APPARATUS AND METHOD FOR PRODUCING AND TRANSMITTING SIGNALS

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Signals, such as elements of the Morse code, are produced by projecting a stream of energy, such as a small gas stream or light beam, against the normally obstructing annular zone of a rotating disc provided with apertures which allow the energy to pass through in a controlled pattern. Means mounting the input stream and the transmitter in axial alignment are mounted for selective shifting to other annuli of the disc; in this way a disc can carry a series of different signals. The transmitter may be a simple transducer, such as an air activated pipe, or whistle, or it may be a light conduit leading to a photosensitive transducer. The tone produced stimulates closely the commercial radio and wireless signals and facilitates teaching the code by means of auroral rather than visual images.

10 Claims, 14 Drawing Figures
APPARATUS AND METHOD FOR PRODUCING AND TRANSMITTING SIGNALS

BACKGROUND AND PRIOR ART
Numerous devices have been proposed for teaching the Morse code to amateur radio operators, boy scouts, military personnel and others, and for producing and transmitting other and analogous signals or bits of intelligence. Many have attempted to teach the code by visual means; generally these have been less successful than audio devices. Some good machines comprising complex electronic circuits have been developed for teaching the code but these are quite expensive and have not been widely used.

While the versatile International Morse radio-telegraph code facilitates communication by both visual and audible means, one who receives the code, or transmits it, must be able to encode and decode directly and without resorting to intermediate images. If transmission is visual (dot and dash), his knowledge of the code must be in the form of visual dot-dash images. For communication by sound, he must be trained in mental-aural "dit" and "dah" signaling. Sound transmission of the code is aural, training in the sound of the code, as actually transmitted and received usually involves use of mechanism which reproduces the "dit," "dah" sound.

Recording devices, employing tapes and other records, are currently used for this purpose. They are relatively expensive and often are not readily adaptable to changes in speed which is highly desirable as the learner progresses.

Particular objects of the present invention are:

a. To generate Morse code sound characters which are precisely accurate as to relative time lengths of the "dits" and "dahs," and the silent spaces between.

b. To accomplish the above at various speeds without greatly changing the pitch or tone of the signal characters generated, using precoded disks of simple form in sets.

c. To design means whereby the code characters can be generated in any desired sequence, using simple elements adaptable as well for self-teaching as for training others.

Motor operation can readily be superimposed, in single or group machines.

d. To make the basic apparatus adaptable to generation of signals from various forms of energy streams, whether a flowing gas, a beam of light, an electric current, etc. With these arrangements, the system becomes adaptable to various functions other than simple code generation and transmission, such as control of machinery cycling, multi-channel tachometer and analogous systems, remote scanning and/or monitoring, static reading of punched cards, tapes, and the like, opto-electronic counting, animated displays and signs, alarm systems, etc.

The use of a flowing energy stream, i.e. a stream of air or of other fluid, an electric current, the transmission of a light beam, and the like, is widely known for creating and transmitting signals, acting mechanical apparatus, controlling slave devices from master mechanism, and the like. Perforate control tapes which uncover vacuum ports to energize various mechanical contrivances are widely used in industry. However, most such devices are relatively complex and quite costly. It is one object of the present invention to provide a relatively simple and very inexpensive device for accomplishing at least the more common of these results.

An important use of the present invention, though not its only use and perhaps ultimately not its primary use, is to teach the Morse code to amateurs by use of very simple and inexpensive but highly effective means. These means comprise primarily a rotatable annularly zoned disc adapted normally to interrupt a transversely flowing energy stream, the disc being apertured at suitable intervals and for suitable aperture lengths to permit the stream to resume flow momentarily to activate a transducer. The latter in its simplest form is a sounding pipe, e.g. a whistle, although a reed or other tone-producing element may be substituted. In more complex form, where the energy stream is a beam of light, the incoming and outgoing transmitter elements are axially aligned, both being adjustable together to shift to other bands or zones of the control disc where other signal combinations are represented.

To keep the structure simple, and to permit concentrated drill and study, only a few characters are represented on a single disc; thus several discs are used to make up a complete numer-alphabetical code plus the usual special symbols. Each accurate zone or path has slots cut in the disc to allow passage of air, or of light, for a predetermined time period, typical of the relative lengths of the "dits" and "dahs" of the code. Simple detent means retain the energy tube and the transducer in axial alignment therewith in the desired annular zone; these may be readily shifted to any other zone. The user may blow into the input tube, using a replaceable sanitary straw if the device is to be used also by others. Mechanical means for switching a light beam from zone to zone are provided in a more sophisticated version with similar results.

