

United States

Deming

1) 3,768,018

5) Oct. 23, 1973

X5439W

[54] TRANSMITTER-RECEIVER ALIGNMENT
SYSTEM AND METHOD

[75] Inventor: Andrew F. Deming, Alliance, Ohio

[73] Assignee: The Alliance Manufacturing
Company, Inc., Alliance, Ohio

[22] Filed: Mar. 30, 1972

[21] Appl. No.: 239,452

[52] U.S. Cl. 325/67, 325/133, 325/134,
325/363, 325/364, 325/428, 325/455

[51] Int. Cl. H04b 1/00

[58] Field of Search. 325/67, 133, 134,
325/363, 364, 428, 429, 455

[56] References Cited

UNITED STATES PATENTS

3,272,920	9/1966	Meurer	325/363
3,009,057	11/1961	Glaser	325/67
2,837,636	6/1958	Richard	325/363

3,512,089 5/1970 Cushman 325/67

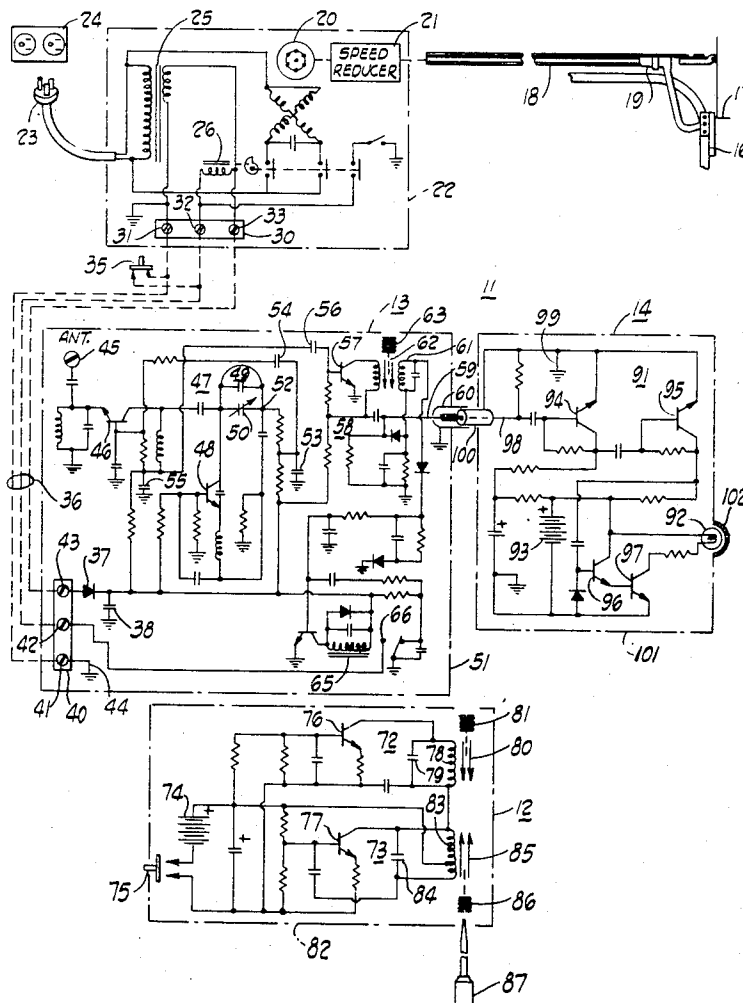
Primary Examiner—Albert J. Mayer

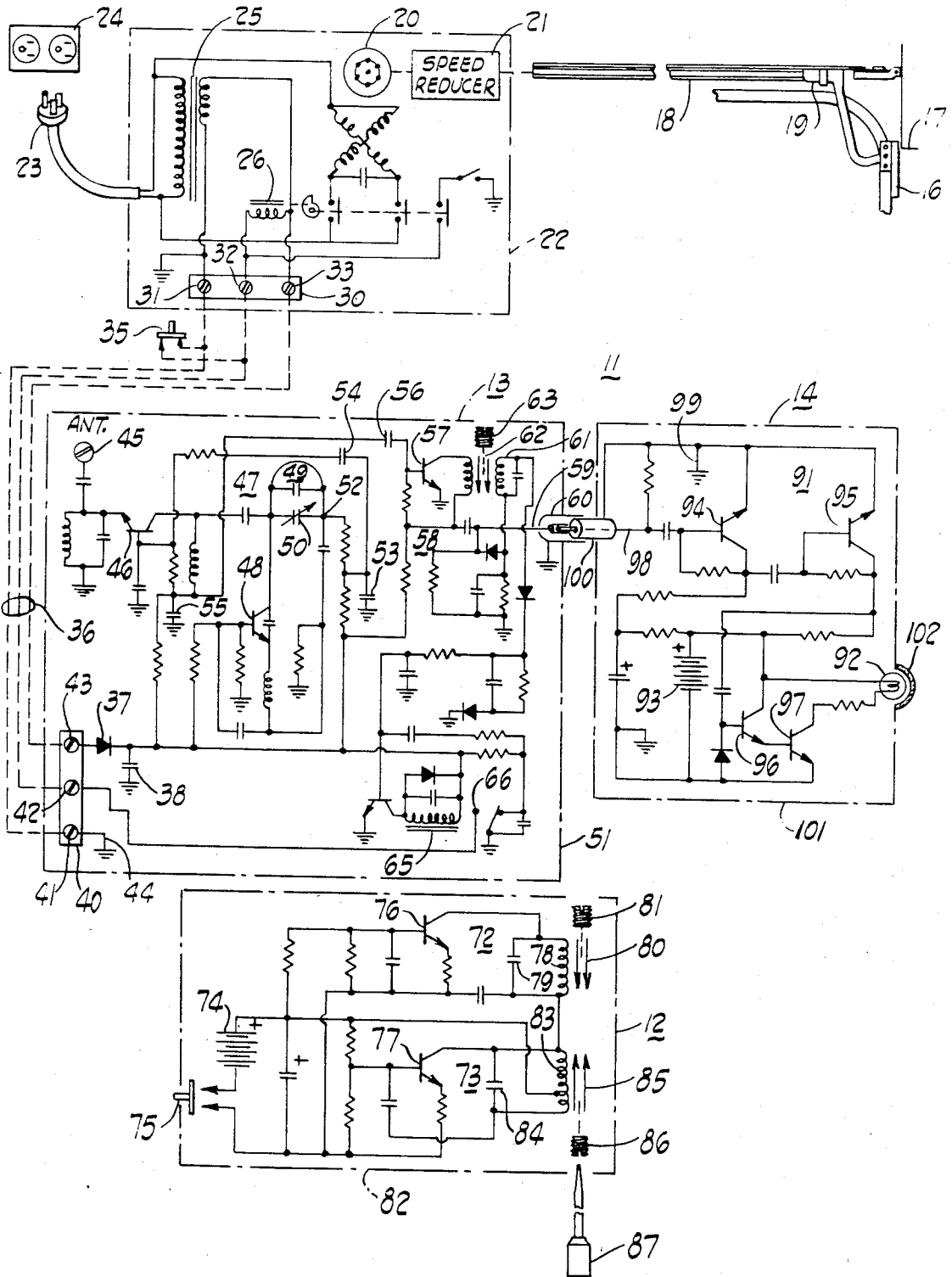
Attorney—George V. Woodling et al.

[57] ABSTRACT

An alignment system to align the frequencies of a transmitter and receiver is disclosed. The modulation frequency of the transmitter is tunable and may be aligned to that of the receiver by radiating a signal into an unenergized receiver. Induction coupling between the transmitter and receiver establishes transfer of energy into the modulation frequency circuits of the receiver. An alignment indicator which includes an amplifier and an output indicator lamp may be plugged into the test point jack of the receiver. The alignment indicator accordingly amplifies the modulation frequency signal in the receiver and the lamp glows most brightly when the transmitter and receiver are correctly aligned.

20 Claims, 1 Drawing Figure





TRANSMITTER-RECEIVER ALIGNMENT SYSTEM AND METHOD

BACKGROUND OF THE INVENTION

Many different means for aligning the frequencies of a transmitter and a receiver have been devised. The general method is to utilize relatively expensive, complex and somewhat delicate instruments for this purpose such as oscilloscopes, frequency generators and vacuum tube voltmeters. These instruments are readily available to the manufacturing company which manufactures the transmitters and receivers and their use is also readily understood by personnel at such manufacturing facilities. Accordingly, it is natural that such complex and laboratory type instruments would be used.

