Nov. 21, 1933. E. E. FREE 1,936,356

FLUID OPERATED RELAY

Filed Sept. 16, 1930 3 Sheets-Sheet 1

FIG. 1

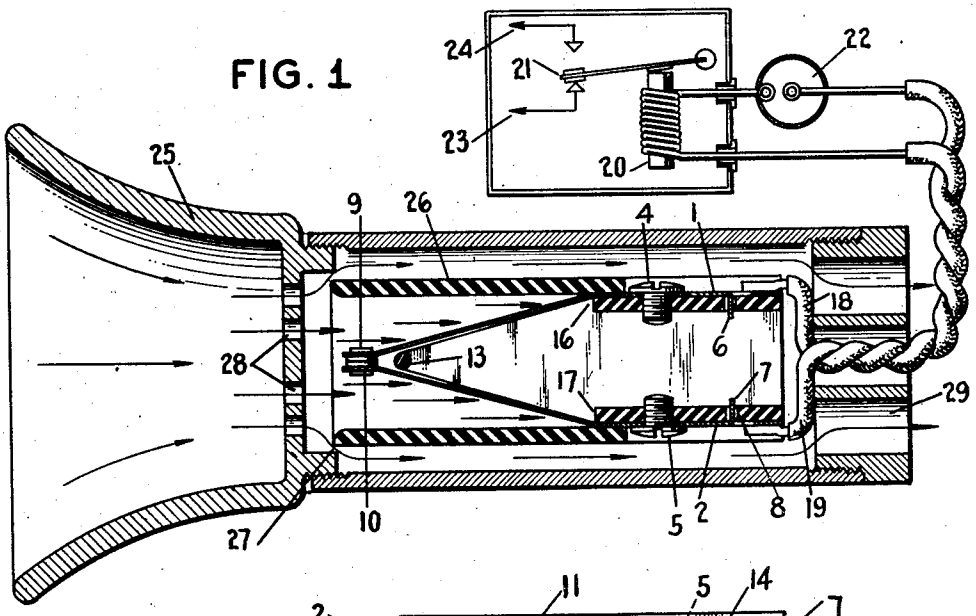
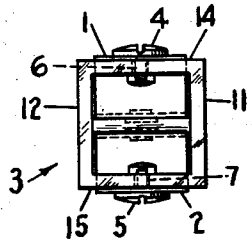


