

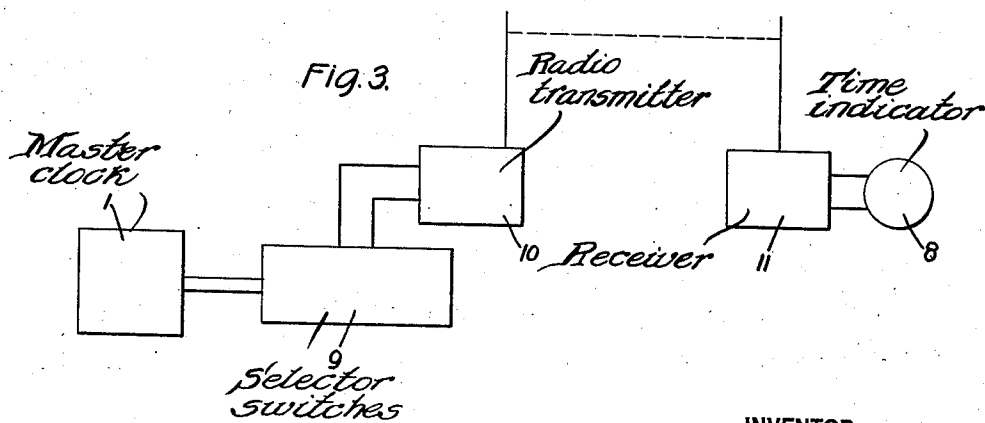
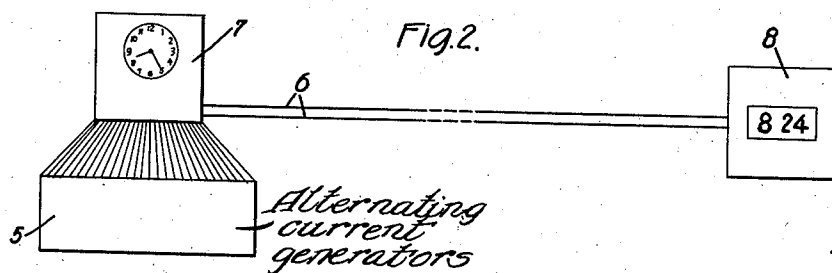
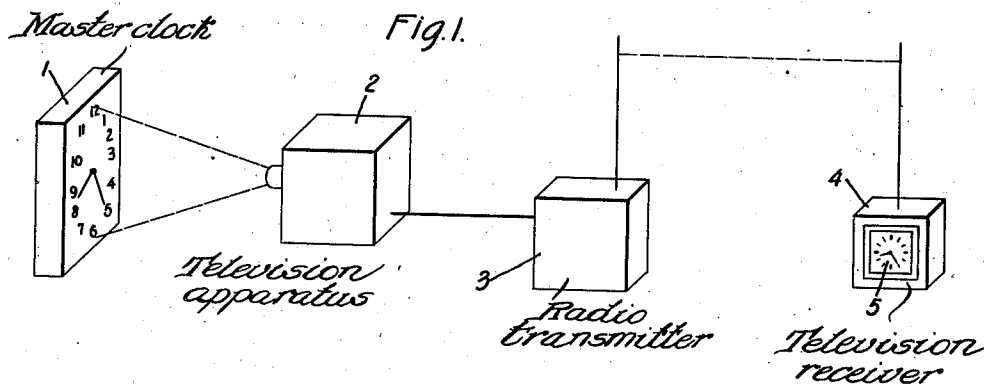
Jan. 23, 1940.