In the remote control of devices such as a radio-controlled garage door operator, it has been customary to use a hand-sized battery operated transmitter in the automobile and a receiver adjacent the motor for the garage door operator. Such receiver may be powered from the same source as the motor which usually is a commercial frequency voltage source, e.g., 120 volt, 60 Hz. A transmitter-receiver pair is thus required for the remote control of the garage door operator and it has been customary to package such units in pairs, for example, 12 pairs to a box, as sold to distributors and wholesalers. It also has been customary that many customers who can afford the remote control garage door operators often have more than one automobile. With a two-car garage, the double garage door needs to be operated from two different transmitters, one in each of the two automobiles. It is therefore customary to supply additional transmitters to distributors and wholesalers so that the customers desiring a second transmitter will be able to purchase them. With garage door openers being distributed throughout the continental United States, there are many different types of distributors. Many are radio and television sales and service dealers who have sophisticated instruments for aligning the extra transmitter. However, many are lumbermen who sell finished lumber to contractors for building houses and who also have garage doors for sale and then also sell garage door openers. Many such distributors do not have available sophisticated electronic equipment nor do they have readily available personnel who could operate such costly, expensive and bulky laboratory-type equipment.

Most remote control transmitter-receiver combinations today have not only a carrier frequency but a modulation frequency in order to increase the security of the customer's garage. The garage may be attached to the house and hence for security reasons, different codes of carrier modulation frequencies are available to make it difficult for a lawbreaker to gain access to the garage or house. There might be twelve different carrier frequencies and 12 different modulation frequencies, as an example. A transmitter-receiver pair may be easily packaged twelve pairs to a box with all at a single carrier frequency and one pair each of the twelve different modulation frequencies. However, the extra transmitters supplied to the distributor or wholesaler would add considerable complexity in the distribution and warehousing problems if such transmitters had to be furnished in all 144 combinations of carrier and modulation frequencies.

Accordingly, an object of the invention is to considerably reduce the distribution and warehousing problems in transmitters and receivers.

Another object of the invention is to provide an alignment system to easily align the frequencies of a transmitter and receiver combination.

Another object of the invention is to provide a method of aligning the frequencies of a transmitter and receiver by a person without any electronic skill or training.

Another object of the invention is to provide an alignment indicator with a lamp which indicates by its brilliance the degree of alignment of a transmitter-receiver pair.

Another object of the invention is to provide a system wherein the number of transmitters required to be distributed and warehoused is clearly reduced.

SUMMARY OF THE INVENTION

The invention may be incorporated in a transmitter-receiver alignment system, comprising in combination, a transmitter capable of transmitting a given carrier frequency, a receiver capable of receiving said given carrier frequency, each said transmitter and receiver having tunable frequency circuit components, a connection on said receiver near the output thereof to have available thereat one of the carrier and modulation frequencies of the particular circuit components therein, an alignment indicator including an amplifier for alternating voltages and an output indicator means, means connecting the input of said alignment indicator amplifier to said receiver connection, means establishing radiation coupling between said transmitters and receiver, means supplying operating voltages to said transmitter and alignment indicator to establish in the circuit components of the receiver a signal from the transmitter to condition the receiver for an output at said connection, and means for tuning the frequency of the circuit components of one of said transmitter and receiver until the alignment indicator output means indicates that the transmitter is transmitting to the receiver a frequency corresponding to the tuning of the circuit components within said receiver.

Other objects and a fuller understanding of the invention may be had by referring to the following description and claims, taken in conjunction with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

The single FIGURE of the drawing is a schematic diagram of an alignment system and method of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The drawing illustrates schematically an alignment system 11 to align the frequencies of a transmitter 12 and receiver 13 by use of an alignment indicator 14. The transmitter-receiver 12,13 may be used in the remote control of movement of a load shown as a door 16. For example, this might be a garage door openable and closable relative to a door frame 17. A track 18 guides a carriage 19 in reciprocation to move the door 16 open and closed. The carriage is driven by a motor 20 operating through a driving connection including a speed reducer 21. The motor 20 and speed reducer 21 may be contained within a motor housing 22 which in

turn is usually fastened to the ceiling of the garage. The housing 22 includes a means to energize the motor 20 including a power cord plug which may be plugged into a convenience outlet 24. This provides energization to the motor 20 and to a step-down transformer 25. The transformer 25 may supply a safe low voltage, e.g., 28 volts, to energize a relay 26 controlling reversible energization of the motor 20. This circuit may be similar to that shown in U. S. Pat. No. 3,625,328, for example. The housing 22 also includes a terminal strip 30 with terminals 31, 32 and 33. The low voltage is applied between terminals 31 and 33 with terminal 31 grounded. Terminal 32 is a switching terminal and a doorbell pushbutton switch 35 is connectable between terminals 31 and 32 for control of the garage door from inside the garage.