FIG. 5



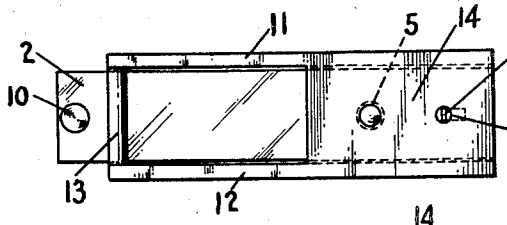


FIG. 4

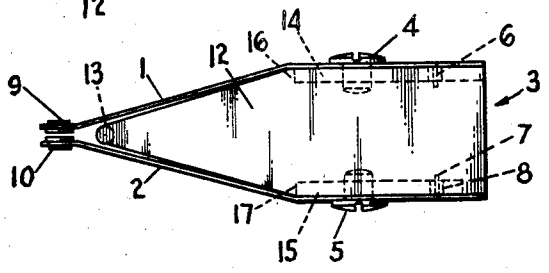


FIG 3

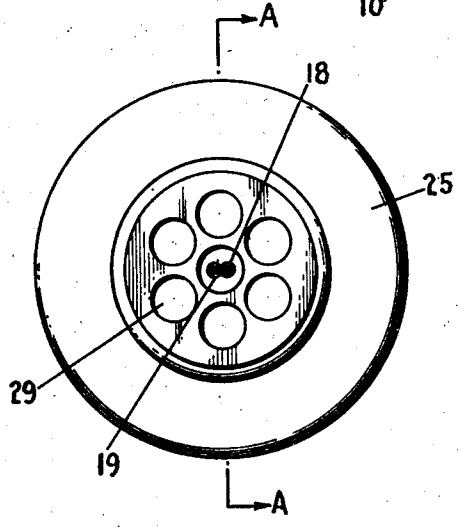


FIG. 2

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FIG. 6

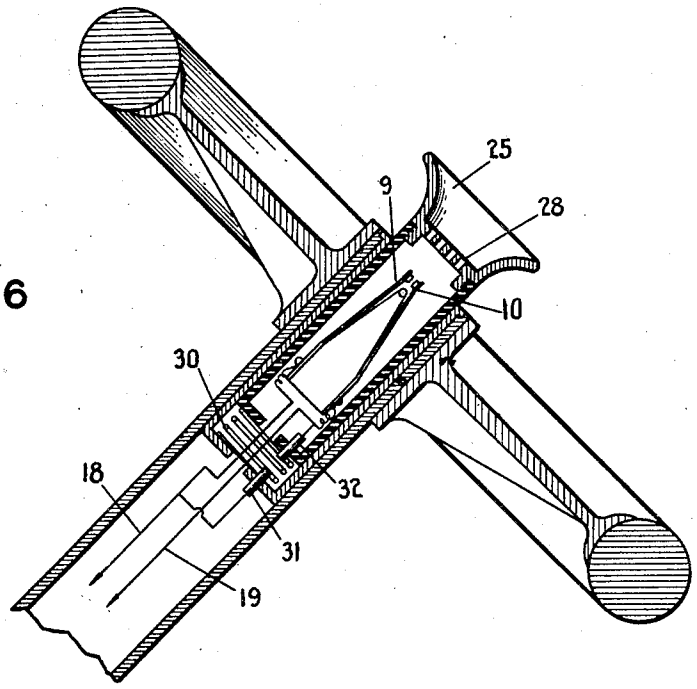
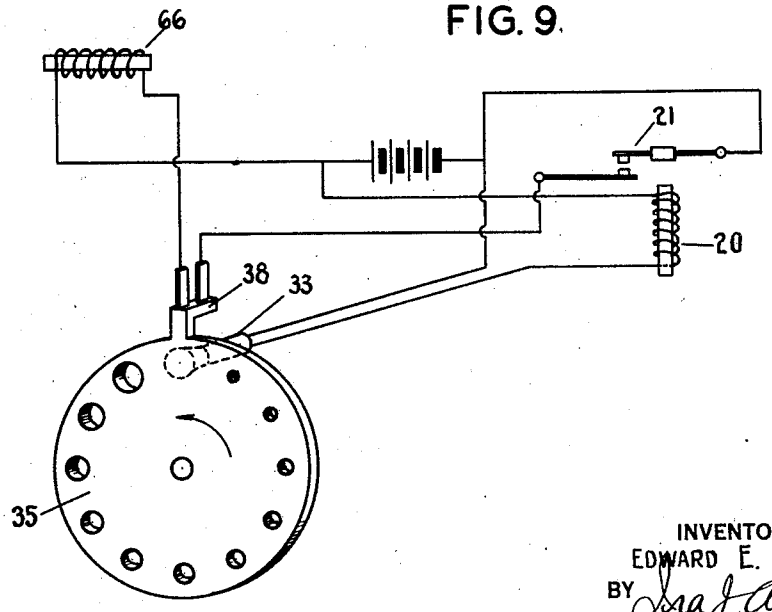


FIG. 9.



