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DATA COMPRESSING SYSTEM

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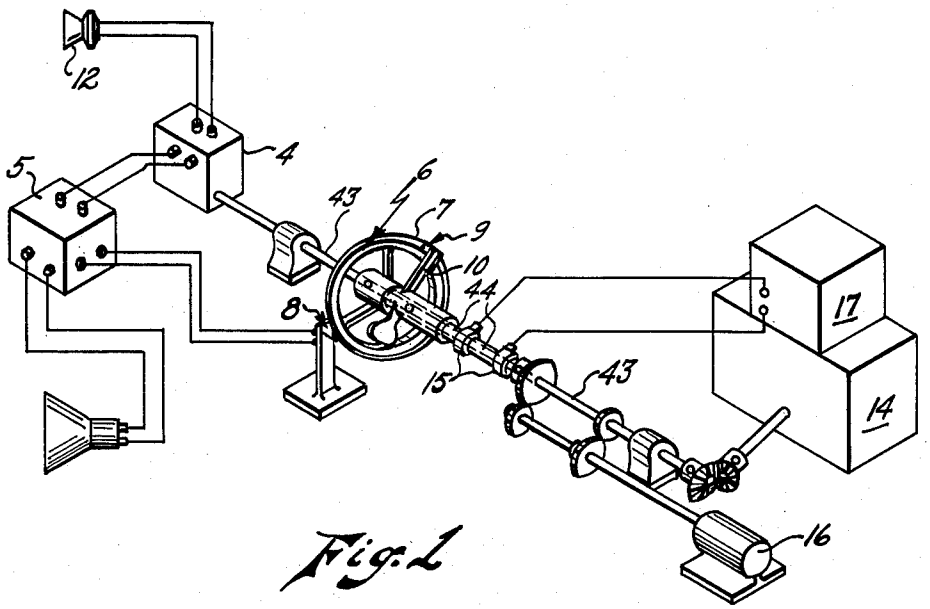


Fig. 1

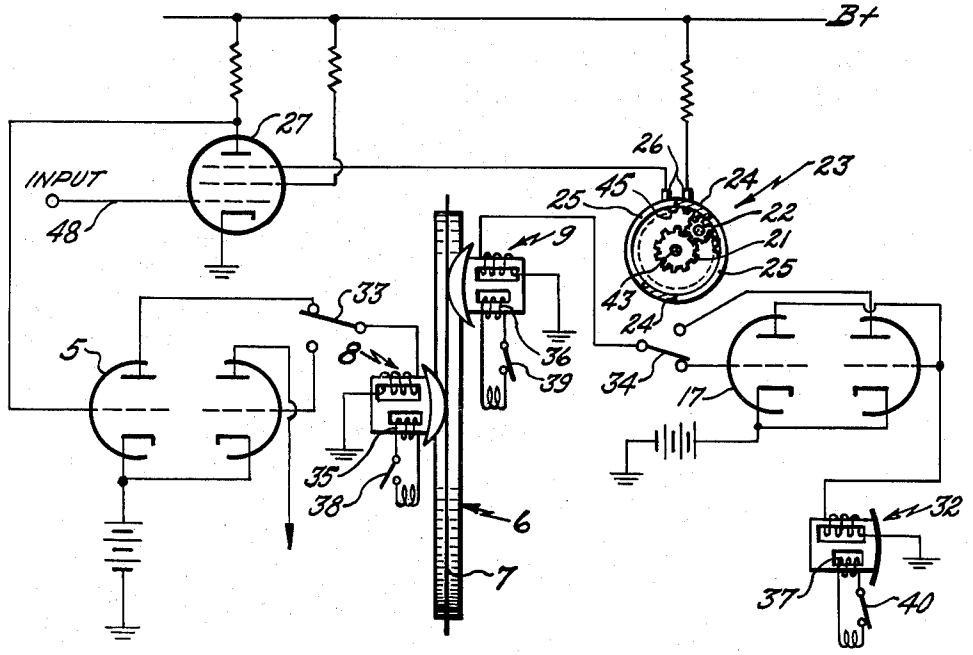


Fig. 2

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DATA COMPRESSING SYSTEM

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The invention described herein may be manufactured and used by or for the United States Government for governmental purposes without payment to me of any royalty thereon.

This invention relates to a recording system for the recording of speech or other message waves or pulses of which only selected signal fragments need be retained. The novel system disclosed herein provides for the recording of said signal fragments in a contiguous manner thereby eliminating the need to record the no-signal period that exists between them. Said recording system is also adapted to play back the recorded signal fragments in their proper time-phase relationship.

There are many communication systems currently in use wherein comprehensible intelligence is transmitted by subdividing the speech wave on a time basis, discarding certain of the subdivided fragments, and transmitting only the intervening fragments. It has been established that speech and other audio frequency information transmitted in this manner can be understood and utilized even though a considerable portion of the speech or information is removed in the process.