The receiver 13 may be a small transistorized receiver which may be mounted for convenience close to the motor housing 22. Also for convenience this receiver may be powered by operating voltages from the same convenience outlet 24. Because transistors operate well on low voltage and in order to avoid high voltage wiring between the receiver and the motor housing 22, the receiver 13 may be powered from the low voltage secondary of transformer 25. The receiver 13 has a terminal strip 40 with terminals 41, 42 and 43. These may be connected by means of a cable 36, shown in phantom, to the terminals 31, 32, 33 on the motor housing 22. Terminal 41 is connected to ground 44. A rectifier 37 and filter capacitor 38 within the receiver 13 provides a DC operating voltage to the receiver 13. The radio receiver 13 is adapted to be operative on a received signal of a predetermined carrier modulated by a modulation frequency, and also subject to receiving random noise signals. The receiver 13 includes a receiving antenna terminal 45 supplying an input to a transistor 46 which is an isolation stage. The signal is then passed to a superregenerative circuit 47 which includes a transistor 48 and a parallel resonant output circuit 49. This output circuit 49 includes a variable capacitor 50 for tuning the carrier frequency. Access to such capacitor is provided through a hole in the housing 51 of the receiver, indicated by the chain line.

This carrier frequency might be in the order of 200-300 MHz. The output of the superregenerative circuit 47 appears at a terminal 52 and contains the carrier frequency, the modulation frequency and also a squelch frequency intermediate these two frequencies. In this example, the modulation frequency may be an audio or super-audio frequency.

The squelch frequency depends upon the constants of the circuit 47 and may be 600 KHz, for example. The squelch frequency is bypassed to ground by a capacitor 53 and the modulation frequency is passed by a capacitor 54 to the transistor 46 in a reflex circuit for amplification of such modulation frequency signal. This amplified output appears across a capacitor 55 and is passed by a coupling capacitor 56 to a modulation frequency amplifier 57. This amplifier is shown as a transistor supplying an output to a detector circuit 58. The detector circuit includes a connection 59 which is the center connector of a coaxial test point jack 60, the shell of which is grounded. The connection 59 is near the output of the receiver 13, and the modulation frequency signal within the circuit components of the receiver 13 is present. Also, it is possible at this test point connection to determine the presence of a proper carrier fre-

quency, by use of suitable instrumentation. The detector circuit 58 also includes tuned circuit components with an audio transformer 61 having a movable magnetic core 62. This is movable by a screw 63 accessible through a hole in the housing 51. By this means the modulation frequency of the receiver 13 may be tuned. The detector circuit 58 passes an output signal, when the proper modulation and carrier frequencies are being received, to an output relay 65. Pull-in of this relay closes a relay contact 66, this thus shorting to ground terminal 42 on the terminal strip 40. A more detailed description of the circuit of the receiver 13 is found in U.S. Pat. No. 3,579,240.