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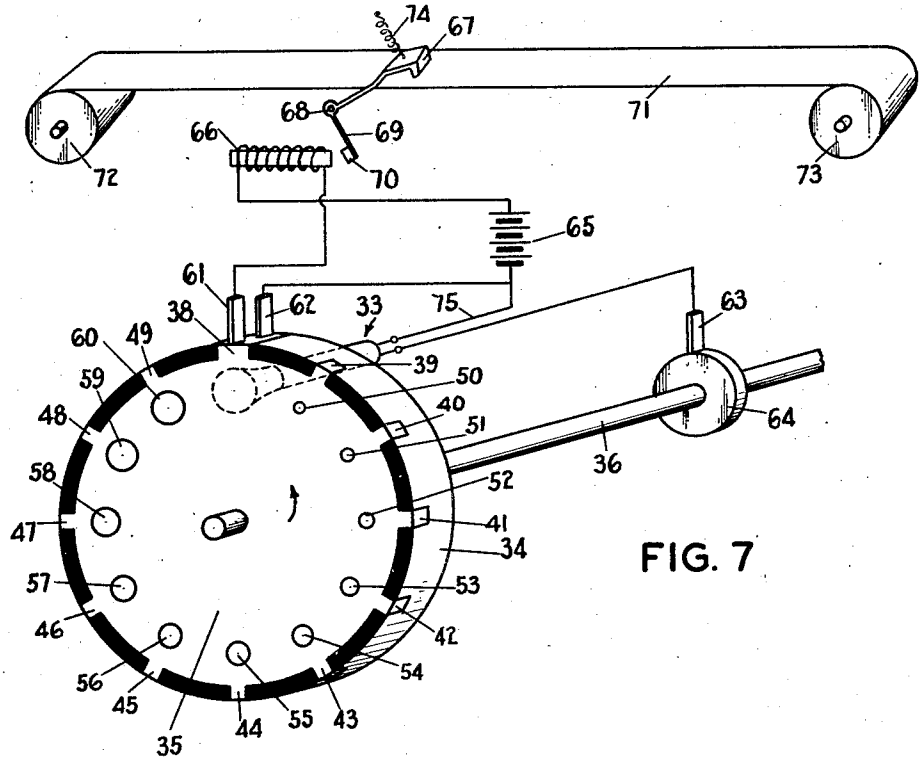


FIG. 7

FIG. 8

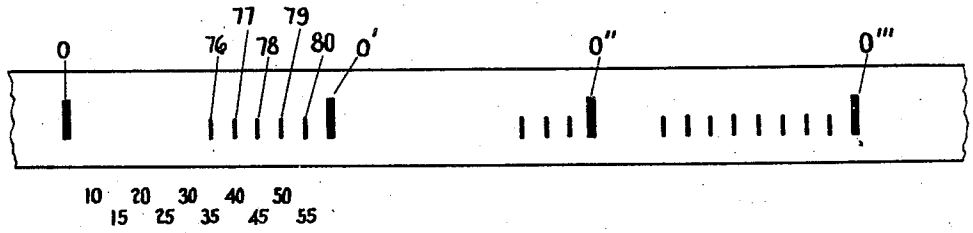
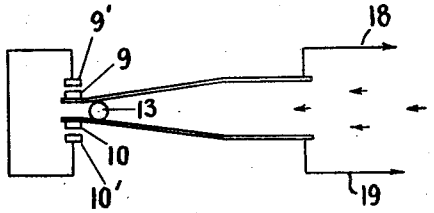


FIG. 10



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UNITED STATES PATENT OFFICE

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FLUID OPERATED RELAY

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Application September 16, 1930
Serial No. 482,356

6 Claims. (Cl. 200—81)

This invention relates to electrical switches adapted to be closed by air currents above a predetermined minimum velocity or force. One of the objects of the invention is to produce an electrical switch or contact device that can be operated either to close or open the circuit without movement of the hands, feet or other physical part of the body, as for example, by breath pressure.

Another object of the invention is to construct a meter for measuring the velocity of air and other fluids, for example, an anemometer for registering the velocity of winds.

Other objects will appear in the following description, reference being had to the drawings in which:

Fig. 1 illustrates the invention in a breath relay, the relay proper being sectioned on the line A—A of Fig. 2.

Fig. 2 is the rear end view of the relay shown in Fig. 1.

Fig. 3 is a side view of the switch mechanism of the relay shown in Fig. 1 but with the contacts in their normal position when no air currents are passing through the relay.

Fig. 4 is a plan view of the switch parts of the relay shown in Fig. 3 but with one of the switch plates or springs removed.

Fig. 5 is a rear view of the switch shown in Fig. 3.

Fig. 6 is a view of the breath relay applied to the steering column of an automobile.

Fig. 7 is a diagrammatic illustration of the invention when used in an anemometer.

Fig. 8 is a view of the section of the recording tape.

Fig. 9 is a view of a modification.

Fig. 10 is a diagrammatic illustration of a modification.

The invention can be applied in many different ways. By way of example, I have shown it as applied to a switch indicated in Fig. 3. In this figure two thin flexible spring members 1 and 2 made of some suitable material such as phosphor bronze are clamped to an insulating frame 3 by any means, such as screws 4 and 5. These springs may have lugs 6 and 7 fitting in holes such as 8 (Fig. 4) of the frame member 3. This will properly line the springs up so that the contacts 9 and 10 will always be in line with each other. It will, of course, be apparent that other means may be used for securing these springs to the insulating body so that they will keep the contacts in correct position.