S. G. FRANTZ

2,188,145

REMOTE INDICATING SYSTEM

Original Filed Sept. 21, 1932 4 Sheets-Sheet 1



INVENTOR
Samuel G. Frantz.
BY *Moses & Nolte*
ATTORNEYS

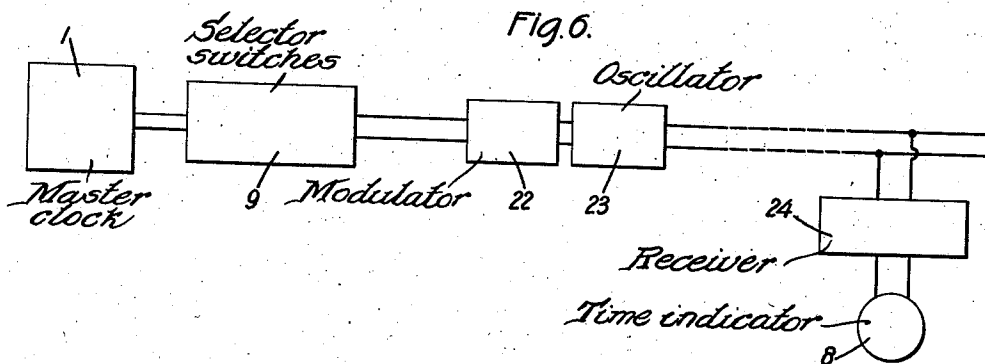
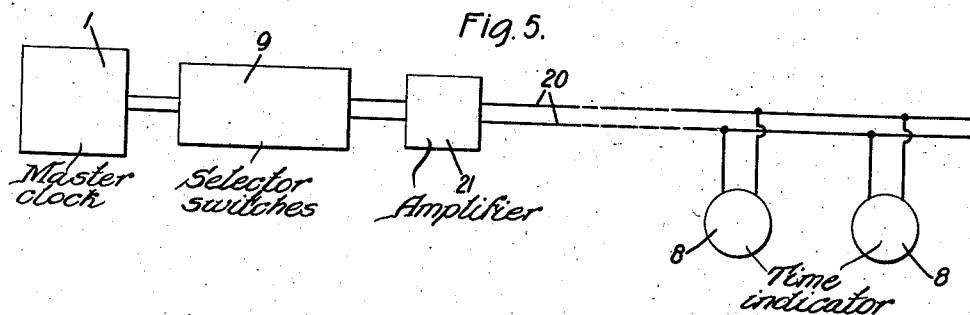
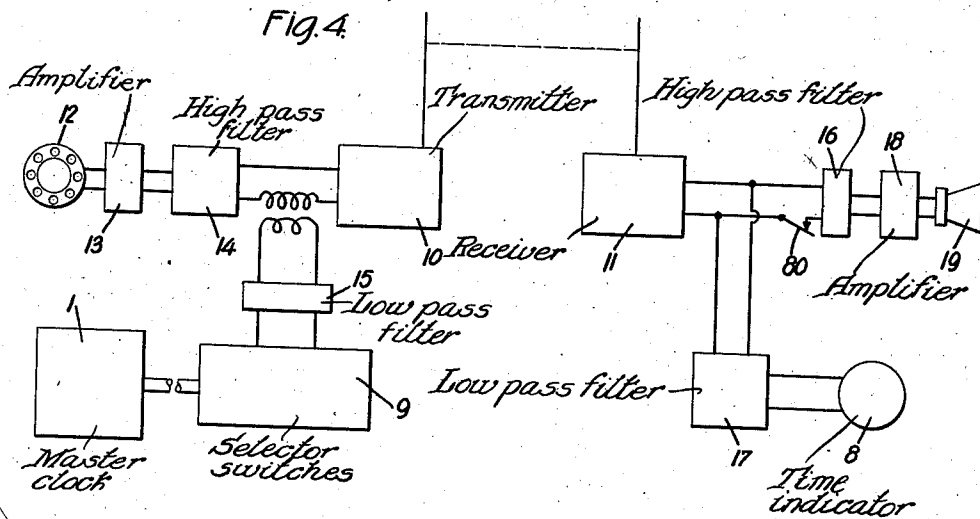
Jan. 23, 1940.

S. G. FRANTZ

2,188,145

REMOTE INDICATING SYSTEM

Original Filed Sept. 21, 1932 4 Sheets-Sheet 2



INVENTOR
Samuel G. Frantz.
BY *Moses & Nolte*
ATTORNEYS

Jan. 23, 1940.