The transmitter 12 has a means 72 to develop a carrier frequency and this is shown as a carrier frequency oscillator. The transmitter 12 also has a means 73 to develop a modulation frequency and this is shown as a modulation frequency oscillator. A power supply 74 provides operating voltage for the transmitter 12 and this may be a dry cell primary battery, especially where the transmitter is of low power, for example, a hand-sized VHF transmitter usable with remote control of garage door operator receivers. A switch such as a push-button switch 75 controls energization of the transmitter from the battery 74. The carrier frequency oscillator 72 includes a transistor 76 and the modulation frequency oscillator 73 includes a transistor 77. Tunable frequency circuit components are used in each of the two oscillators with a parallel resonant circuit comprising an inductance 78 and capacitor 79 in the carrier frequency circuit. The capacitor 79 may be variable to tune the carrier frequency but as shown in this preferred embodiment, inductance 78 is variable by having a magnetic core 80 which is movable by means of a screw 81 accessible through a hole in the housing 82 of the transmitter 12. The modulation frequency oscillator 73 also has a parallel resonant circuit including an inductance 83 and a capacitor 84. The capacitor 84 may be variable to tune the modulation frequency but as shown in this preferred embodiment, the inductance 83 is variable by having a magnetic core 85 which is movable by means of a screw 86 to tune the modulation frequency. The screw 86 is accessible through an aperture in the housing 82 so that a tool 87 may engage the screw and turn it to effect this tuning of the modulation frequency. There is no antenna as such on the transmitter 12, energy being radiated by inductance coil 78. A captive magnetic induction field, without radiation, extends from coil 83. Radiation from coil 78 is at the carrier frequency modulated at the modulation frequency and the induction field surrounding coil 83 is at the modulation frequency. Even though the transmitter 12 is a low power device, for example, powered by a 9-volt dry cell battery, this magnetic induction form of radiation from the coil 85 extends for a foot or two.

The alignment indicator 14 provides the means to align the modulation frequencies of the entire system. This alignment indicator 14 includes an amplifier 91, output indicator means 92 and a power supply 93 shown as a dry cell battery. The alignment indicator 14 is a small, lightweight, unit on a printed circuit board and including four transistors 94-97 forming part of the amplifier 91. The amplifier 91 has an input at 98 relative to ground 99 and this input is connected to the coaxial plug 100 which is receivable in the test point jack 60 of the receiver 13. When so received, this plug 100

physically supports the alignment indicator 14 on the receiver 13, because of the smallness and light weight of the indicator. The transistors 94-97 are capacitively coupled in cascade and the last two transistors 96, 97 form a Darlington pair with an output to the output indicator means 92 which is shown as an incandescent lamp. The alignment indicator 14 has a housing 101 with an aperture therein or a protective lens 102 through which to view the output indicator lamp 92. The amplifier 91 is an amplifier for alternating voltages and with economical transistors, the modulation frequency band is primarily that being amplified by amplifier 91, and is substantially the only frequency present at terminal 98.

OPERATION

The alignment indicator 14 permits tuning transmitters and receivers to the same frequency. In this preferred embodiment the tuning is for alignment of the modulation frequencies and whereas the circuit components within the receiver 13 may be tuned by means of screw 63, this preferred embodiment shows tuning of the modulation frequency components 85 in the transmitter 12 by means of the screw 86.

In the case of remote control devices such as garage door operators, a transmitter-receiver pair 12, 13 may be aligned as to frequencies so that they will operate together. The receiver 13 is generally located within the garage adjacent to the motor housing 22 and is designed to obtain operating voltage supplied therefrom via the cable 36. A transmitter-receiver pair may be aligned as to carrier frequency and modulation frequency at the factory, however, often the customer desires a second transmitter for use in a second automobile. Where a number of carrier frequencies and a number of modulation frequencies are used in order to provide a large number of codes for maximum security, then the distribution and warehousing requirements for a large number of extra transmitters becomes an acute problem. For example, there might be twelve carrier frequencies and twelve modulation frequencies and this would require stocking 144 extra transmitters all of different frequencies in order to have an extra transmitter to match with any given transmitter-receiver pair. The present alignment system 11 eliminates this necessity for such stocking and distribution of such a large number of extra transmitters. The organization selling the garage door openers may not have sophisticated electronic test equipment nor personnel able to operate such equipment. The sellers may be lumbermen, for example, which sell finished lumber and garage doors to house building contractors, and this is merely one example of sellers who may not have trained personnel nor equipment such as oscilloscopes, frequency generators or vacuum tube voltmeters.

By the present invention it is a very simple process to align the extra transmitter 12 to the frequency of the receiver 13. The door operator motor housing 22 need not yet be installed in the garage of the customer, in fact, it may still be in the carton in which packaged. The receiver 13 is a transistorized receiver and is small and light and may be easily removed from its cardboard packaging. However, the interconnecting cable 36 does not need to be fastened to the terminals 31-33 nor to the terminals 41-43. Further the push-button 35 need not be connected to the terminals 31,32. Still further the power cord plug 23 of the motor housing 22 does

not need to be plugged into the convenience outlet 24, nor does the antenna need to be connected to the antenna terminal 45.