The insulating frame member 3 may be formed of various shapes, but in the drawings I have made the frame of square section, as indicated in Fig. 5. The sides 11 and 12 of this frame member are tapered towards the front and an insulating bar 13 extends across and is secured to the two sides. This bar 13 acts as a stop to prevent the contacts 9 and 10 from moving unduly beyond the center line, yet it will permit the contact plates to move sufficiently towards each other to bring the two contacts 9 and 10 together.

The top 14 and bottom 15 of the frame 3 terminate at 16, 17 so as to permit the passage of currents of air or other fluid sufficiently to move the spring members towards each other.

The construction of the frame member and of the spring plates may be made in various ways without departing from the spirit of the invention and the construction described has been by way of example only.

In the body of the invention shown in Fig. 1, wires 18, 19 are connected to the spring strips 1 and 2 and one of these wires is wound around the core 20 of the switch 21 and thence to a source or electromotive force 22, shown by way of example as a dry cell. The leads 23, 24 may be connected to any device such as a signalling lamp, a control switch, a sound producing device or any other device, the operation of which is to be controlled by currents of air or other fluid.

When the relay is to be operated by the breath it is preferable to have a bell shape mouth piece 25, such as is used on ordinary telephones to concentrate the force of the air and converge the air currents into the relay.

To control within predetermined limits the operation of the switch, the frame 3 may be encased in a sheath 26 which by way of example, is shown circular in the drawings. The sensitivity of the switch plates 1 and 2 to the air pressure may be controlled by adjusting the frame and its associated parts towards the mouth piece 25 to afford greater or lesser clearance 27 at the periphery. No means for making the adjustment is shown in the drawings but it will be at once apparent how such adjustment can be readily obtained.

The sensitivity of the device also can be controlled by the perforations 28 at the bottom of the mouth piece and by perforations 29 in the back end of the relay.

When the breath relay has been constructed to produce the desired impedance to air currents against and around the switch plates the switch contact will be brought together at or above the desired pressure.

The operation of the arrangement shown in Fig. 1 is as follows:

When a slight puff of air produced by the mouth, for example, is directed into the mouth piece 25 air currents will pass through the perforations 28 and there will be enough pressure against the springs 1 and 2 to bring the contacts 9 and 10 together. This will cause current to flow from battery 22 through the springs 2, contacts 10, 9, spring 1 and through the coil on the core 20 of the switch 21 and back to the battery. This will operate the switch 21 to send current (by means not shown) to the signalling device, circuit breaker, or other device, to be operated by means of the breath relay. When the pressure from the breath is discontinued the switch plates 1 and 2 will spring apart from their natural resiliency and the circuit of the relay will be interrupted.

The circuits to which the breath relay is connected may also be designed to operate the device to which the relay is connected, continually after the contacts 9 and 10 have been brought into position, to be reversely operated by another puff of the breath. It is immaterial as far as the spirit of this invention is concerned how the devices are thus controlled and the practical application of the relay to various systems will be apparent from the foregoing description.

The breath relay above described is so constructed that there is minimum, and practically no chance that the contacts will be brought together by stray vibrations in the relay itself and by sound vibrations transmitted either through the air or through the walls of the relay. If the relay is grasped in the hand and intentionally shaken in the plane of the paper on which Fig. 1 is drawn the downward thrust of the relay as shown in that figure would tend to cause contact 10 to give an apparent swing upward due to its inertia. It would not touch contact 9, however, because the same inertia tending to hold the contact 9 motionless would give that contact an apparent swing upward in relation to the downwardly moving frame. The bar 13 also would stop further movement of contact 10 in relation to the relay body after it has proceeded slightly past the center line. When the relay is swung in reverse direction toward the top of the illustration in Fig. 1 inertia would cause contacts 9 and 10 to move in the opposite direction relative to the body of the relay itself but there would be no contact between the two points 9 and 10 as they would move in the same direction.