S. G. FRANTZ

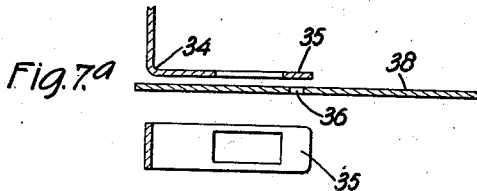
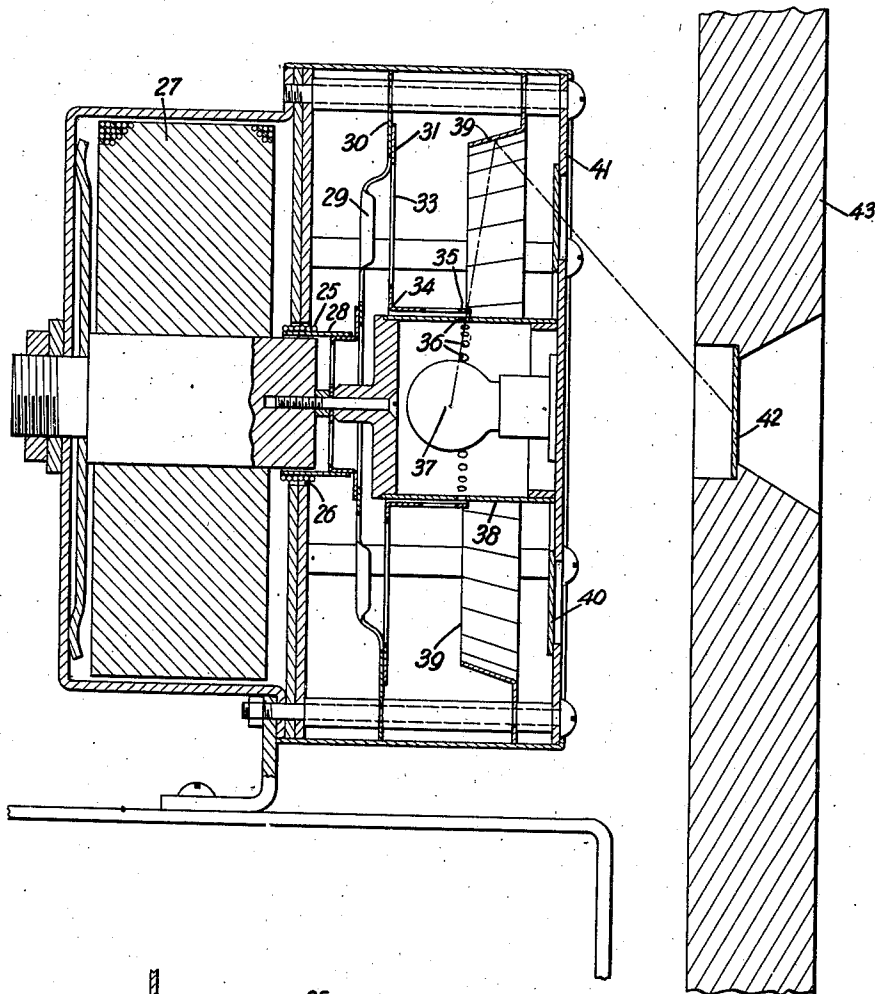
2,188,145

REMOTE INDICATING SYSTEM

Original Filed Sept. 21, 1932

4 Sheets-Sheet 3

Fig. 7.



INVENTOR
Samuel G. Frantz
BY *Moses & Nolte*
ATTORNEYS

Jan. 23, 1940.

S. G. FRANTZ

2,188,145

REMOTE INDICATING SYSTEM

Original Filed Sept. 21, 1932 4 Sheets-Sheet 4

Fig. 8.

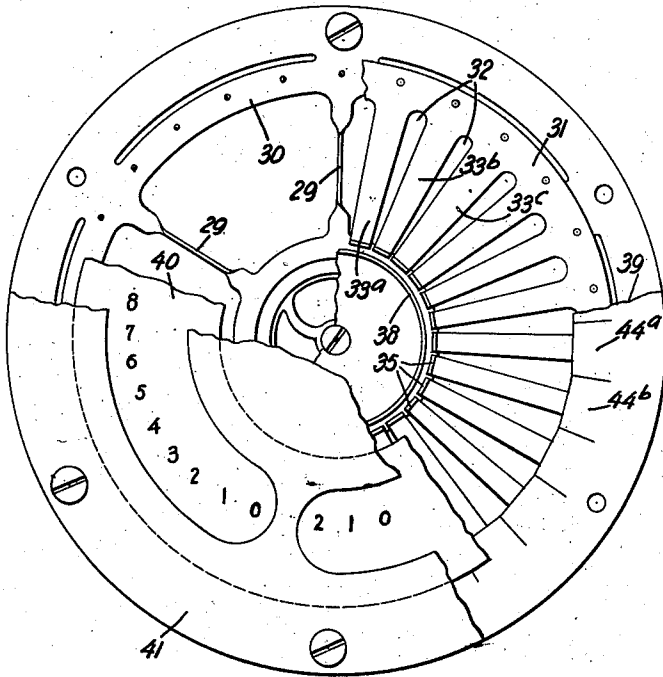
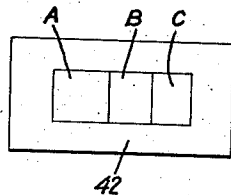