While the device is described largely in connection with the Morse code and means for its transmission and simulation, other signals and operations of various types may be produced, transmitted, redirected and otherwise used for a variety of control and analogous functions. For transmitting the English alphabet and numerals in Morse code, 36 separate characters are required. In order to keep the discs of convenient size, it is preferred to place six characters on each disc, thus requiring a set of six discs, plus an extra one for the punctuation characters, a total of seven. However, the number of characters per disc, and the number of discs, can be varied.

BRIEF DESCRIPTION OF DRAWINGS
FIG. 1 is a perspective view of a relatively simple signal device or basic unit of the invention.
FIG. 2 is a front elevational view of the device of FIG. 1.
FIG. 3 is an enlarged sectional detail view taken substantially along line 3-3 of FIG. 2.
FIG. 4 is a vertical sectional view of the unit of FIGS. 1 and 2 with a drive means associated therewith.
FIG. 5 is a fragmentary face view of the drive means taken substantially along line 5-5 of FIG. 4.
FIG. 6 is a detail sectional view of a detent arrangement, taken substantially along line 6-6 of FIG. 2.
FIG. 7 is a sectional view of a modification equipped with optical means for transmitting signals.
FIG. 8 is a face view of a typical record disc as seen along the line 8-8 of FIG. 7.
FIG. 9 is a sectional view of certain switching apparatus of FIG. 7, taken substantially along the line 9-9 of the latter FIG.
FIG. 10 is a sectional detail view taken along the line 10-10 of FIG. 9.
FIG. 11 is a perspective view of a part of the apparatus of FIGS. 7 and 9.
FIG. 12 is a sectional view of a modified light transmitting mechanism, a variant of the input (left) side of FIG. 7.
FIG. 13 is a sectional view of a modified light sensing mechanism, a variant of the output (right) side of FIG. 7.
FIG. 14 is a perspective view of a composite system made up of a plurality of the basic units combined with control means adaptable for a variety of uses.

The invention will be described by referring first to the code carrying interchangeable disc elements 10, seen in FIGS. 1 to 4, 7, 8 and 14. For generating the Morse International code, e.g. for the English language, a total of some 42 or more distinct code units are required, as already explained. These 42 discs are made of suitable metal or plastic material, and are preferably somewhat resilient.

For clear and distinct signals, using the "dits" and "dahs" (dots and dashes) of the Morse code, the signal bits have time lengths proportioned as follows: "Dits," one element of length; "dahs," three elements, spaces between "dits" and/or
"dahs," one element, spaces between successive characters of the alphabet or numbers, etc., three elements. For spaces between words, a spacing line approximately as shown at S. Fig. 2, successive annular areas of the disc, beginning at the outer periphery, are utilized one for each character of the alphabet or number system, etc. Thus, six characters are represented on disc 10, Fig. 2, which is a thin metal plate, e.g., of aluminum, slotted in arcuate patterns to represent the Morse code bits. The outer annulus shows "dit", "dah", "dah", representing the letter "W," the next represents the letter "D" ("dah, dit, dit"), the next the letter "G," etc.

Each of the discs 10 is adapted to be mounted on a hub and to be rotated past a signal creating device, the arcuate slot determining the timing and the duration of each signal bit, as will be described in detail below.

The code discs 10 are adapted to be supported for rotation on a stand or frame comprising a base or foot member 11. The latter may be attached by screws or bolts to any suitable support. Integral with the base 11 is an upwardly extending standard or main frame element 13 having an arm 15 projecting upwardly and to the right as seen in Fig. 2. Protrudingly mounted at 17 on the standard or frame element 13 is a bifurcate bracket consisting of a transverse hollow shaft or bridge element 18, a front arm 19 extending more or less parallel to the face of member 13, and a rear arm 23. The latter arm includes a mounting opening or recess 24 adapted to receive a cylindrically shaped signal device 25. In Figs. 1 and 4 this device 25 is a whistle; other devices may be placed in the same opening, as will be indicated below.

