

June 16, 1942.

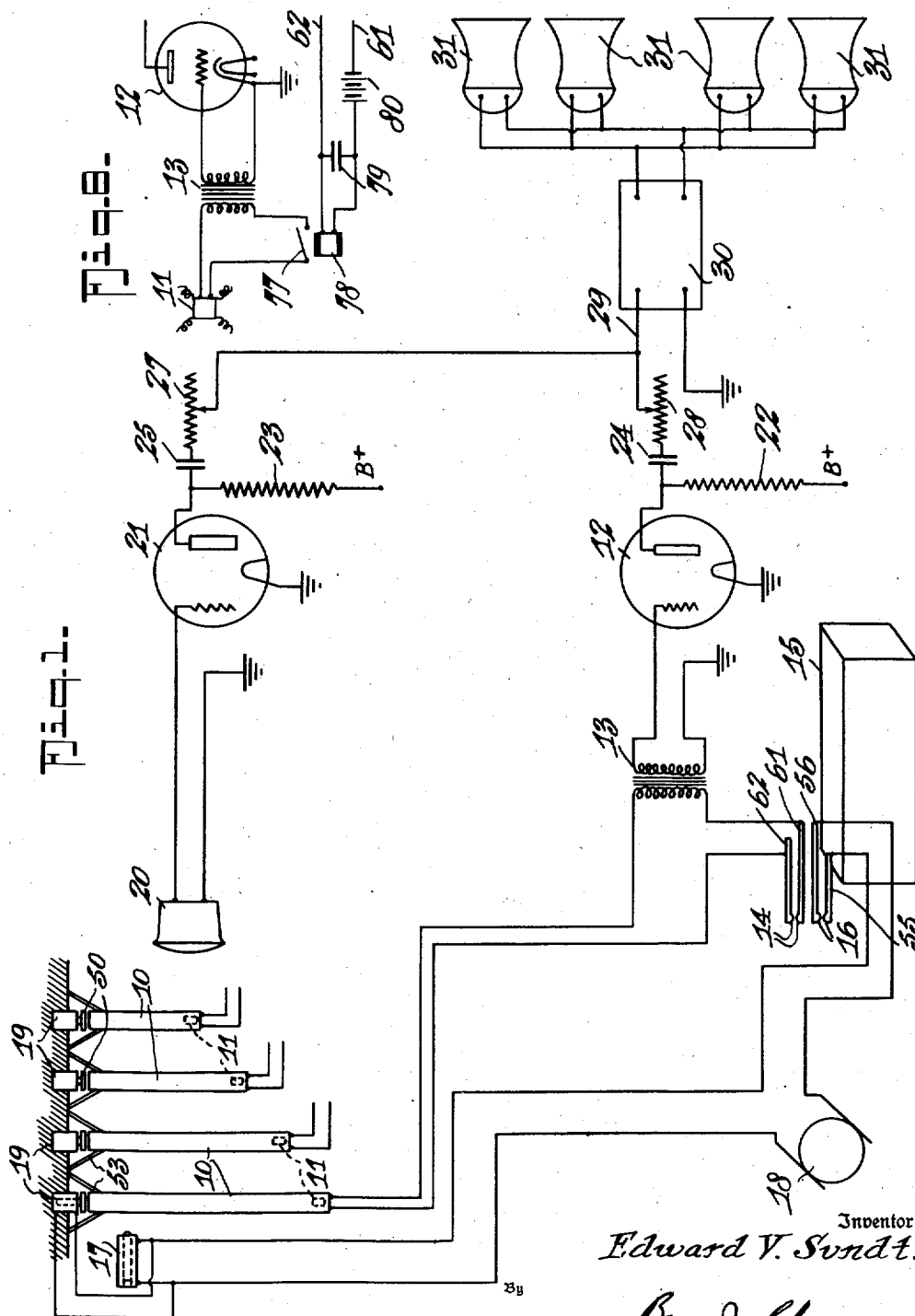
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2,286,587