Fig. 8a



INVENTOR
Samuel G. Frantz.
BY *Moses & Nolte*
ATTORNEYS

UNITED STATES PATENT OFFICE

2,188,145

REMOTE INDICATING SYSTEM

Samuel G. Frantz, Princeton, N. J., assignor to
Radio Corporation of America, New York, N. Y.,
a corporation of Delaware

Application September 21, 1932, Serial No. 634,107
Renewed June 19, 1937

7 Claims. (Cl. 58-24)

This disclosure relates to an invention which may be described as a remote indicating system, and more particularly, in one of its uses, as a remote time indicating system.

My system may use any transmission channel in which a variable such as electric current may be varied simultaneously at several different frequencies. Examples of such channels are:

Wire
Radio
Telephone
Telegraph
Power line
Light beam

In general the changes in the variable required to give the indications at the receiving end may be transmitted either as simple periodic changes of the variable at the frequencies required for the indication, or as a modulated carrier wave, the frequency of the carrier being higher than that of any of the signal frequencies.

My system is particularly adapted to the continuous transmission and reception of correct time from a sending station at which there is a master clock or the equivalent, to a plurality of receiving stations at which it may be desired to know the correct time.

Figure 1 illustrates schematically the use of a radio television system for the purpose of giving continuous time indications.

Figure 2 illustrates the general application of a multiplicity of frequencies to give a remote indication of time.

Figure 3 illustrates the application of such a method using a special radio channel.

Figure 4 illustrates the application of the system, using a radio channel which simultaneously is being used for ordinary radio broadcasting purposes.

Figure 5 illustrates the use of a wire channel upon which the various signal frequencies are imposed directly.

Figure 6 illustrates the application to a wire channel in which the various frequencies are used to modulate the carrier frequency.

Figures 2, 3, 4, 5 and 6 are also schematic.

Figures 7 and 8 show a preferred form of a time indicator made in accordance with the present invention. Figure 7 shows the device in vertical cross section, and Figure 8 shows a broken away front view of a part of the device.

Figure 7a is an enlarged view of a detail of the invention showing a reed and a pinhole.

Figure 8a is a front view of the screen, as incorporated in the device described.

In Figure 1, 1 is a correct master clock, whose face is scanned by the television scanner 2. This is connected in the conventional way to the radio transmitter 3. The television receiver 4 receives the broadcast from 3 and this gives an image 5 of the face of the clock. In this way, assuming that the clock is always correct, the indication at 5 will be correct.

The disadvantage of the arrangement illustrated in Figure 1 is the necessity of using a very wide radio channel, this being inherent in any television system. I shall show that the time indication of the master clock 1 may be duplicated at any remote point by the use of a frequency band which is extremely narrow, compared to that used by a television system.

Referring to Figure 2, 5 represents a battery of twenty-eight alternating current generators. These generators may conveniently be twenty-eight electrically driven tuning forks provided with suitable electrical pick-up means. The output of any of these generators may be connected to the output wires 6 by means of a commutator. The clock and the commutator are shown schematically at 7. They are so arranged that there will always be impressed on the output 6 a group of three different frequencies which may be designated A B C. Frequency A is a particular one of a sub-group of twelve out of the total twenty-eight, and it is that particular one which is arbitrarily designated to represent the existing hour out of a possible total of twelve hours. Frequency B is one out of a sub-group of 6 frequencies arbitrarily designated to represent the existing tens of minutes out of a possible total of 6 tens of minutes in any given hour. Frequency C is one of a sub-group of ten frequencies arbitrarily designated to represent the existing minute out of a possible total of ten minutes in each ten minute period. Thus, an observer having access to the remote ends of wires 6 and provided with means for measuring frequencies and also provided with the arbitrary code relating the various frequencies to the hour, tens of minutes, and minutes, would be enabled to ascertain the time shown by the clock 7. The clock 7 is connected to the commutator in such a way that the frequencies impressed upon 6 will correspond according to the arbitrary code with the existing time. In the actual use of my system, however, the detection and decoding of these frequencies is done automatically by the time reception device 8, which gives a plain uncoded visual indication