Arm 23 also comprises a downwardly directed extension 26 which carries a spring-pressed detent ball 27 as best shown in Fig. 6, this detent is adapted to snap into a selected one of a plurality of holes or depressions 28, formed in the rear face of standard 13, to hold the bifurcate member in a particular angular position about its pivot point 17; see also Fig. 2.

The front arm member 19 of the bifurcate device is offset as shown at 29, Fig. 1, and is bored at 49 to receive and hold snugly a cylindrical member or part 51. The latter may be a simple tube through which air is blown and directed into the whistle on the opposite arm when there is no obstruction or solid plug of disc 10 between. Ordinarily the disc 10 is interposed between cylindrical members 51 and 25 but when and if there is an opening in the disc at the axis of these members the air can flow through and activate the whistle W, or some other medium, such as light, or an electric current can be passed from bore 49 to bore 24. In the latter case, light conduits or electric conductors will replace the cylindrical members 51 and 25, as described below.

The disc 10 is adapted to be mounted for retention and rotation on a hub member 35. See Fig. 3. The arm 15 of the main frame member 13 is journaled at 31 to receive a stub shaft 33. Shaft 33 is secured to or integral with hub 35 and its rear end, or right end as seen in Figs. 1 and 4 is split at 34 to accommodate between words, seven elements. The most common characters in Morse code bits, as the number zero (0), made up of five "dahs," thus will occupy a total of 19 elements, five "dahs" of three elements each, with four space elements interspersed between. Other characters require less than 19 units, as a rule. By dividing up the disc into 24 imaginary sectors of 15° each, as shown in dotted lines at the top of Fig. 2, and beginning at any starting line approximately as shown at S, the disc 10, Fig. 2, successive annular areas of the disc, beginning at the outer periphery, are utilized one for each character of the alphabet or number system, etc. Thus, six characters are represented on disc 10, Fig. 2, which is a thin metal plate, e.g., of aluminum, slotted in arcuate patterns to represent the Morse code bits. The outer annulus shows "dit", "dah", "dah", representing the letter "W," the next represents the letter "D" ("dah, dit, dit"), the next the letter "G," etc.

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and then rotating it to engage bosses 47 and 48 in the holes in the disc, which requires slight deformation or springing of elements 43 and 44. The disc is secured to the hub and will be rotated as crank 42 is turned.

Obviously, by passing a stream of air through tube 51, Fig. 1, while rotating the shaft 42, the detent 27 having been moved into a selected depression 28, the particular annular zone of the disc passing over the air stream will permit activation of the whistle W whenever a short slit 60, representing a "dit," or a longer slot 61, representing a "dah," comes along. A small connecting tube 63, such as a conventional drinking straw, is fitted into the opening 64 in member 51. When the user blows continuously on the straw and rotates the disc, he produces a coded whistle. With the parts set as shown in Fig. 2, that is with the outer annulus of disc 10 set to pass intersecting the axis of members 51 and 25, the signal bits "dit, dah, dah" will be produced at the whistle W. The signal is repeated for each revolution of disc 10 as long as blowing continues. The speed of rotation of crank 42 can be varied, according to the needs and abilities of the listener or the self trainer, and the detent 27 can be moved as often as the demonstrator desires, to bring in other characters as coded in the disc 10. The whistle W has been found to give clear, sharp, and distinct signal bits which closely resemble the sound of commercial signals.

The instructor can hold the device in one hand and rotate crank 42 with the other. If desired, the base 11 may be secured to a comfortable handle or may itself be formed as such. For different users, the straw or tube 63 may be replaced for sanitary reasons.

Figs. 4 and 5 show an arrangement wherein the disc is motor driven. The frame 11, 13, is mounted on a base or panel 70 on which is mounted also a drive motor 72 having appropriate speed reducing mechanism with an output gear 74. The latter drives a mating gear 76 fixed to a shaft 78 on which a split clamp bracket 80 is secured, being tightened on the hub of gear 76 by a screw 82. The bracket 80 has a slot 84 into which the crank 42 of the disc mounting mechanism can be inserted. By aligning the members reasonably well, exact alignment being unnecessary, the motor will drive the signal disc at an appropriate speed. A variable speed motor is preferred to give the teacher or self instructor, a variety of signal speeds suited to the aptitudes of the trainees.