CARILLON

Filed July 15, 1940

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

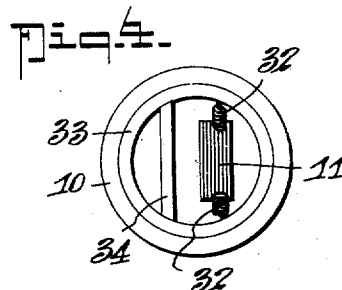
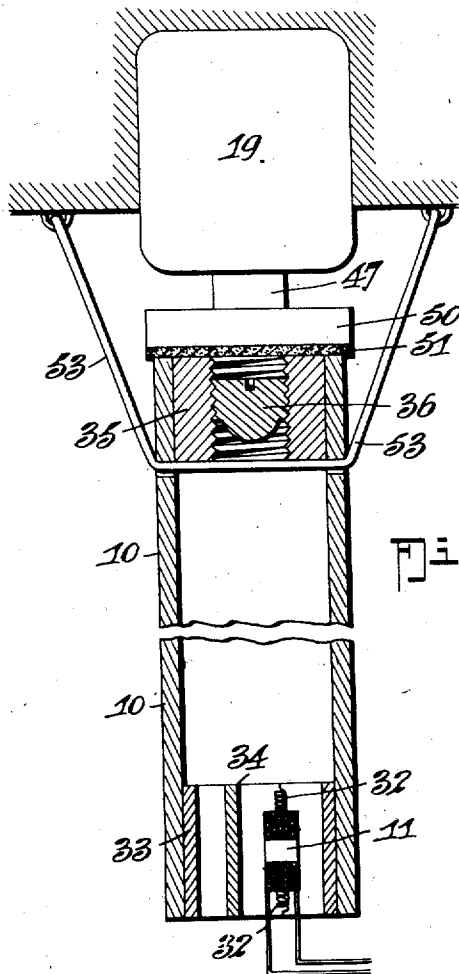
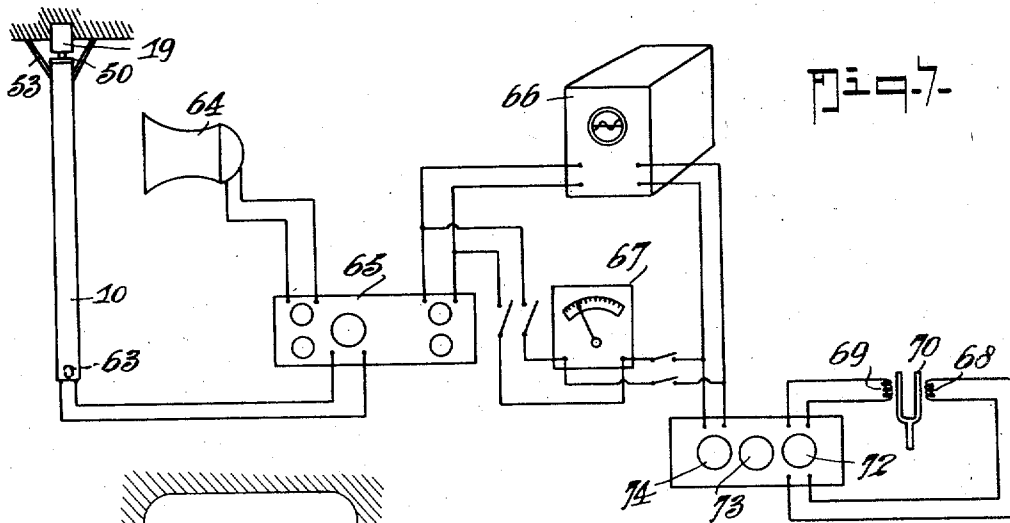
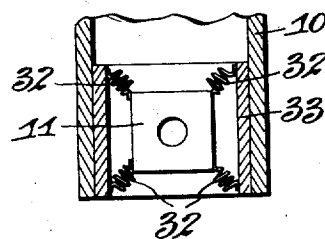


Fig. 3.



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Fig. 5.

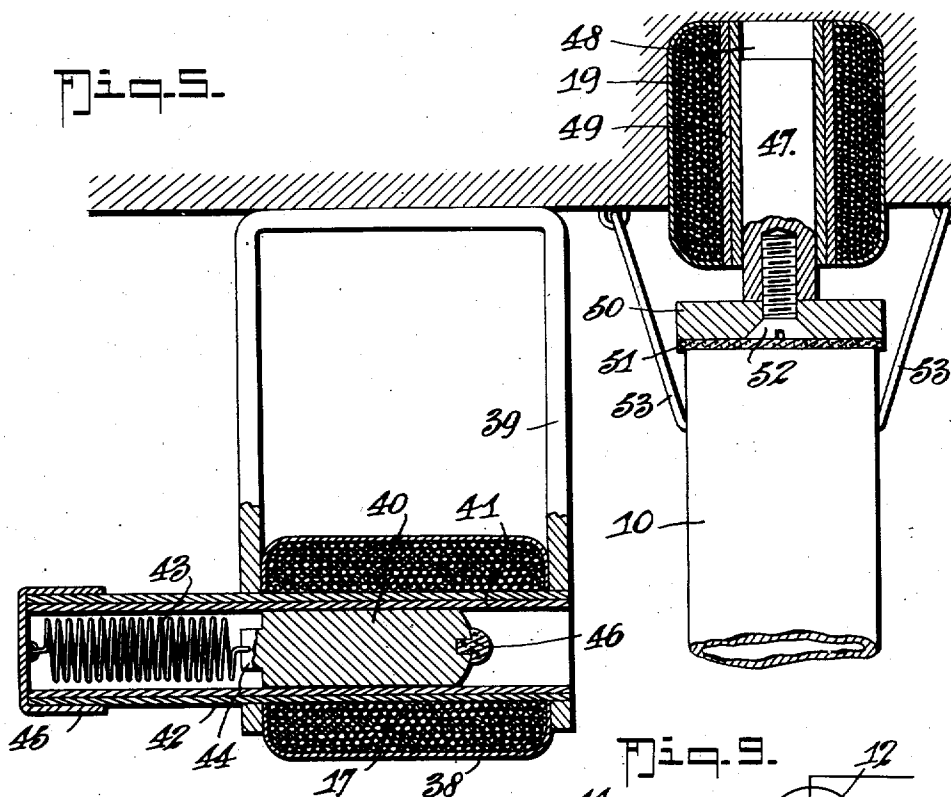


Fig. 9.