of the time. It is obvious that this indication will be the same as the indication of the clock 7 whenever 8 is in communication with 7 and that if this communication is restored after a temporary interruption the indication will still accurately duplicate the indication of 7. This is in contrast to the ordinary electric synchronous clock, in which an interruption causes the remote clock to fall out of step and give an incorrect indication. In general in my system the device 8 gives no indication at all when the communication channel is interrupted, but immediately gives a correct indication when the channel has been restored.

Figure 3 illustrates the application of my system, using a special radio channel. 1 is the master clock, connected to the switching device 9, by means of which the appropriate frequencies, which preferably are within or below the audio band, are impressed upon the modulation circuit of the radio transmitter 10. The transmitter 10 thus sends out the carrier wave at some radio frequency modulated by the appropriate three signalling frequencies. This is received by the radio receiver 11 whose low frequency output is connected to the time indicator 8.

Figure 4 shows how the system may be applied to a radio broadcasting system which is already being used for the transmission of entertainment or the like. In Figure 4, 12 is the microphone used for picking up the regular broadcasting program. The microphone current is amplified in 13 and the output of 13 is passed through the high-pass filter 14, which removes all frequencies below say 30 cycles. 1 is the master clock, connected to the switching device 9. The output of 9, consisting of the three appropriate coded frequencies, passes through the low-pass filter 15, and is impressed upon the output of 13 and 14. In this case the time signal frequencies are included in a band lying below the audible range, say between 13 and 25 cycles. The purpose of the low-pass filter 15 is to remove any harmonics which might cause unpleasant interference with the audible program. The outputs of 9 and 13, filtered as described, are combined and impressed upon the radio transmitter 10. The ordinary radio receiver tuned in to the radio frequency of 10 would be unaffected by the sub-audio time signals. In Figure 4, however, the radio receiver 11 has its low frequency output divided into audio and sub-audio components respectively by the high-pass filter 16 and the low-pass filter 17. The audio component may be further amplified by the amplifier 18 and is fed into the usual speaker 19. This audio component may be switched off by means of the switch 20, in case it is desired to have only the time indication, and no audible program from the speaker. The sub-audio component is applied to the time indicator 8 which gives a visual indication of the time shown by the clock 1. The amplitude of the sub-audio signals imposed upon the transmitter 10 will naturally be small enough to modulate the output of 10 to only a small degree. My experiments have indicated that the percent modulation by sub-audio signals should not exceed about 5%; otherwise an unpleasant fluttering noise may be heard from the speaker 19, due to cross-modulation in the detector of the radio receiver 11.

My invention may, of course, be used in connection with a wire channel, without the use of radio frequencies, and such embodiment is especially adapted to the requirements of hotels,

apartment houses and the like, where it is desired to have in each room a clock which will never have to be reset, regardless of possible interruptions or disturbances to the master clock or to the communication channel. Such an arrangement is shown in Figure 5 where 1 is the master clock, controlling the switching device 9 which imposes the appropriate frequencies upon the wire channel 20 preferably through the amplifier 21. The wires 20 are brought to each location at which it is desired to have a time indicator, at which points the indicators 8 are connected. In a very large system where the distance from the master clock to the indicators is great, other amplifiers may be connected ahead 15 of the indicators 8.

Figure 6 illustrates a system employing a modulated carrier wave which is suitable for operation over long distances, and is particularly suitable when the wire channel to be employed is 20 already being used for power, telephone or telegraph services. In this case the coded time signal frequencies are fed into the modulator 22 which modulates the output of an oscillator 23. This output is impressed upon the channel in a way which is appropriate to the nature and use of the channel as is well known to those skilled in the communication art. The high frequency receiver 24, by appropriate take-off means, receives the modulated signal, demodulates it and 30 feeds the low frequency signals to the time indicator 8.