Present means for recording audio signals from which certain portions have been removed are costly and technically difficult. The use of a fast acting clutch which will start and stop the recording tape at the required bit speed is illustrative of the present state of the art. This method is unsatisfactory in that it requires the starting and stopping of the tape motion almost instantaneously at audio frequency rates. Alternatively, continuous recording of both signal and no-signal periods results in an extravagant waste of tape and requires recording means having the capacity to accommodate much larger tape reels.

Applications of my invention in which the resulting economy of recording medium is of paramount importance include, enter alia, the continuous monitoring and permanent recording of conversations and messages; the recording of variations or strain gauge outputs in various scientific investigations, such as aircraft testing, where recorded bits would provide representative sampling and reduce the magnitude of data to be examined; and the recording of telemetered instrument readings.

Accordingly, it is a principal object of my invention to provide a novel means for recording intermittent fragments of speech waves or other periodic discontinuous signals adjacent to each other thereby making optimum, economical use of the recording medium.

It is a further object of my invention to provide a recording means whereby periodic signal fragments may be recorded in a continuous manner in combination with means for reproducing said signal fragments in their proper time phase and interval.

It is a further object of my invention to provide a method whereby recordings of speech, electrical outputs, monitored radio transmissions and other similar intelligence can be made in such a way that the recorded information is compressed, thereby vastly reducing the amount of tape or other material required for recording it.

It is a further object of my invention to provide a novel recording means whereby information in the form of intermittent, periodic, signal fragments may be recorded on foreshortened electromagnetic tape, grooved records or photo-sensitive film simply and with reliable components.

These and other advantages, features and objects of the invention will become more apparent from the following description taken in connection with the illustrative embodiment in the accompanying drawing, wherein:

FIG. 1 is a diagrammatic representation illustrating one physical arrangement of an embodiment of my invention; and

FIG. 2 is a schematic wiring diagram of said embodiment of my invention.

Referring now to FIG. 1, electronic switch **4** is synchronized with recording transfer wheel **6** in such a way that it is on, allowing information from input **12** to be recorded on recording material **7** for one complete rotation of transfer wheel **6**. Electronic switch **4** is then off for a number of complete revolutions of transfer wheel **6** corresponding to that portion of the input signal which is to be rejected. For example, if the off to on or reject to record radio is three to one, then electronic switch **4** would pass the input signal during one revolution of transfer wheel **6** and reject the signal during three revolutions of said transfer wheel.

Transfer wheel **6** is driven by driving motor **16**. Said transfer wheel carries on its outer edge a width of thin magnetic recording material **7** in the plane of the transfer wheel such that recording head **8** can be placed on one side and pick up head **9** on the other side. Both recording head **8** and pick up head **9** are conventional, combined, recording-pickup-erasing heads, and while each may perform the function of recording, detecting or erasing according to the instant function of the present invention, they have been designated recording head and pick-up head, respectively, in the interest of clarity of description. The tape need only be of a type which has a base that would allow pick-up or recording therethrough. The type of base would affect the power requirements of the recording and pick-up system.

The relative actions of transfer wheel **6**, recording head **8**, and pick up head **9** follows.

Electronic switch **4** passes signal fragments to amplifier **5**, wherein it is amplified and passed to recording head **8**. Recording head **8** records said signal fragment on the magnetic recording material on recording transfer wheel **6**. Electronic switch **4**, being synchronized with recording wheel **6**, passes a signal fragment, the duration of which is exactly equal to the length of time required for recording wheel **6** to make one complete revolution. One signal fragment has thus been recorded on magnetic recording material **7**, and occupies the entire circumference of transfer wheel **6**.

Pick up head **9** is suitably mounted on rotatable arm **10**, and is driven by any suitable speed reducing means in such a way as to make one complete circuit of magnetic recording material **7** during the period from the start of recording of one signal fragment to the start of recording the next. Thus, if the off to on ratio is three to one, pick up arm **10**, carrying pick up head **9**, would make three revolutions while magnetic recording material **7** being disposed on the outer circumference of transfer wheel **6** makes four revolutions. Pick up head **9** detects the signal fragment which has been recorded on magnetic material **7** by recording head **8**. The output of pick up head **9** is applied, by the conventional use of slip rings **15** to recorder **14** through amplifier **17**. Inductive or capacitive coupling may be substituted for slip rings. Recorder **14** is synchronized with the transfer wheel **6** and pick up head **9** by means of a conventional speed reducer. Pick up head **9**, in addition to detecting the signal recorded on recording material **7**, serves to erase the signal, thereby leaving recording material **7** ready to receive a subsequent recording from recording head **8** during the next cycle of operation. Alternatively, the recording

head could serve as an erasing means when it is recording its next bit on the recording material **7**.