As seen in Figs. 1 and 4, the split end 34 of stub shaft 33 is normally held snugly by a sleeve 22 about the shaft 40 which is formed or bent in such a way that radial element 42A of the crank is within the split element 34. Sleeve 22 bears against the rear or right face of the journal element 31; thus when the parts are assembled, with radial arm 42A bearing against the outer end of sleeve 22 and its other end 41 bent into slot 39 in the hub 35, holds the parts snugly without longitudinal or axial play while permitting free rotation of the hub and disc.

As suggested above, the cylindrical elements 51 and 25, which are axially aligned with each other but separately held in the bores 49 and 24, respectively, of the bifurcate pivoted member, need not always be air tubes and whistle elements. Figs. 7 to 14 show alternative arrangements making use of optical fibers or analogous light-transmitting devices for transmitting signals and the like.

In Fig. 7, the code generating mechanism is much the same as in the previously described embodiment. It is associated with a switch mechanism, designated generally at 90, which is mounted on a panel 91 and comprises a control shaft 92 having a control knob 93 attached to its exposed end and passing through a clearance hole in panel 91 and subframe 94 of the mechanism 90. This shaft extends through the mechanism 90 and can be rotated to fit an end opposite knob 93 with various devices, such as switches, switches, motors, control elements, or equivalent as will appear more clearly below. A gear 96 is secured to shaft 92 and meshes with a gear 97 on the left which may be considered a receiving side, and a gear 98 on the right, which may be considered a transmitting side. The
gear 96 which drives the others, has a series of detent openings or depressions 99 adapted to receive one or more spring-pressed detent balls 100. To avoid uneven pressure on the gear 96, it is preferred to use three of these detent balls, as indicated at 106a, 106b, and 106c, FIG. 9. Obviously, three, four, or more gears such as gear 96 may be driven by gear 96.

The gears 97 and 98 are secured on vertical shafts 102 and 103, respectively, mounted in upper and lower members of the subframe 94. A U-shaped rod or filament of plastic material 105 having high internal light reflection characteristics, and hence suitable for use as optical fiber means, extends through a bore 106 in shaft 102 and a side slot 107 from which it loops to the left and upwardly into a vertical bore through a marginal portion of gear 97. Fiber 105, of course, may be replaced with prism or lens means, if desired. Above gear 97 and at the left is a light source 110 from which another light beam carrier, shown as an optical fiber 111, extends to the right and bends downwardly to align with the upper end of fiber or element 105 in shaft 102. A series of similar light carriers or fibers 113a, 113b, 113c, etc., having their lower ends arranged vertically in the upper frame member 94, connect to individual members 51a analogous to the tube 51-mountings previously described.

The light source 110 may be a simple incandescent light or a more sophisticated light source, such as a laser, for complex or extensive installations. Obviously, by rotating knob 93, to overcome detents 100 and shift the gear 97 to a new position, a different light fiber is brought into use and the signal from light source 110 is passed to a different disc 10 or through a different annulus of the same disc, depending on how the upper ends of optical fibers 113a, or 113b, etc., are connected. See also FIG. 11.

The gear 98 at the right, FIGS. 7 and 9, likewise has an optical fiber 120 or equivalent passing from the margin of the gear and through the center of the shaft 103. There it comes in alignment with a transmitting fiber 121 which leads to an appropriate sensor device, such as a photoelectric cell or the like 122. The fiber 120 in gear 98 is adapted to be brought into axial alignment with any one of a set of light carriers or fibers 124, which are led from mounting means or holding means 25a, analogous to the whistle element W, previously mentioned. Each of these fibers 124a, 124b, etc. is connected to a different annulus on disc 10; if desired it may be connected to a different disc 10 on a separate mounting, see FIG. 10. This is true also of the fibers 113a, 113b, etc.

When the knob 93 is turned to shift the middle gear 96, by displacing the detents 100 and allowing them to seat in another set of depressions 99, both the input connection, i.e., to fibers 113a, 113b, etc., and to fibers 124a, 124b, etc., change at the same time. This mechanism thus constitutes a multiposition switch mechanism. Power for the signal comes from the emitter 110; the particular coded signal to be transmitted is determined by the setting of knob 93. The signal is created by the timed rotation of the disc 10 which, with its particular arrangement of slots transmits and locks the light signal in the desired timing and sequence. The sensor 122 picks up the signal and sends it into an appropriate transducer to produce an audible tone or signal or to utilize it in some other suitable manner.