In Figure 7, 25 is the moving coil of the driving element, which is very similar to that used in a dynamic speaker for instance, the voice coil. 25 is supported in the air gap 26 through which a strong magnetic flux is passing due to the field coil 27. The low frequency time signal frequencies are impressed upon the coil 25 causing it to vibrate axially. Coil 25 is wound upon the tube 28, which is connected by the radial arms 29 to the rim 30, in such a way that the vibration of the coil 25 is communicated to the rim 30. Fixed to the inner part of the rim 30 is the reed-plate 31. This is shown as a stamping of thin metal from which the slots 32 have been cut out, leaving the reeds 33a, 33b, etc., projecting inwards. Separate reeds attached at their outer ends may, however, be used if desired. The inner end of each reed is turned out axially at 34, and the extreme end forms a shutter 35, which normally covers a corresponding pinhole 36. An enlarged view of the end of a reed and a pinhole is shown in Figure 7a. The reeds are tuned respectively to the twenty-eight different frequencies to be used in communicating the time. This tuning may be accomplished either by varying the width of the slots 32 so as to change the stiffness of the various reeds, by attaching different weights to the inner ends of the reeds, or in any other suitable way. As a result of this tuning only those reeds vibrate whose natural period corresponds with one of the frequencies impressed upon the coil 25. On the axis, at 37, is a light source, preferably a concentrated filament electric lamp. Surrounding this lamp is a sleeve 38 in which are pierced the twenty-eight pinholes 36, each co-operating with a shutter 35. 39 is a mirror, which may be of polished metal. It is pressed or stamped so as to present twenty-eight facets 44a and 44b, etc., each facet being approximately in line with the source 37 and the corresponding shutter and pinhole 35 and 36. 40 is a stencil supported by the plate 41. This stencil has the general appearance shown in Figure 8 except 71

that the figures are transparent and the background is opaque. 42 is a translucent screen of ground Celluloid mounted in the front of the case 43. A front view of this screen is shown in Figure 8a.

The operation of this device will now be explained. The coil 25 is simultaneously supplied with three frequencies, one each from sub-groups A, B and C corresponding to the hour, tens of minutes, and minute. This causes three of the reeds 33 to vibrate. The twenty-eight reeds 33 may thus be considered to be divided into three sub-groups A, B and C, comprising respectively twelve, six and ten reeds. One reed of each of these groups will therefore be in vibration, and its shutter 35 will uncover for the greater part of its cycle the corresponding pinhole 36. This allows three light beams, one for each group A, B and C, to emerge from the source 37, to be reflected upon the appropriate facets 44, to pass through the stencil 40, and impinge upon the screen 42. The shutters, pinholes, and facets belonging to each sub-group, A, B or C, are so disposed that any beam belonging to the sub-group A will fall upon that part of the screen 42 which is marked A, and similarly beams belonging to sub-groups B and C will fall respectively upon spaces marked B and C, respectively. The figures on the stencil are so positioned that each is centered on the optical axis of the ray passing through the source 37, the pinhole 36 and the center of the appropriate space A, B or C, on the screen. Thus the presence of any frequency belonging to sub-group C in the coil 25 will cause the appearance of a figure of light in the space C of the screen 42 and similarly frequencies in sub-groups A and B will cause figures of light to appear in spaces A and B. A complete time indication is the result of three frequencies, one pertaining to each of these sub-groups.

It will be seen from this specification that my system may be applied in two general cases, first, where a special channel of some sort is provided for the exclusive use of time transmission, and second, where existing facilities in the form of radio broadcast carriers, telephone lines or power lines are used to carry time signals in addition to and without interference with their original functions. Naturally the usefulness of my invention is greatly increased in the latter case. I have already described how coded time signals may be added to the regular program from a radio broadcasting station so as to give a time indication at the receiver without interfering with the regular program. Of course, it will be understood that even though the entertainment program is not being set out, the carrier may continue to be used, preferably at reduced power and increased modulation, for the purpose of sending time signals alone. The same kind of advantages are found in the use of existing telephone circuits for supplying accurate time indications to telephone subscribers. In this case the coded time signals may well be impressed on the telephone circuit as a modulated carrier wave which will cause no interference with the ordinary use of the telephone, and which will give the desired time indications at any subscriber's station at which the proper receiving device may have been installed.