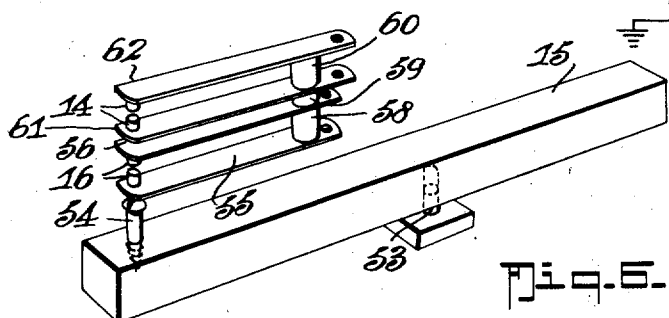
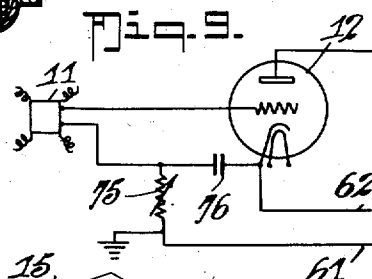


Fig. 6.

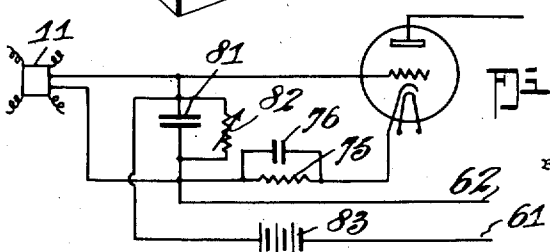


Fig. 10.

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UNITED STATES PATENT OFFICE

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CARILLON

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Application July 15, 1940, Serial No. 345,659

14 Claims. (Cl. 84-405)

This invention relates to musical instruments generally. More particularly this invention relates to a method and means for tuning musical instruments and to a carillon of the amplified type wherein the vibrations from suitably actuated chimes are amplified and broadcast by radio or direct from church belfries or other places of mounting through the medium of loud speakers.

An object of this invention is to provide an novel form of vibration pick-up for receiving or picking up the vibrations produced in the chimes or other vibrating instruments or members and blending or mixing these vibrations in suitable circuits such as the circuits of an amplifier to produce desired musical effects which may be impressed upon a loud speaker system directly or transmitted over an electrical or radio circuit.

Another object of this invention is to provide a carillon employing tubular chimes of an improved type which may be tuned without difficulty by means of an adjustable plug.

Still another object of this invention is to provide an improved type of chime solenoid action which is quiet in operation, is highly wear resistant and will operate over a long period of time without attention or lubrication.

A further object of this invention is to provide a double touch keyboard to the carillon so that the musician playing the carillon can control the music produced.

Still another object of this invention is to provide an arrangement for tuning percussion type musical instruments in which vibrations from the musical instrument are picked up electrically and fed back to the vibrating member as amplified acoustic vibrations to maintain the vibrating member in vibration long enough so that the frequency and wave form thereof may be checked, observed and compared to a standard.

Other and further objects of this invention will be apparent to those skilled in the art to which it relates from the following specification and the claims.

In accordance with this invention I provide an amplified carillon which has many basic advantages over that of the outdoor un-amplified carillons heretofore used almost exclusively, in that tubular chimes can be used with great carrying power and in this way secure greater purity of tone than is possible with the conventional bells. It is well known that the conventional bell has harmonics, or overtones, that are not in tune with their fundamental. This is not true on correctly constructed tubular chimes. Also, the accuracy of tuning of a tubular chime is very close when done according to the process of tuning I will describe later. Also, the ease of playing an amplified carillon of the type here disclosed permits musical effects and performance of compositions not possible where the bells of

the carillon are struck manually by the musician. Furthermore the cost is in most cases less than one-tenth of bell carillons; and the building structure used to house the speakers does not need to be so strongly and expensively made as when huge bells are to be hung.

While I have emphasized the use of tubular chimes, both as a source of musical vibrations, and as the object of my process of tuning, it is obvious that tubular chimes need not necessarily be used since rods or spiral chimes, bars, and other instruments of a percussion nature, may also be used and amplified. Furthermore, my process of tuning is not limited to tubular chimes, but embraces all percussion instruments.

Further details of this invention are set forth in the specification and the drawings in which, briefly:

Fig. 1 is a schematic wiring diagram of the amplified carillon;

Fig. 2 is a cross-section of one of the tubular chimes;

Fig. 3 is a perspective view of the magnetic pick-up and spring suspension;

Fig. 4 is an end view of one of the tubular chimes showing the position of the magnetic pick-up;

Fig. 5 is a detail view of the chime solenoid action including the striker and the damper;

Fig. 6 illustrates details of one of the double touch keys of the keyboard;

Fig. 7 is a schematic circuit diagram of the chime tuning circuit and

Figs. 8, 9 and 10 illustrate time delay circuits connected to the chime pick-up device and amplifier tube.

Referring to the drawings in detail reference numeral 10 designates the tubular chimes used in this amplified carillon; these are in general conventional, but have added to them a special magnetic pick-up 11 which is used to pick-up the relatively weak fundamental note of these chimes. This fundamental note is amplified separately by means of a vacuum tube amplifier 12, the input of which is coupled to the magnetic pick-up by means of the transformer 13. The primary of this transformer is connected to the magnetic pick-up through the contacts 14 of the double touch key 15 which is also provided with additional contacts 16 for connecting the striker solenoid 17 to the source of current supply 18. The contacts 16 are closed when the key is depressed, energizing the circuit of the striker solenoid 17 and the damper solenoid 19 which is connected in parallel with the solenoid 17. When the contacts 16 are closed by depressing the key 15 the armature of the striker solenoid 17 strikes the chime 10 adjacent one end thereof and sets the tubular chime into vibration. Just before the striker strikes the chime the damper is raised

by the solenoid 19 so that the chime is free to vibrate.