In FIG. 12 a modification is shown wherein the light source or emitter 130 is mounted directly above the center of shaft 102. This has the advantage of close coupling. Likewise, the sensor, shown at 140 in FIG. 13, can be closely coupled to the output line by mounting it directly above the shaft 103 of gear 98.

FIG. 14 shows a combination arrangement, made up of a plurality of code transmuting devices comprising discs 210a, 210b, 210c, mounted respectively on bases 211a, 211b, 211c, and standards 213a, 213b, and 213c. The bifurcated members 219a, etc., are identical with those of FIGS. 1, 2 and 4 and the drive mechanism, motor 272, gear 266, etc. are the same as in FIG. 4. A single rod or shaft 240 connects all the signal devices to the drive motor. The sleeves 22 of FIGS. 1, 3 and 4 are replaced by split ring clamps 222a, 222b and 222c, respectively. These are tightened by screws 223 around the split parts 34 of the hub shafts 33, described above. Thus the rod 240, through crank 242 engaging a hole 284 in motor arm 280, positively drives each of the hub members 235 and the discs 210a, 210b, etc. FIG. 22 shows the other methods of connecting parts 235 which transmit the signal to the next drum, 213a, etc., and parts 235b are provided. FIG. 14.

With the arrangement shown in FIG. 14, an emitter, such as a light source 206 introduces energy into the system through optical fiber 207. Knob 293 is set to connect the output of fiber 207 to an appropriate signal line 208 b which leads to one of the discs such as 210b. The signal there produced returns through optical fiber 209b, to the receiving side of box 200 which essentially houses a fiber optic switch such as is shown in FIG. 7, FIG. 9, etc. From there the signal passes through fiber 301 to photo cell 302 in the signal transducer 303 which may include a speaker or other audible, visual or recording device for the signals transmitted.

The simple arrangement of FIGS. 1 to 6 is preferred for individual instruction such as teaching Morse code, for example, to beginners, such as boy scouts, new signal corps troops, etc., and for their self-teaching. The audio devices of FIGS. 1 and 4 obviously can be ganged together, as in FIG. 14, and motor driven, so that an instructor can switch quickly from one disc to another, thus avoiding particular sequences of signals that can be memorized and thus may interfere with efficient learning of the code. The motor driven arrangement of FIG. 4 has advantages in its capacity to transmit at regulated speeds; the speed may be increased as learning progresses. For self-training and for scoutmasters training boys, and for similar uses, the manual device of FIG. 1 is useful for field practice while a motor driven model such as in FIG. 4, or a ganged arrangement, as in FIG. 14, may be preferred for more formal training of groups.

Either the optical or the audio system, of course, has application beyond the mere teaching of the Morse code. In control systems, wherever multiple signals are to be produced and transmitted, the arrangements of FIGS. 7 to 13 can be used to switch signals to and/or from various stations as may be needed, as will be obvious. With rapid switching, signals will appear to flow from path to path, rather than appearing to be discontinuous. A few typical applications will be suggested; others will suggest themselves to those skilled therein.

1. Control of cyclical machine operations, such as in commercial and domestic laundry equipment, cooking equipment, sprinkling systems.
2. Multichannel tachometer systems, to sense and/or control rotational and other speeds of various machines and parts, e.g., in electronic circuitry, printing machines, etc.
3. Multiple alarm systems, for fire, burglar and other detection at various locations, with separate circuit from each detection point.
4. Memory systems, e.g. for optical readouts and static reading devices for punched cards and the like.
5. Application to animated illuminated signs and displays.
6. Monitoring physical conditions, such as liquid levels in tanks, e.g. in chemical plants, petroleum refinery, etc., solid in bins, and the like.
7. Counting devices, e.g., in traffic surveys, turnstile countings, etc.
8. Monitoring production or packaging lines, e.g., checking of count of bottles in cases, cans on conveyors, etc.