It will be understood that a number of modifications are possible in my system without departing from the spirit of the invention. As the system has been described, a first group of three

frequencies is chosen from a second group of 28 possible frequencies, and of this second group 12 frequencies represent the 12 possible hours of the day, 6 frequencies the possible tens of minutes within the hour, and 10 frequencies the possible units of minutes within a ten minute period. This method of coding has the great advantage of requiring only three frequencies in the first group, that is, three frequencies to be transmitted simultaneously. Thus in my receiving device the sub-group A consisting of 12 possible frequencies, represents both the tens of hours and hours, and the stencil is made accordingly.

It is of course possible, however, to use four sub-groups with four frequencies to be transmitted simultaneously, the first group representing tens of hours, the second units of hours, the third tens of minutes and the fourth units of minutes. In this case, if only the hours from one to twelve inclusive are to be transmitted, the first sub-group would contain only one frequency which by its presence or absence would indicate whether or not there were any tens of hours in the total time figured to be transmitted, so that between one o'clock and 9:59 this frequency would be absent and only three frequencies would be transmitted.

It is also possible to use the method of time designation common in European countries in which hours are designated from one to twenty-four, or zero to twenty-three, 23 o'clock being 11 p. m. In this case a first sub-group of two frequencies is required for the tens of hours; a total of four frequencies are to be transmitted simultaneously, and the total number of possible frequencies will be 29.

Also it is obvious how this invention may be applied to the transmission of a time indication which includes the seconds. If this is done two additional sub-groups representing tens of seconds and units of seconds are required, containing respectively six and ten possible frequencies. So that if seconds are to be transmitted as well as hours and minutes according to any of the above described systems the total number of frequencies from which the frequencies to be transmitted are chosen will be 43, 44, or 45, the number depending on the method used to designate the tens of hours; and the number of frequencies actually transmitted at one time will be either five or six.

I consider it desirable, especially when only hours and minutes are to be transmitted, to use for the total group of frequencies a group in which the ratio of each frequency to the one immediately below it is a constant, and such that the ratio of the highest frequency to the lowest is less than two, that is, the entire group should lie within an octave. The reason for this is that in such a case the presence of a second or higher harmonic in any of the lower frequencies will have no tendency to cause any of the tuned elements in the receiving device to respond to such harmonic and give a spurious indication. In a system employing a total group of 29 frequencies, for example, the ratio of each frequency to the one immediately below it might very well be the 29th root of 2. While it might be extremely difficult to tune electrical circuits to select between frequencies as close together as these, the much greater selectivity of mechanically tuned elements makes them well adapted to good selection in such a case as this.

I have described what I believe to be the best embodiment of my invention. I do not wish,

however, to be confined to the embodiment shown but what I desire to cover by Letters Patent is set forth in the appended claims.

I claim:

1. In a time code receiving device, a group of vibratory elements mechanically tuned to respond selectively to different frequencies, a motor element for impressing vibrational forces on said group of elements, and means whereby the motion of said elements is caused to give a time indication, said means comprising shutters connected respectively to said vibratory elements, means for producing beams of light to be affected by said shutters, and means cooperating with said beams of light to produce time indications.

2. In a radio receiver adapted to receive a radio wave modulated simultaneously by audio and a plurality of sub-audio components, said sub-audio components comprising a first group of frequencies chosen from a second group of possible frequencies, the choice of the first group being related to the time by an arbitrary code; a sound reproducing device and a time indicating device, said devices being responsive, respectively, to the audio and sub-audio components of modulation of the received wave, said time indicating device comprising a group of vibratory elements mechanically tuned to respond selectively to the different sub-audio frequencies, a motor element for impressing vibrational forces on said group of elements and means whereby the motion of a plurality of said elements is caused to give a time indication.

3. In a system which includes a radio receiver adapted to receive a radio wave modulated simultaneously by audio and a plurality of sub-audio components, said sub-audio components comprising a first group of at least three frequencies chosen from a second group of not more than approximately twenty-nine possible frequencies, the choice of the first group being related to the time by an arbitrary code; a sound reproducing device and a time indicating device, said devices being responsive, respectively, to the audio and sub-audio components of modulation of the received wave, said time indicating device comprising a group of vibratory elements mechanically tuned to respond selectively to the different sub-audio frequencies, a motor element for impressing vibrational forces on said group of elements and means whereby the motion of a plurality of said elements is caused to give a time indication.