A whole series of tubular chimes corresponding to one or more octaves of the chromatic scale is employed or if desired the chimes may be arranged in accordance with any other predetermined scale or in a series of chords. In each case each of the chimes is provided with a striker solenoid, a damper raising solenoid and a magnetic pick-up.

The striker solenoid 17 is shown positioned adjacent to the supported end of the chime 10 and this being the case the predominating tone generated by the chime will be the second harmonic. The second harmonic, or "strike note" as it is often called, is picked up by one or more microphones 20, although other pickups may also be used, if desired, to secure this harmonic. The microphone 20 is connected to the input of the amplifier tube 21 through a suitable coupling circuit such as a transformer or a resistance and a condenser as is conventional in the art. Likewise the magnetic pick-up device 11 may be connected to the input of the amplifier tube 12 through coupling devices such as resistors and condensers instead of the transformer 13. In cases where the microphone 20 is of the correct impedance to match the amplifier tube employed this microphone may be connected directly to the grid of this tube without the use of any other coupling circuits for matching the impedance of the microphone to that of the tube. However in cases where a plurality of microphones is employed a coupling network may be desirable. Furthermore amplifier tubes other than the three electrode types illustrated may be employed for the tubes 12 and 21 particularly where high amplification is desired in these tubes. The anodes of the tubes 12 and 21 are connected to a suitable source of anode current supply through the plate resistors 22 and 23 respectively. The anode circuits of these amplifier tubes 12 and 21 are coupled through coupling condensers and volume control resistors consisting of the coupling condenser 24 and variable resistor 28 for the tube 12 and the coupling condenser 25 and variable resistor 27 for the tube 21, to the input conductor 29 connected to the input of the power amplifier 30. The volume control resistors 27 and 28 are arranged to be controlled by suitable pedals which may be arranged to be operated by hand, knee or foot of the musician playing the instrument and are for the purpose of controlling the energy derived from the pick-ups 11 and 20 to be impressed upon the power amplifier 30 and loudspeakers 31 connected to the output thereof.

It will be observed that the magnetic pick-ups 11 are not connected to the input of the amplifier 12 simultaneously as the striker solenoid 17 is energized through the contact 16 of the key 15 but that this key must be still further depressed so that it not only closes the contacts 16 but also the contacts 14 which close the circuit of the magnetic pick-up and the primary of the transformer 13. This feature of the invention will be more readily appreciated from the description of the construction of the key and its associated contacts.

The magnetic pick-up 11 consists of an insulated winding of a multiplicity of turns of relatively small wire wound around a small permanent magnet. This is supported by means of elastic members 32 which may be in the form of springs, rubber, synthetic rubber and the like, in the short ring member 33 adjacent to the iron

armature 34 which is rigidly fastened in said ring. It is important that the magnetic pick-up 11 be suspended freely by an elastic means which will permit the chime tube 10 to vibrate without a damping effect upon it, reacted from the pick-up itself. While I show the magnetic pick-up in Fig. 2 as located at the extreme end, its location may be in any part of the tube. And the particular harmonic that it picks up is determined by its position along the length of the tube. Thus, several pick-ups may be used, if desired, to blend various harmonics.

In Figure 2 is also shown a construction which facilitates the tuning of the chime. This consists of an iron plug 35 mounted inside of one end of the chime and a solid screw 36 threaded inside of said iron plug so as to be capable of being screwed in or out to give the effect of shortening or lengthening, respectively, the entire chime. In this way the chime can be tuned more quickly and easily than was possible with the old method of filing off part of the chime until the correct tuning was obtained. It also has the advantage that in the event the chime is tuned too sharp, the plug can always be unscrewed a small distance to produce the same effect as lengthening the tube. With the other method of tuning, if the chime was ever tuned too sharp, it would then have to be cut off to the next semi-tone, since length could not be added very well.

A very important feature in the operation of my carillon is the action used to strike the chime shown in detail in Fig. 5. These actions must be quiet, highly wear-resistant, and must operate over long periods of time without attention or lubrication. The action used in the carillon here disclosed is actuated by a solenoid winding 17 enclosed in a thin iron case 38 and positioned between the poles of an iron yoke 39 which forms part of the magnetic circuit. The iron striker 40 rides inside of the graphite bronze sleeve 41. In order to provide lubrication without oiling, I have made the sleeves 41 of these striker solenoids from a composition graphite and bronze material in which the graphite and the bronze are mixed and then placed under intense hydraulic pressure, so that a hard, homogeneous bearing material is formed. As the sleeve wears, the graphite becomes exposed and also furnishes a well lubricated surface, which does not require oil. A bronze sleeve with graphited grooves may also be used. The sleeve 41 is positioned inside of the brass sleeve 42 and these two sleeves pass through the center of the solenoid winding. A coil spring 43 is attached to the end 44 of the iron striker 40 and to the cap 45 attached to the ends of the sleeves so as to maintain the solenoid armature or striker normally somewhat displaced from the center of the winding. When the solenoid winding is energized by closing the contacts 16 the magnetic lines of force set-up act on the armature 40 and accelerate it toward the center of the winding. However this acceleration is great enough to cause the armature to shoot out of the winding and hit the chime tube 10, mounted adjacent thereto, with the leather tip 46 setting the chime into vibration. The spring 43 functions to bring the armature back to its normal position.