As previously explained, recording head **8** records a signal fragment on transfer wheel **6** only during every fourth revolution of said wheel. Pick up head **9** detects the signal from recording material **7** continually.

Appropriate speed reduction for producing the desired speed ratios may be achieved, as shown in FIGURE 1, by applying power from motor **16** by means of gearing to a gear on shaft **43** to which transfer wheel **6** is fixed and to a gear on outer, hollow concentric shaft **44** to which pick up arm **10** is secured. The appropriate speed ratio between transfer wheel **6**, pick up arm **10** and recorder **14** may be achieved by means of gearing from shaft **43** to the tape speed mechanism, for example, by means of the bevel gears shown in FIGURE 1.

To clarify and explain one cycle of operation of my invention the following description and sequence of operation is made with reference to the aforementioned, arbitrary three to one, off to on, ratio. Recording head **8** records for one complete rotation of transfer wheel **6** and then stops due to the action of electronic switch **4**. One signal fragment or "bit" has now been recorded.

When recording stops, pick up head **9** is directly opposite recording head **8** at a position of dead space and begins detecting data from the recording material. Due to pick up head **9** traveling at a slower rate than transfer wheel **6**, transfer wheel **6** makes four revolutions during the time it takes pick up head **9** to make three revolutions. Thus, magnetic recording material **7** on transfer wheel **6** passes under pick up head **9** completely one time during one cycle of operation. At the instant transfer wheel **6** has completed four revolutions, pick up head **9**, which has completed three revolutions, is positioned exactly opposite recording head **8**, and recording again commences and proceeds for a period of time equal to one revolution of the transfer wheel. Pick up head **9** is detecting the recorded data continually, but because it is moving in the same direction as transfer wheel **6** and at a slower rate, it detects information at a rate slower than it was delivered. Thus, the cycle is repeated.

The information detected by pick up head **9** is recorded on recording means **14** which is synchronized by any suitable means with the speed of rotation of transfer wheel **6**. The preferred method of recording is by means of a conventional magnetic tape recorder. The tape recorder speed is adjusted in relation to the speed of the pick up arm in such a manner as to take advantage of the optimum recording rate of the tape recorder, with the result that all space on the tape is utilized, even though the signal fragments selected by electronic switch **4** are time spaced.

For telemetering the original time spacing need not be reconstructed, however, normal operation to play back or read out the recording requires reversal of the recording process. The recorded signal fragments are fed from recording means **14** through amplifier **17** to pick up head **9** which now acts as a recording head. During the succeeding four revolutions of transfer wheel **6**, which constitute one cycle of operation, one signal fragment is recorded. This requires one less revolution by pick up head **9** than by transfer wheel **6**. In the three off to one on ratio described above there would be four revolutions of transfer wheel **6** and three revolutions of pick up head **9**. At the instant pick up head **9** completes its recording cycle (three revolutions in the example), it is directly opposite recording head **8**. Recording head **8**, now acting as a pick up, plays back that which had been recorded. This play back period extends for only one revolution of transfer wheel **6**. The signal which has been thus picked up by recording head **8** can be recorded on tape as bits followed by no signal, and can be played by any suitable means such as through loud speakers, or recorded by pen and ink on paper, depending on the type signal or data recorded and the original purpose for making the recording.

In order to play back the compressed signal fragments originally recorded on recording means **14**, it is necessary to synchronize the magnetic tape or other recording medium the speed of transfer wheel **6** and pick up head **9**. One method by which this can be readily accomplished provides that, when the data is recorded, a click is recorded when recording head **8** and pick up head **9** are adjacent. By monitoring the clicks and the position of pick up head **9**, the tape can be adjusted by any suitable means.

Although an off to on ratio of three to one was used as an illustrative example in the foregoing description, there is no intent to restrict my invention to this ratio. Any on to off ratio wherein the transfer wheel **6** rotates an integral number of times greater than that of the transfer arm **10** may be utilized.

In the description, magnetic recording material **7** was described as lying in the plane of transfer wheel **6** at its outer edge. Other configurations would be equally suitable, their choice being dictated by fabrication or manufacturing considerations. Thus, the material could be placed cylindrically on the edge of the transfer wheel with the recording head and pick up head being placed inside and outside respectively.

An example of electronic means which may be employed in the embodiment of my invention described herein for providing the signal fragments referred to in the above description is illustrated by the schematic diagram of FIG. 2. The input signal is applied to the control grid of a conventional coincidence or gating pentode **27** by means of lead **48**. Coincidence pentode **27** together with rotary switch **23** comprise electronic switch **4**. Rotary switch **23** is geared directly to shaft **43** of transfer wheel **6** by means of gear **21** and idler gear **22** and ring gear **45**. Conductive segments **24** and non-conductive segments **25** of rotary switch **23** are so proportioned with relation to their speed of rotation as to provide the desired on to off ratio. Contacts **26**, therefore, close the circuit by their interaction with conductive segments **24** during the desired on period, thereby biasing the suppressor grid of coincidence pentode **27** in order to allow it periodically to conduct said input signal.