4. In an indicating device, means provided with an air gap for producing a strong magnetic flux through the air gap, a moving coil structure mounted within the air gap, a rim of substantially larger diameter than the coil structure, a plurality of radial arms connecting the coil structure and the rim and arranged so as to support the rim co-axially with the coil structure and so that vibrations of the coil structure are communicated to the rim, a reed plate mounted on the rim, a plurality of differently tuned radially arranged reeds mounted on the plate by attachment thereto of their respective outer ends around the reed plate and so that the reeds converge toward the axis of the coil, the inner end of each of said reeds being turned out axially.

5. In an indicating device, means provided with an air gap for producing a magnetic flux through the air gap, a moving coil structure mounted within the air gap, a rim of larger diameter than the coil structure, means for mounting said rim on the coil structure and co-axially therewith, said means being arranged so

as to transfer vibrations of the coil structure to the rim, a plurality of differently tuned radially arranged reeds mounted on the rim by attachment of their respective outer ends axially around the rim and so that the reeds converge toward the axis of the coil, the inner end of each of said reeds being turned out axially, a hollow cylindrical member of substantially the same diameter as the coil structure fixedly mounted co-axially with and alongside the coil structure and so that its outer surface is closely adjacent the inner faces of the turned out ends of the reeds, a plurality of pin holes formed around said cylindrical member and positioned thereon with respect to the turned out ends of the reeds so that said turned out ends form shutters for said holes and means for providing a source of light within said cylindrical member.

6. In indicating apparatus, a diaphragm having the form of a circular flat ring so supported that it is adapted to vibrate substantially as a whole, means for actuating said diaphragm comprising a coil, a plurality of differently tuned reeds attached to the diaphragm, said reeds comprising spoke-like elements, the outer ends of which are attached to the diaphragm, said spoke-like elements converging toward the axis of the coil, the inner ends of said reeds being turned out axially, a cylindrical sleeve mounted hub-like with relation to said spoke-like elements, said sleeve member having such a diameter that the outer surface thereof is closely adjacent to the inner surfaces of the turned up portions of the reeds, a plurality of pin-like openings arranged around said sleeve and so as to be covered by the turned out portion of the reeds when the reeds are at rest, a source of light within said sleeve, a mirror having the form of a truncated cone which is open at its top fixedly supported in co-axial relationship with respect to the sleeve and so that light from the source passing through the pin-like openings impinges upon the surface of the mirror, a stenciled disc sheet mounted co-axially with said sleeve member and arranged so that light reflected from the mirror surface passes through the stencil and a screen located near the stencil and adapted to intercept the light passing through the stencil.

7. In an indicating device, means provided with an air gap for producing a magnetic flux through the air gap, a moving coil structure mounted within the air gap, a rim of substantially larger diameter than the coil structure, means for mounting the rim on the coil structure and co-axially therewith, said means being arranged so as to transfer vibrations of the coil structures to the rim, a plurality of differently tuned radially arranged reeds mounted radially in spoke-like fashion around the rim, the inner ends of said reeds being turned out axially and so that said turned out ends form a sleeve-like structure having an axis which coincides substantially with the axis of the coil, a sleeve member mounted within said sleeve-like structure in close proximity thereto, the axis of said sleeve member coinciding substantially with the axis of said coil, a plurality of pin-like openings arranged around said sleeve, the number thereof corresponding to the number of tuned reeds, said pin-like openings being positioned around said sleeve so that each thereof is covered by a corresponding one of the turned ends of the reed, a source of light within said sleeve member, a plurality of mirror facets positioned around said

sleeve but spacially removed therefrom, the number of facets corresponding to the number of reeds and being positioned with respect to the reed and cooperating pin-hole so that upon vibration of a reed the corresponding pin-hole is uncovered and light from said source travels through the corresponding pin-hole and is reflected by the corresponding mirror facet, all of said facets being angularly disposed in such a

way that light reflected from any one of them converge toward a single small area, a stencil disc in the path of the light reflected by said facets and a screen positioned approximately at substantially the point of convergence of said reflected light, said stencil being interposed intermediate said convergence point and the mirror facets.

SAMUEL G. FRANTZ.