The damper mechanism including the solenoid winding 19, iron core 47 inside of the graphite bronze sleeve 48 and brass sleeve 49 is mounted so that the lead weight 50 thereof normally presses the felt 51 against an end of the respective chime tube to damp the vibration of the tube

except when such vibration is desired. The lead weight 50 is attached to the armature 47 by means of a bolt 52 and the felt is cemented to a face of the lead weight. Inasmuch as the tubes 10 are supported from ends thereof by suspension cords 53, as shown in Figs. 1 and 2, it is convenient to mount the damper mechanism at the top of each chime between these cords so that the weight 50 rests on the chime except when the winding is energized.

A further feature of this carillon is the double-touch keyboard whereby the musician can control the music picked up by the microphones 20 and the music obtained by the magnetic pick-ups 11, separately. This is accomplished by a double-touch keyboard employing a plurality of keys, such as, key 15 pivotally mounted on the pin 53 and provided with a contact actuating member 54 screwed into the far end of the key as illustrated in Fig. 6 are employed. The member 54 engages the contact spring 55 when the key is depressed and forces the lower contact 16 to engage the upper contact 16 which is supported by the spring 56. These springs 55 and 56 are supported upon an insulation block 58 and above the spring 56 is positioned another insulation block 59. The contacts 14 are attached to the springs 61 and 62 which are spaced by the insulator 60 and supported on the insulator 59. By this construction, when the key 15 is depressed only part way by a light touch, the circuit between contacts 16 is closed to energize the striking solenoid 17, and simultaneously the damper 50—51 is lifted from the chime tube by the solenoid 19. The sound produced by this action is picked up by one or more microphones 20, and the volume produced is controlled by a separate pedal volume control 27 connected to the output of the amplifier 21 employing one or more tubes. As the key is further depressed contact is made between contacts 14 which results in closing the circuit through one or more magnetic or similar pick-ups 11 used on the particular chime tube struck. The output of these pick-ups is amplified by the amplifier 12 consisting of one or more tubes and the output of this amplifier is controlled by another pedal volume control 28. This arrangement allows the musician to blend the two types of music secured from the instrument in any proportion with respect to volume, and he can fade out one while increasing the other to secure distance effects, echo effects, or use the one as an accompaniment to the other.

A further feature of this action is a time delay introduced in the magnetic pick-up circuit to avoid a sharp interruption of the low bell tone sounds secured through the magnetic pick-ups. Several methods may be used and the most practical ones I have illustrated in Figs. 8, 9 and 10. In Fig. 8 time delay action is obtained through the use of a relay 78, the contacts 77 of which are connected between the pick-up 11 and the primary of the transformer 13. A condenser 79 of relatively large capacity, for example, 1000 mfd., for 4 seconds delay action, is shunted across a relay coil which, after it is charged by the closing of the keyboard contacts 14, connected to the conductors 61 and 62, tends to hold the relay closed for a time depending upon the size of the condenser, after the musician has released the key.

In the form of time delay circuit shown in Fig. 9 the key contacts 14 are connected through the conductors 61 and 62 to the grid bias resistor 75 and cathode of the tube 12, respectively. 75

When the key contacts 14 are closed grid bias potential is applied through the resistor 75 to the grid of the tube so that the tube functions as an amplifier and at the same time the cathode of the tube is grounded to the chassis or frame of the amplifier to which the negative terminal of the anode current supply and the resistor 75 are connected. In this way a charge is supplied to the condenser 76 and when the key circuit 61—62 is opened this charge is applied between the grid and cathode until it leaks off or is dissipated through the condenser dielectric. A separate battery such as, battery 83 shown in Fig. 10, may be provided for charging the time delay condenser. When the key contacts 14 are closed the battery 83 charges the condenser 81 connected to the grid of the tube 12. This battery 83 may be used as the grid bias battery during this same time to bias the tube and cause it to act as an amplifier. When the key contacts 14 are opened the charge of the condenser 81 furnishes the bias potential for 1, 2, 3, 4 or more seconds depending upon the size of the condenser and the rate of leakage through the resistor 82 and condenser. Where the condenser has the proper leakage the resistor 82 is not necessary although it is desirable to permit adjustment of the time delay action. Furthermore the resistor 75 and condenser 76 may be eliminated in this case since the condenser 81, resistor 82 and battery 83 furnish the proper bias potential. However where it is desirable to alter the amplifying characteristics of the tube 12 after the key contacts 14 are opened the grid bias circuit may be divided into two sections as shown.

One of the most important factors in the production of this carillon is the process of tuning. It has always been very difficult to play several bells, or chimes simultaneously for the reason that the sound of an instrument of this type is particularly rich in the high harmonics. When tuning by ear, it is difficult, if not impossible, to tune closer than one or two cycles. And even expert tuners, when they get this close, can not differentiate between a high or low pitch, i. e., they may be able to tell the pitch is off one or two cycles per second, but they can not tell whether the pitch is sharp or flat. When two chimes are out of tune by only one cycle in their fundamental, it follows that their harmonics are going to be out of tune by the increased ratio of their frequencies with respect to the fundamental—and this clash of higher frequencies tends to cause the out-of-tune sound so often heard in bell carillons.