While it is conceivable that the relay body might be vibrated at sufficient velocity and with such amplitude that contacts 9 and 10 might under some conditions be brought together accidentally, I have found it easy to design the parts so that there is no danger of accidental contact through any mechanical or sound vibrations to which the instrument can ever be subjected in practice. It therefore can readily be made to respond only to predetermined velocities of air intentionally directed into the relay.

In Fig. 6 I have diagrammatically illustrated the breath relay as attached to a steering column of an automobile for sounding the automobile horn or signal. When this relay is attached to a steering column the operator of the vehicle will have both hands free for the control of the machine and yet be able to sound the horn by directing a puff of air into the mouth piece 25. On closing the contacts 9 and 10 in this adaptation current will be sent through the conductors 18 and 19 to the relay (not shown in this figure) which will close the contacts to the signalling device. The form shown in Fig. 6 is so designed that operation of the signal may also be brought about by pressing on the mouth piece 25 with the hand. This will compress spring 30 and permit the contacts 31, 32 in parallel with contacts 9 and 10, to close and thus sound the signal. The operator therefore may use either form, if desired. While I prefer to use two spring contact members, one spring only may be used which will contact with an immovable point. Such an arrangement, however, is not so free from stray vibrations. I also may design the apparatus so that the air enters the rear of a device such as that shown in Fig. 1 with the contacts 9 and 10 normally in engagement with each other. The breath or other air pressure would then force the contacts apart and open the circuit. Also air pressure can be directed against the plates from the rear and caused to bring the contacts 9 and 10 into engagement to close the circuit. This is diagrammatically illustrated in Fig. 10. On breath pressure separating the springs 1 and 2 the contacts 9 and 10 will be brought against engagement with auxiliary contacts 9′ and 10′ joined together and the circuit completed.

Various other modifications may be made in the relay without departing from the spirit of the invention. As already above stated, the sensitivity of the breath relay may be adjusted by varying the clearance space 27 to control the by-passing of the pressure around the contact springs and by changing the size and number of the openings 28 or 29. By screwing the mouth piece 29 toward or away from the frame member 3, the annular space 27 may be readily changed and the sensitivity varied while in use.

Still another way to control the sensitivity in the factory is by varying the thickness, length and rigidity of the spring members 1 and 2. Various other adjusting means may be devised.

Various other uses may be made of the breath relay such as the control of so-called buzzers for summoning an employee by blowing into the device instead of pushing the usual button.

The relay may be used around dangerous machinery at working positions in a factory, for example, so that any workman without removing his hands or feet from the operating mechanism can blow into the relay in case of accident and instantly sound an alarm or stop the machinery by operation of the circuit breaker or similar device. The relay may also be used in semi-automatic machinery, for example, a screw cutting machine which follows a definite cycle and then must be reset for beginning of the following cycle. At present it is customary to reset such machinery by means of a hand or foot lever or by means of hand or foot operated electric switches. All of these uses involve an element of hazard as well as of delay since the use of either hand or foot for this purpose may unbalance the body position of the worker and result in injury. With a breath relay hung in any convenient position the worker may operate the controlling mechanism by a puff of the breath without interrupting the use of the hands or feet in the mechanical operation of the machine. An analogous use would be the employment of a breath relay on a sewing machine to replace the present foot or knee switch.

The relay may be used on typewriters, calculating machines, "line-a-time" copying holders for typists with appropriate electrical mechanism to cause the shifting of the machine without removing the hands from the operating position at the keyboard. The breath relay in this case could be suspended in front of the operator or worn on the chest as now done in connection with telephone switchboard operators. The breath relay may also be used as a speed governor by attaching it to a flywheel with a mouth piece pointed in the direction of the movement of the wheel and the instrument adjusted to operate at a predetermined velocity of air through it. It also may be used to sound an alarm in case of escape of gases or steam from safety valves and the like. The relay is capable of use in various places where the public use the same operating button or lever, for example, in automatic sales machines and various other places where numbers of the public dislike to touch devices that have been continually touched by other persons and possibly contaminated with germs of disease.

Also, when the relay is used as a door bell switch, or a switch for opening gates, doors and the like, a person with an arm full of bundles or other material may blow into the relay and produce the desired result without disengaging the hands.