The switch mechanism of FIGS. 7 to 14 is designed, among other things, to enable a single emitter to supply activation energy to a number of points where data, code, or other information is acquired or formulated in intelligible form, and/or to direct the acquired information or data, etc., to a single sensor 172, 212 for appropriate conversion, forwarding, or other use. An analogous system, using electrical current, can readily be designed by those skilled in the art. The fiber optics modification has advantages because signals conveyed thereby are not nearly so susceptible to spurious noises, alterations, aberrations, etc., as are the more conventional electromagnetic

3,656,157
forms of energy generated by most electrical and electronic devices. Hence the use of these fiber optic elements, in the manner and for the purposes described above, is of merit.

Mention has been made above of use of an electric current as the energy stream, in which case the discs 10 would have appropriate insulated and conduction elements.

It will be obvious that many variations and modifications, and many applications not suggested above, may be made of this invention by those skilled in the art without departing from the purpose, concept and spirit thereof. It is intended by the claims which follow to cover the invention as broadly as the state of the prior art properly permits.

What is claimed is:

1. Apparatus for producing from a flowing energy stream the elements of code signals for alpha-numeric symbols, as in International Morse Code and the like, comprising, in combination, a set of stencil members in the form of a plurality of discs each having a plurality of annular bands, each of which bands bears the code elements for a single character of alphabet, numerals or punctuation symbols, the plurality of discs comprising in total the complete set of symbols needed for transmitting conventional messages but each individual disc bearing only a few of said symbols in coded form suitable for rapid memorization by a listener, each of said discs being designed for quick and secure attachment and rapid detachment and replacement on a driving member, a driving member adapted to hold securely and drive an attached disc in rotation at various selected speeds, said driving member being provided with cooperating means for quick attachment, detachment and replacement of said discs, a first means for shifting and thereby directing said flowing energy stream to any selected one of the annular bands on an attached disc, to break said stream into intermittent bits representing a single symbol for each revolution of said disc, and means controlled and shifted by said first shifting means for sensing said intermittent energy bits and converting them into audible signals.

2. Apparatus according to claim 1 wherein the stencil is rotatable perforate disc having signal bits defined by perforations along each of a plurality of annular paths, and wherein the energy flow is directed against a face of said disc so as to be blocked when no perforation is in the line of energy flow and to pass through said perforations, and wherein means for converting the energy as they appear passing through said perforations to sensible signals is mounted on the opposite side of said disc and in axial alignment with said energy flow.

3. Apparatus according to claim 2 wherein the energy flow is in the form of a stream of air and the converting means is a whistle.

4. Apparatus according to claim 2 wherein the energy flow is a beam of light along an optical transmitter and the converter comprises a light conductor and a photocell.

5. Apparatus according to claim 1 wherein there are means provided for generating a beam of light and conducting it to the stencil device as flowing energy, wherein the stencil means is a rotatable disc having a plurality of annular stencil paths each containing light interrupting and light transmitting elements to thereby generate bits of intelligence, and wherein the converting means comprises a light conduit and a photocell.

6. Apparatus according to claim 5 wherein the photocell is combined with a sound transducer to produce audible signals.

7. Apparatus according to claim 1 which comprises as the stencil device a rotatable disc having a plurality of annular paths, means for directing a gas stream perpendicular to said disc by moving the energy flow in a plane parallel to the plane of the disc to any selected one of said paths, and means in line with said gas flow for converting the stenciled signal bits to intelligible audible signals.

8. Apparatus according to claim 7 which comprises a tube for directing the energy flow in the form of a stream of gas, and converting means directly in the path of said stream comprising a pipe and a whistle for converting air pulses, as stenciled, to audible signals.

9. A method of teaching Morse Code by ear which comprises the steps of encoding the standard alphabet, numerical and punctuation symbols of a written language in separate stenciled bands on separate rotatable discs with a single character on or in each band being represented by the dot and/or dash elements of the Morse Code with appropriate spacings, whereby each separate disc bears a few only of the total group of character symbols appropriate to quick learning and convenient disc size and resolution, placing a rotatable disc between a flowing energy source and a sound producing device which can be activated by said flowing energy, with a selected band aligned to pass the code elements of only one character at a time for each rotation of said disc, rotating said disc continuously at a preselected speed while applying the energy source continuously to repeat a selected single character symbol over and over and thus familiarize the listener with a single coded symbol, thereafter shifting both the energy and the sound producing device to another band for another character symbol, and repeating and shifting until the whole code is learned one symbol at a time.

10. Method according to claim 9 wherein the flowing energy is a stream of air and the sound producing device is a whistle.

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