By my process I use conventional cathode ray oscillograph circuits to tune the chimes within limits as close as one-fiftieth of one cycle; and the carillon resulting from a combination of such closely tuned chimes is capable of musical effects that are very beautiful and pleasing indeed. The basic diagram of the tuning circuit used is shown in Fig. 7.

Even in using an oscillograph, or other frequency sensitive instrument, it is almost impossible to tune closely if the instruments are struck in the conventional manner. The reason for this is that the volume of sound rises to a peak immediately after the chime is struck, and then dies down quite rapidly, four or five seconds as a matter of fact. This time is too short to permit a close observation and comparison of frequencies in the measuring instruments. In my process, however, I make the vibration of the chime self-sustaining, and by this method I am

able to tune to the close limits of accuracy mentioned above.

In order to make the vibration of the chime self-sustaining, I mount a pick-up 63 of very light weight on the chime tube 10 so as not to add appreciably to the mass of the tube. Once the tube has been set in vibration by striking it with a mallet, the vibrations are translated into electrical energy by this pick-up, fed into a vacuum tube amplifier 65 consisting of one or more amplifier tubes coupled by suitable circuits, and the output of this amplifier is fed into a speaker 64 which is located relatively close to the chime. The energy of the sound waves striking the chime from the speaker 64 are sufficient to re-energize it so that the chime continues to vibrate at its natural frequency. Furthermore, by shifting the position of the pick-up 63 along the length of the chime, I am able to pick off various harmonics whose frequencies are direct multiples of the fundamental resonant frequency of the chime. And in this way even more accurate tuning can be accomplished, since I can pick off a harmonic eight times (for instance) the frequency of the fundamental and by tuning them to a limit of $1/20$ of a cycle, the actual accuracy of the fundamental would, therefore, be one-eighth of that, or $1/160$ of a cycle. Other means than magnetic of picking off the fundamental or harmonic vibrations may be used with excellent results, although some of the methods are not so practical from the standpoint of actual utility and service. Among these methods, however, are electro-static pick-ups, reflections of light utilizing photo-electric cells, and methods where the audio frequencies produced by the chime tube are used to modulate a radio frequency carrier wave. The important feature of all of these methods, however, is to make the chime tube self-excited for the purpose of tuning.

Inasmuch as it is very difficult to tune by ear and to tell whether the instrument being tuned is sharp or flat with respect to the standard when they become close to unison, I use a cathode ray oscillograph 66 to indicate the relative frequencies. Two methods of doing this may be used. In one, the standard frequency from an oscillator such as the tuning fork oscillator 70 is applied to one set of the cathode ray tube deflector plates and the frequency under observation, that is part of the output of the amplifier 65, is applied to the other set of cathode ray tube deflector plates, resulting in the conventional Lissajous figures. Thus, where the frequencies are in unison, an ellipse is formed on the cathode ray tube screen; with double frequency a figure 8, etc. In the other method, the frequency under observation is applied to the vertical deflecting plates and the standard frequency is used to control the sweep of the horizontal deflecting plates. By this method the frequency under observation appears to stand still on the cathode ray tube screen when the frequencies are in perfect unison. When the frequency under observation is flat with respect to the standard frequency, the image drifts in one direction, and if sharp, it drifts in the opposite direction. The amount of drift per second is equal to the difference in frequencies per second. In my method of tuning I use both of these systems—the latter for the more rough tuning and the former for very close adjustment.

In some instances where I desire to emphasize certain harmonics I may provide frequency selective filters or networks, such as, band pass fil-

ters, high or low pass filters may be connected between the loud speaker 64 and the amplifier so that as the pick-up 63 is moved along the tube the desired selected harmonic may be given preference. Likewise such selective circuits may be interposed in the connections between the amplifier 65 and the deflector plates of the cathode ray oscillograph 66.

As a standard I found a self-excited tuning fork circuit employing a tuning fork 70 magnetically coupled to the grid coil 68 and the plate coil 69 of the tuning fork oscillator tube 72, to be the most practical. The signal from this tuning fork oscillator is fed into the amplifier portion of the apparatus 71 consisting of one or more tubes 73—74 and then to the cathode ray oscillograph tube. Where the tuning fork oscillator is used to control the sweep frequency of the cathode ray oscillograph, for example, as in the second tuning method given, a suitable saw-tooth oscillator controlled by the tuning fork oscillator may be incorporated in the apparatus 71. Tuning forks calibrated to an accuracy of one part in ten thousand are preferably employed in the oscillator.

Another simple, though not so effective method of tuning consists of using a dual channel amplifier to receive the standard frequency and observed frequency, respectively, and then observe the interference beats, caused by these two frequencies when close to unison, in a meter 67 connected between the output of the amplifier 65 and the tuning fork amplifier apparatus 71. This meter 67 may be coupled to the amplifier 65 and the tuning fork amplifier 71 through a suitable transformer having one or more primary windings and/or through a suitable rectifier or rectifiers of the dry disc type for example. Very accurate results can be obtained by this method, but it has the same shortcoming as the human ear, namely, that it isn't easy to tell when the observed frequency is high or low with respect to the standard. This difficulty, however, can be over-come by the use of a properly polarized bridge circuit connected to the meter; and while this method is good for rapid production, the cathode ray oscillograph method has the advantage that it also portrays the wave form under observation as well as indicating its relative frequency.