A transmitter 12 is selected which has the same frequency as the receiver 13. In this preferred embodiment the selected frequency is the carrier frequency so that both are capable of operating on this same carrier frequency. The transmitter 12 comes equipped with a dry cell battery 74 and the alignment indicator 14 also comes equipped with its dry cell battery 93. It is only necessary to place the transmitter 12 in proximity to the receiver 13 and to plug the alignment indicator 14 into the test point jack 60 of the receiver 13. This physically supports the alignment indicator 14 on the receiver 13. Then a person depresses the pushbutton switch 75 to make the transmitter 12 transmit a signal. With the pushbutton switch 75 depressed, the tuning tool 87 is used to turn the screw 86 and move the magnetic core 85 from one end toward the other of its travel. At some point in the travel, the energy radiated from the modulation frequency coil 83 will be on the frequency of the modulation frequency circuit components 61 within the receiver 13. Because this is a parallel resonant circuit, it will respond and the modulation frequency will appear across this parallel resonant circuit 61 and thus appear at the connection 59. This is the center conductor of the test point jack 60 and will accordingly be passed to the input of the amplifier 91. This will cause the indicator lamp 92 to be illuminated. Turning the tuning tool 87 back and forth through the point of proper alignment will permit the tuning to be set at the point of maximum brilliance of the indicator lamp 92. To assure maximum uniformity of alignment of frequencies, the transmitter, with the pushbutton switch 75 still depressed, may be moved away from the receiver 13 until the lamp 92 nearly goes out. The re-tuning by tuning tool 87 until the light is at its brightest level will secure maximum correspondence of alignment of frequencies.

It will be noted that the transmitter 12 and alignment indicator 14 are energized from their internal power supplies yet the receiver 13 is not energized. This is an advantage in three ways. The first way is that much of the equipment need not be interconnected and thus much saving of time and simplicity of procedure is effected. The power cord plug 23 does not need to be connected to a convenience outlet, the cable 36 does not need to be connected to the terminals 31-33 nor does it need to be connected to the terminals 41-43. The second advantage is that the antenna, a quarter-wave stub, need not be connected to the antenna terminal 45. The third advantage is that with no power to the receiver 13, then the noise output of the receiver, characteristic of an energized superregenerative receiver, is not present on the output connection 59. Such noise being passed by the superregenerative circuit, if energized, would also be passed to the alignment indicator 14 and thus turn on the indicator lamp 92. Such would defeat the purpose of providing the proper alignment of the transmitter and receiver frequencies.

Another advantage to the alignment indicator 14 is its extreme simplicity in use. The dry cell battery 93 is contained within the alignment indicator and there is no power supply switch to bother about. In one unit actually constructed in accordance with the present invention, the amplifier used has a very high input impedance and a very low battery drain, for example, 15 mi-

cro-amperes so that the device has a 2-year life, approximately equivalent to the shelf life of the battery 93. The indicator lamp 92 may be a 2-volt, 60 milliamper lamp easily energized by the small battery 93, so there is little point in incurring the cost or added instructional complexity by adding a power on-off switch.

The alignment indicator system and method of the present invention greatly simplifies the distribution and warehousing of transmitters and receivers. If 12 carrier frequencies and 12 modulation frequencies are provided for a total of 144 codes, for example, then 144 extra transmitters need not be stocked and distributed. Instead, only 12 different transmitters may be stocked, one for each of the carrier frequencies. Then by use of the alignment indicator, such extra transmitter may be easily and simply tuned to the particular modulation frequency required. All this without any use of complex, costly and somewhat delicate test instruments. Also, the alignment may be done in the field and may actually be done by the customer himself without any special training.

The present disclosure includes that contained in the appended claims, as well as that of the foregoing description. Although this invention has been described in its preferred form with a certain degree of particularity, it is understood that the present disclosure of the preferred form has been made only by way of example and that numerous changes in the details of the circuit and the combination and arrangement of circuit elements may be resorted to without departing from the spirit and scope of the invention as hereinafter claimed.