The signal fragments periodically appearing at the output of coincidence pentode **27** are amplified by one half of dual-triode amplifier **5**. Said amplified signal fragments are then applied to recording head **8** through selector switch **33** which is shown in the record position. The signal fragments being recorded on transfer wheel **6** are detected by pickup head **9** in accordance with the foregoing description and are then applied to the grid of one half of dual-triode amplifier **17** by means of selector switch **34**. Selector switch **34** is also shown in the record position. The amplified output of dual-triode amplifier **17** is then applied to recording head **32** whereby it is permanently recorded on any desirable recording medium. Recording heads **8** and **32** and pick up head **9** are all conventional recording pickup heads having included therein erasing coils **35**, **37** and **36** respectively. Switches **38**, **39** and **40** permit erasure of the recorded information whenever required. Separate erase coils would not be necessary where the recording action eliminates the pre-recorded signal. Also, the coincidence tube is merely a refinement and may be substituted by any mechanical or electronic switch which would produce the desired switching times.

Playback of the recorded information is achieved by throwing selector switches **33** and **34** to their playback positions. Information detected by recording head **32** is then amplified by the other half of dual-triode amplifier **17** and recorded on transfer wheel **6** by pickup head **9**. Recording head **8** then detects the information in its proper time-phase sequence as described above in connection with FIG. 1 and applies it to the grid of the other half of amplifier **5** through selector switch **33**. The output of amplifier **5** is then applied to a loudspeaker, recording milliameter or other desired output means.

Although the invention has been described with reference to a particular embodiment, it will be understood to those skilled in the art that the invention is capable of a variety of alternative embodiments within the spirit and scope of the appended claims.

I claim:

1. A data compressing system comprising means for dividing an electrical signal into intermittent fragments, said means including an electronic switch and a rotatable message receiving wheel having switch-actuating segments operatively connected thereto for causing said electronic switch to interrupt said electrical signal periodically, means for providing a first recording of said fragments in their normal time-spaced relationship, and means for providing from said first recording a second recording of said fragments in a contiguous relationship.

2. The system defined in claim 1 including means for reproducing from said second recording said fragments in their original spatial relationship.

3. A data compressing system in accordance with claim 1 wherein said means for dividing said intermittent fragments comprises a switching circuit.

4. A data compressing system in accordance with claim 1 wherein said means for providing said first recording comprises a rotatable wheel having a recording medium disposed on the outer periphery thereof, said wheel being synchronized with said means for dividing said electrical signal, and a fixed recording head, said fixed recording head being in close proximity to said recording medium and adapted to record thereon the output from said means for dividing said electrical signal.

5. A data compressing system in accordance with claim 1 wherein said means for providing said second recording comprises a rotatable member, said rotatable member being in close proximity to a rotatable wheel having a recording medium disposed on the outer periphery thereof and disposed to revolve on a common axis therewith at a fractional speed thereof, a pickup head, said pickup head being disposed on said rotatable member in close proximity to said recording medium and adapted to detect a signal fragment recorded thereon, and a tape recorder, said tape recorder being adapted to record the output of said pickup head.

6. In a communications system, data compressing apparatus comprising, means to sub-divide a modulated electrical wave into periodic fragments, said means including an electronic switch and means for causing said switch to interrupt said electrical wave periodically, means for providing a first record of each of said fragments at preselected time intervals, means for providing from said first record a second record of each of said fragments, the relative recording times of said first and said second records being adapted to provide a contiguous relationship of said fragments in said second record and means for subsequently reproducing said fragments in their original time-spaced relationship.

7. A system as defined in claim 6 including means for erasing said first record.

8. A data compressing system comprising means for providing an electrical signal, means for cyclically obtaining segments of said signal, said means including an electronic switch and rotatable means for causing said switch to interrupt said electrical signal periodically, said rotatable means including a data storage device holding intelligence in the form of a continuous train of said signal segments, means for continuously detecting from said storage device said signal segments, and means for permanently recording said detected signal segments for subsequent reproduction in their original time-spaced relationship.

9. In a system for recording selected signal fragments, apparatus for presenting said signal fragments in a time-wise contiguous relationship, said apparatus comprising a recording head, a temporary recording medium, a pick-up head wherein the relative motion between said recording head, said temporary recording medium and said pickup head are such that said pickup head detects one complete signal fragment during the time-interval from the commencement of recording of one signal fragment to the commencement of recording of the next succeeding signal fragment, and electrical current interrupting means forming part of said temporary recording medium for periodically interrupting signal transmission.

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