While in the above specifications I have confined my remarks principally to tubular chimes, the same method can be applied to such instruments as bells, bars, tuned rods, and other percussion instruments.

In addition to the uses of the carillon I have described as an outdoor instrument, the same amplifying system can also be used in a church for indoor speakers, hard-of-hearing aids, and a phonograph reproducer may also be introduced to take the place of manually operated chimes when desired.

What I claim is as follows:

1. In a chime carillon, a chime, a striker for said chime, a solenoid for actuating said striker, a double touch key having means for closing the circuit of said solenoid when partially depressed, electrical pick-up means positioned on said chime to pick up vibrations corresponding to the fundamental tone of said chime, amplifier means, means on said key for closing the circuit between said magnetic pick-up and said amplifier means when said key is further depressed, additional pick-up means for picking up acoustic vibrations from said chime, and connections be-

tween said additional pick-up means and said amplifier means.

2. In a chime carillon, a chime, a striker, a vibration pick-up for said chime, an amplifier, connections for connecting said pick-up to said amplifier, said connections including a condenser, connections for charging said condenser, and connections for applying a grid biasing potential to said amplifier from said condenser after said chime is struck and said first mentioned connections are opened for maintaining said amplifier operative until the charge of said condenser is dissipated so that the amplification of said pick-up output is not sharply interrupted.

3. In a chime carillon, a chime, means for setting said chime into vibration, a vibration pick-up for said chime, an amplifier connected to said vibration pick-up to amplify the output thereof, switch means for connecting said vibration pick-up to said amplifier substantially when said chime is set into vibration, and time delay means consisting of a condenser connected across said switch, means for charging said condenser when said switch is closed, the time delay action of said time delay means being initiated by the opening of said switch so that the charge of said condenser is applied to an electrode of said amplifier and maintains said amplifier operative until said charge is dissipated gradually.

4. In a chime carillon, a chime, means for setting said chime into vibration, a vibration pick-up for said chime, an amplifier connected to said vibration pick-up to amplify the output thereof, switch means for connecting said vibration pick-up to said amplifier substantially when said chime is set into vibration, and time delay means connected to said switch, said time delay means including a condenser, means for charging said condenser when said switch is closed and for applying the charge of said condenser to a grid of said amplifier to initiate the time delay action when said switch is opened.

5. In a chime carillon, a chime, a striker for said chime, a solenoid for actuating said striker, a double touch key having means for closing the circuit of said solenoid when only partially depressed, pick-up means positioned to pick-up vibrations of said chime, amplifier means and means on said key for closing the circuit between said pick-up and said amplifier means when said key is further depressed so that the circuit of said pick-up and said amplifier means is not energized immediately upon the striking of said chime by said striker.

6. In a carillon a plurality of vibrating members for producing the tones of a musical scale, each of said members being adapted to produce a number of substantially harmonically related tones, strikers for said members, a double touch keyboard, each of the keys of said keyboard having two sets of contacts, one of said sets of contacts being closed when the key is partially depressed and the other being closed when the key is further depressed, solenoids for controlling said strikers connected to the contacts of said keyboard that are closed when the keys thereof are only partially depressed, solenoid controlled dampers for said vibrating members connected to said striker solenoids, an electric pick-up for each of selected ones of said plurality of members positioned to pick up the deep bell-like tones of said vibrating members, amplifying means, connections for connecting selected ones of the other of said sets of contacts of said keys to the input of said amplifying means and to selected

ones of said electric pick-ups for connecting these electric pick-ups to said amplifying means when said keys are further depressed, microphone means positioned to receive acoustic vibrations from said plurality of members, means for connecting said microphone means to said amplifying means, and electrical damping means connected between said electric pick-ups and said amplifying means for preventing the abrupt stopping of the picking up and amplifying of the deep bell-like tone vibrations picked up by said electric pick-ups, said microphone means being continuously connected to said amplifying means so that said microphone picks up vibrations of said chime members as long as said members vibrate and even after said electric pick-ups stop picking up said vibrations.

7. In a carillon a plurality of members for producing the tones of a musical scale, each of said members being adapted to produce a number of substantially harmonically related tones, an electric pick-up for each of selected ones of said plurality of members, amplifying means, connections for connecting said amplifying means to said electric pick-ups, microphone means positioned to receive acoustic vibrations from said plurality of members, means for connecting said microphone means to said amplifying means, and electrical damping means connected between said electric pick-ups and said amplifying means for preventing the abrupt stopping of the picking up and amplifying of the deep bell-like tone vibrations picked up by said electric pick-ups, said microphone means being continuously connected to said amplifying means so that said microphone picks up vibrations of said chime member as long as said member vibrates and even after said electric pick-ups stop picking up said vibrations.

8. In a carillon a plurality of members for producing the tones of a musical scale, each of said members being adapted to produce a number of substantially harmonically related tones, strikers and dampers for said members, a double touch keyboard, each of the keys of said keyboard having two sets of contacts, one of said sets of contacts being closed when the key is partially depressed and the other being closed when the key is further depressed, solenoids for controlling said strikers and dampers connected to the contacts of said keyboard that are closed when the keys thereof are only partially depressed, an electric pick-up for each of selected ones of said plurality of members, amplifying means, connections for connecting selected ones of the other of said sets of contacts of said keys to the input of said amplifying means and to selected ones of said electric pick-ups for connecting these electric pick-ups to said amplifying means when said keys are further depressed, microphone means positioned to receive acoustic vibrations from said plurality of members, means for connecting said microphone means to said amplifying means, and electrical damping means connected between said electric pick-ups and said amplifying means for preventing the abrupt stopping of the picking up and amplifying of the deep bell-like tone vibrations picked up by said electric pick-ups, said microphone means being continuously connected to said amplifying means so that said microphone picks up vibrations as long as one of said keys is kept partially depressed to withhold the corresponding damper and the corresponding chime member vibrates and even after said electric pick-ups stop picking up said vibrations.