What is claimed is:

1. A transmitter-receiver alignment system, comprising in combination,
 - a transmitter capable of transmitting a given carrier frequency,
 - a receiver capable of receiving said given carrier frequency,
 - one of said transmitter and receiver having tunable frequency circuit components,
 - a connection on said receiver near the output thereof to have available thereat one of the carrier and modulation frequencies of the particular circuit components therein,
 - an alignment indicator including an amplifier for alternating voltages and an output indicator means, means connecting the input of said alignment indicator amplifier to said receiver connection,
 - means establishing radiation coupling between said transmitter and receiver,
 - means supplying operating voltages to said transmitter and alignment indicator to establish in the circuit components of the receiver a signal from the transmitter to condition the receiver for an output at said connection,
 - and means for tuning the frequency of the circuit components of one of said transmitter and receiver until the alignment indicator output means indicates that the transmitter is transmitting to the receiver a frequency corresponding to the tuning of the circuit components within said receiver.
2. An alignment system as set forth in claim 1, including modulation frequency circuit components within each of said transmitter and receiver,
 - and means for tuning the frequency of one of the modulation frequency circuit components until the

modulation frequencies are aligned in the transmitter and receiver.

3. An alignment system as set forth in claim 2, wherein said coupling establishing means is accomplished by physically placing the transmitter and receiver in proximity to each other to have the modulation frequency components of the transmitter and receiver inductively coupled.
4. An alignment system as set forth in claim 1, wherein said coupling establishing means is accomplished by physically placing the transmitter and receiver in proximity to each other to have the tunable circuit components of the transmitter and receiver inductively coupled.
5. An alignment system as set forth in claim 1, wherein said frequency tuning means tunes the frequency of said transmitter to be equal to that of said receiver.
6. An alignment system as set forth in claim 1, wherein said receiver connection includes a test point jack connected in the receiver circuit and accessible on the outside of the receiver housing.
7. An alignment system as set forth in claim 6, wherein said input connecting means includes a plug receivable within said test point jack.
8. An alignment system as set forth in claim 7, wherein said alignment indicator is a unit separable from said receiver and is physically supported on said receiver by said plug being receivable within said test point jack.
9. An alignment system as set forth in claim 1, wherein said voltage supply means supplies operating voltages to said transmitter and said alignment indicator but not to the receiver.
10. An alignment system as set forth in claim 1, wherein said voltage supply means includes dry cell batteries in said transmitter and said alignment indicator but not in the receiver.
11. An alignment system as set forth in claim 1, including means continuously connecting said dry cell battery in the circuit of said alignment indicator.
12. The method of using an alignment indicator having an amplifier and output indicator means to align to the same frequency a transmitter and a receiver, comprising the steps of,
 - selecting a transmitter capable of transmitting a given carrier frequency,
 - selecting a receiver capable of receiving said given carrier frequency,
 - providing a connection on said receiver near the output thereof to have available thereat one of the carrier and modulation frequencies of the particular circuit components therein,
 - connecting the input of said alignment indicator amplifier to said receiver connection,
 - coupling for radiation of frequencies between said transmitter and receiver,
 - supplying operating voltages to said transmitter and alignment indicator to establish in the circuit components of the receiver a signal from the transmitter to condition the receiver for an output at said connection,
 - and tuning the frequency of the circuit components of one of said transmitter and receiver until the alignment indicator output means indicates that the transmitter is transmitting to the receiver a fre-

9

quency corresponding to the tuning of the circuit components within said receiver.

13. The method as set forth in claim 12, including tuning the modulation frequency circuit components of one of the transmitter and receiver until the modulation frequencies are aligned.

14. The method as set forth in claim 12, including tuning the circuit components of the transmitter until the radiated frequency is aligned with the tuning of the circuit components of the receiver.

15. The method as set forth in claim 14, including tuning the modulation frequency components of the transmitter.

16. The method as set forth in claim 12, wherein said connecting of the amplifier input includes physically supporting the alignment indicator on the receiver.

17. The method as set forth in claim 12, including

10

providing a coaxial separable connector between the alignment indicator amplifier and the receiver to physically support the alignment indicator on the receiver.

18. The method as set forth in claim 12, including providing an indicator lamp on the alignment indicator as the indicator means, the brilliance of which indicates the degree of closeness of tuning of the circuit components.

19. The method as set forth in claim 12, including connecting a dry cell battery in said alignment indicator and in said transmitter as the operating voltage supply.

20. The method as set forth in claim 19, including maintaining the receiver in an unenergized condition to avoid passing spurious frequencies to the alignment indicator.

* * * * *

20

25

30

35

40

45

50

55

60

65