna switching arrangement comprising a plurality of spaced-apart feeder lines for supplying current to an antenna, a tubular insulating housing surrounding said feeder lines, a plurality of stationary disconnect contacts respectively connected to one end of said feeder lines, a conductive casing supported on one end of said tubular insulating housing and surrounding said stationary disconnect contacts, movable disconnect contacts within said housing for respectively mating with said stationary disconnect contacts, means for mechanically connecting said movable contacts together for movement in unison,

actuating means coupled to said movable contacts for causing said movable contacts to move in unison into and out of engagement with said stationary disconnect contacts, a radio frequency transmission line for conveying radio frequency current to said switching arrangement, conductive means for connecting said movable contacts in parallel with each other and in series with said radio frequency transmission line, and means for conducting de-icing current to and from a predetermined pair of said feeder lines when said disconnect contacts are out of engagement.

2. The switching arrangement of claim 1 in combination with means for electrically connecting said feeder lines to said conductive casing when said disconnect contacts are in engagement whereby said casing is then at substantially the same potential as said disconnect contacts, said casing having a smooth, external configuration that renders it capable of serving as a corona shield for said disconnect contacts.

3. The antenna switching arrangement of claim 1 in which the means for conducting de-icing current to said predetermined pair of feeder lines comprises a pair of disconnect switches located externally of said conductive casing, each of said switches comprising a stationary de-icer contact and a circuit controlling member movable into and out of engagement with said stationary de-icer contact, means for mounting each of said stationary de-icer contacts on said conductive casing externally thereto and for electrically insulating said stationary contacts from said conductive casing when said disconnect contacts are disengaged, and means for electrically connecting said stationary de-icer contacts to said predetermined pair of antenna feeder lines.

4. The antenna switching arrangement of claim 1 in combination with a motor at ground potential for supplying the force for engaging and disengaging said disconnect contacts, and means of insulating material for mechanically coupling said motor to said movable disconnect contacts and for electrically isolating said motor from said movable disconnect contacts.

5. An antenna switching arrangement comprising a plurality of spaced-apart feeder lines for supplying current to an antenna, a tubular insulating housing surrounding said feeder lines, a plurality of stationary disconnect contacts respectively connected to one end of said feeder lines, a conductive casing supported on one end of said tubular insulating housing and surrounding said stationary disconnect contacts, movable disconnect contacts within said housing for respectively mating with said stationary disconnect contacts, means for mechanically connecting said movable contacts together for movement in unison, actuating means coupled to said movable contacts for causing said movable contacts to move in unison into and out of engagement with said stationary contacts, a radio frequency transmission line for conveying radio frequency current to said switching arrangement, conductive means for connecting said movable contacts in parallel with each other and in series with said radio frequency transmission line, means for electrically connecting said feeder lines to said housing when said disconnect contacts are in engagement whereby said housing is then at substantially the same potential as said disconnect contacts, and means for conducting de-icing current to and from a predetermined pair of said feeder lines when said disconnect contacts are out of engagement comprising a set of stationary de-icer contacts disposed externally of said conductive housing, insulating means for mounting said stationary de-icer contacts on said conductive housing and for maintaining at least one of said stationary contacts at a higher voltage than said casing while de-icing current is flowing through said de-icer contacts, means for electrically connecting said stationary contacts to said predetermined pair of antenna feeder lines, and a set of conductive switch blades for respectively engaging said stationary de-icer contacts to provide a power circuit through which de-icing current can be conducted to and from said pair of feeder lines.

6. In a radio transmitting system comprising an antenna panel, a tubular insulating housing, at least three spaced-apart feeder lines extending through said insulating housing for carrying radio frequency current to said panel, two of said feeder lines being respectively connected to opposite terminals of said panel and the other of said feeder lines being connected to at least one intermediate circuit point on said panel, the improvement comprising a plurality of stationary disconnect contacts respectively connected to one end of said feeder lines, a conductive casing supported on one end of said tubular insulating housing and surrounding said stationary disconnect contacts, movable disconnect contacts within said housing for respectively mating with said stationary disconnect contacts, means for mechanically connecting said movable disconnect contacts together for movement in unison, actuating means coupled to said movable contacts for causing said movable contacts to move in unison into and out of engagement with said stationary contacts, a radio frequency transmission line for conveying radio frequency current to said switching arrangement, conductive means for connecting said movable contacts in parallel with each other and in series with said transmission line, and switching means operable when said disconnect contacts are out of engagement for connecting the two feeder lines that are connected to the terminals of said panel across a source of de-icing current.

7. The switching arrangement of claim 1 in combination with a grounding switch comprising a pair of relatively movable electrodes, means for supporting one of said electrodes on said casing and for electrically connecting said one electrode to said casing, means for connecting the other of said electrodes to ground, and means for moving said other electrode into engagement with said one electrode when said disconnect contacts are out of engagement.

8. The switching arrangement of claim 1 in combination with a grounding switch comprising a pair of relatively movable electrodes, means for supporting one of said electrodes on said casing and for electrically connecting said one electrode to said casing, means for connecting the other of said electrodes to ground, means for moving said other electrode into engagement with said one electrode when said disconnect contacts are out of engagement and for moving said other electrode into a predetermined position spaced from said one electrode when said disconnect contacts are engaged, said two electrodes defining when said other electrode is in said predetermined position a flash-over gap having a breakdown voltage slightly greater than normal radio transmitting voltage and less than the lowest breakdown voltage to ground of any insulation in the radio frequency transmitting circuit.

9. An antenna switching arrangement comprising a plurality of spaced-apart feeder lines for supplying current to an antenna, a tubular insulating housing surrounding said feeder lines, a plurality of stationary disconnect contacts respectively connected to one end of said feeder lines, a conductive casing supported on one end of said tubular insulating housing and surrounding said stationary disconnect contacts, movable disconnect contacts within said housing for respectively mating with said stationary disconnect contacts, means for moving said movable disconnect contacts into and out of engagement with said stationary disconnect contacts, a radio frequency transmission line for conveying radio frequency current to said switching arrangement, conductive means for connecting said movable contacts in parallel with each other and in series with said radio frequency transmission line, and means for conducting de-icing current to and from a predetermined pair of said feeder lines when said disconnect contacts are out of engagement.

10. The antenna switching arrangement of claim 9 in

which the means for conducting de-icing current to said predetermined pair of feeder lines comprises a pair of disconnect switches located externally of said conductive casing, each of said switches comprising a stationary de-icer contact and a circuit controlling member movable into and out of engagement with said stationary de-icer contact, means for mounting each of said stationary de-icer contacts on said conductive casing externally thereto and for electrically insulating said stationary contacts from said conductive casing when said disconnect contacts are disengaged, and means for electrically connecting said stationary de-icer contacts to said predetermined pair of antenna feeder lines.

11. The antenna switching arrangement of claim 9 in which the means for conducting de-icing current to said predetermined pair of feeder lines comprises a pair of disconnect switches located externally of said conductive casing, each of said switches comprising a stationary

de-icer contact and a circuit controlling member movable into and out of engagement with said stationary de-icer contact, means for mounting each of said stationary de-icer contacts on said conductive casing externally thereto and for electrically insulating said stationary contacts from said conductive casing when said disconnect contacts are disengaged, and means for electrically connecting said stationary de-icer contacts to said predetermined pair of antenna feeder lines.

12. The antenna switching arrangement of claim 9 in combination with a motor at ground potential for supplying the force for engaging and disengaging said disconnect contacts, and means of insulating material for mechanically coupling said motor to said movable disconnect contacts and for electrically isolating said motor from said movable disconnect contacts.

No references cited.