9. In a carillon a plurality of members for producing the tones of a musical scale, each of said members being adapted to produce a number of substantially harmonically related tones, solenoid actuated dampers for said plurality of tone producing members, a double touch keyboard, each of the keys of said keyboard having two sets of contacts, one of said sets of contacts being closed when the key is partially depressed and the other being closed when the key is further depressed, connections for connecting said damper solenoids to the contacts of said keyboard that are closed when the keys thereof are only partially depressed, an electric pick-up for each of selected ones of said plurality of members, amplifying means, connections for connecting selected ones of the other of said sets of contacts of said keys to the input of said amplifying means and to selected ones of said electric pick-ups for connecting these electric pick-ups to said amplifying means when said keys are further depressed, microphone means positioned to receive acoustic vibrations from said plurality of members, means for connecting said microphone means to said amplifying means, and electrical damping means connected between said electric pick-ups and said amplifying means for preventing the abrupt stopping of the picking up and amplifying of the deep bell-like tone vibrations picked up by said electric pick-ups, said microphone means being continuously connected to said amplifying means so that said microphone picks up vibrations as long as one of said keys is kept partially depressed to withhold the corresponding damper and the corresponding chime member vibrates and even after said electric pick-ups stop picking up said vibrations.

10. In a carillon, a member for producing tones, an elongated striker having a body of magnetic material for striking and setting said member into vibration, an elongated race of graphited material for said elongated striker, a retaining member of non-magnetic material surrounding said elongated race, a solenoid consisting of a plurality of turns of wire surrounding said retaining member of non-magnetic material, means for normally holding the magnetic body of said striker substantially off center in said solenoid so that application of an electric current to said solenoid will produce a magnetic field therein projecting said striker against said first member, said race of graphited material being formed of such shape that it presents a relatively friction free, non-gripping, highly wear-resistant surface to said striker whereby quiet, uniform striker operation over long periods of time is obtained.

11. In a carillon, a member for producing tones, an elongated striker having a body of magnetic material for striking and setting said member into vibration, an elongated race of graphited material for said elongated striker, a retaining member of non-magnetic material surrounding said elongated race, a solenoid consisting of a plurality of turns of wire surrounding said retaining member of non-magnetic material, a U-shaped yoke of magnetic material with the ends thereof adjacent the ends of said solenoid, said retaining member extending into holes formed into said yoke ends for supporting said solenoid substantially in said yoke, means for normally holding the magnetic body of said striker substantially off center in said solenoid so that application of an electric current to said solenoid will produce

a magnetic field therein projecting said striker against said first member, said race of graphited material being formed of such shape that it presents a relatively friction free, non-gripping, highly wear-resistant surface to said striker whereby quiet, uniform striker operation is obtained over long periods of time.

12. In a carillon, a member for producing tones, an elongated striker having a body of magnetic material for striking and setting said member into vibration, a tube of substantially non-magnetic material for normally housing said striker, a solenoid consisting of a plurality of turns of wire surrounding said tube of non-magnetic material, a surface of graphited material between said striker and said tube of non-magnetic material, means for normally holding the magnetic body of said striker substantially off center in said solenoid so that application of an electric current to said solenoid will produce a magnetic field therein projecting said striker against said first member, said surface of graphited material being of such shape and positioned between said striker and said tube that said striker slides into and out of said tube in a quiet relatively friction free, non-gripping manner so that uniform, wear resistant operation is obtained over long periods of time.

13. In a carillon, a member for producing tones, an elongated striker having a body of magnetic material for striking and setting said member into vibration, a tube of substantially non-magnetic material for normally housing said striker, a solenoid consisting of a plurality of turns of wire surrounding said tube of non-magnetic material, a surface of graphited material between said striker and said tube, said tube extending well beyond one end of said solenoid, a U-shaped yoke of magnetic material with the ends thereof adjacent the ends of said solenoid, said tube extending into holes formed into said yoke ends for supporting said solenoid substantially in said yoke, spring means for normally holding the magnetic body of said striker substantially off center in said solenoid so that application of an electric current to said solenoid will produce a magnetic field therein projecting said striker against said first member, said spring means having one end attached to the end of said tube that extends beyond said solenoid, the other end of said spring means being attached to said striker so that said spring is stretched when said striker is projected from said tube and functions to guide the striker back into said tube after striking said first member, said surface of graphited material being of such shape and positioned between said striker and said tube that said striker slides into and out of said tube in a quiet relatively friction free, non-gripping manner so that uniform, wear resistant operation is obtained over long periods of time.

14. In a chime carillon and similar musical instruments, a vibrating member, a vibration pick-up device, an amplifier, a switch for connecting said pick-up device and said amplifier for amplifying the output of said device, an electrical storage device, means for charging said storage device when said switch is closed and connections between said storage device and said amplifier to gradually permit said amplifier to become inoperative as the charge of said storage device is dissipated when said switch is open.

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