Another modification of the invention is shown in Figs. 7 and 8 for measuring or indicating the velocity of the wind or other fluid. In this modification the air relay is indicated generally at 33, details not being shown. This relay is placed with the mouth piece closely adjacent to a metal disc or flange 35 having a plurality of contacts integral with or electrically joined to the disc. Between these contacts is an annular rim 34 of insulation, preferably flush with the circumferential surface of the contacts somewhat resembling a commutator construction. This disc 35 is secured to a shaft 36 revolved by electric motor wind vane or any other source of power, the constancy of the speed of which is more or less immaterial so long as the motor runs within reasonable limits. On the periphery of this wheel is placed one long contact 38 and eleven short contacts 39 to 49 inclusive. Under each contact 39 to 49 inclusive is placed perforations 50 to 60 inclusive, the perforations increasing in diameter successively from 50 to 60. Under the contact 38 there is no perforation for reasons that will be explained later. The contact 38 is wide enough to contact with brushes 61, 62, but the contacts 39 to 49 inclusive are wide enough to contact only with brush 61.

One of the contacts, such as 9, in the air relay 33 is connected to a brush 63 sliding on slip ring 64 in contact with shaft 36. Brush 62 is connected to one terminal of battery 65 and brush 61 is connected to coil 66, the other end of which is connected to the remaining terminal of the battery or other course of electromotive force. An anchor or other recording point 67 is pivoted at 68 and has secured to it an actuating arm 69 having an armature 70 adapted to be moved by the magnetic flux in core 66 when it is energized. A tape of paper or other material 71 passes beneath the contact point 67 and is wound over reels 72 and 73 by any source of power at constant speed or otherwise. The speed of this tape is also immaterial, but of course it is preferable to have it travel at a speed that is somewhere near constant, though the accuracy of the reading does not depend upon the constancy of the speed. If desired, one of the reels may be fastened to the device that is driving the shaft 36.

The operation of this anemometer is as follows:

Suppose the disc is rotating in the direction of the arrow and a wind of five miles per hour velocity is blowing against the disc. In the position shown no air currents will reach the breath relay 33 because there is no hole through the disc at this point. However, the circuit is closed through coil 66 since the strip 38 is wide enough to bridge brushes 61 and 62. This pulls the inker 67 downward and makes a mark such as is indicated at 0 in Fig. 8. The contact 38 may be wider in the circumference of rotation so that the ink mark made at the zero point will be heavier than subsequent marks to be later referred to.

As soon as the contact 38 passes from under the brushes 61 and 62 a spring 74 or any other means pulls the inker 67 back to its normal position. When the disc rotates to bring contact 39 upon brush 61, hole 50 is too small to permit sufficient air to pass through to the breath relay to bring the contacts such as 9 and 10 of Fig. 1 into engagement. Therefore, no current is sent through the coil 66 and no mark is made on the strip 71 at the 10 mile point as indicated in Fig. 8. When the contacts 50 to 54 engage brush 61 successively there likewise will be no operation of the relay because the holes or perforations 50 to 54 inclusive are too small to permit sufficient air to pass through to bring the contacts into position, but when contact 44 engages 61 perforation 55 is of sufficient size to pass enough air into the relay 33 to bring the contacts 9 and 10 into engagement. This will cause current to pass from the battery 65 through leads 75, contacts 9 and 10 (not shown in Fig. 7) brush 63, slip ring 64, shaft 36, disc 35, contact 44, brush 61, coil 66 and back to the other terminal of the battery. This will pull the inker 67 down on the tape 71 and produce a mark at 76, as shown in Fig. 8. Since the strips 39 to 49 inclusive are narrower in the direction of travel of the disc than the contact strip 38, a narrower mark will be made to distinguish from the zero marks. When each of the contacts 45 to 49 inclusive pass under brush 61 the holes 56 to 60 inclusive are increasingly larger than the hole 55 and of course sufficient air will pass through to operate the relay. Therefore, each of these contacts will make marks 77 to 80 inclusive, all being of the same width and preferably of less width than the zero marks as already described. The blank part of the space under contact 38 will next come under the brushes 61 and 62 and cause an additional zero mark to be made, indicated at 0'. The record on this strip can be readily interpreted as follows:

It will be evident that the velocity of the wind is given by the first narrow ink mark 76. On account of the construction of the anemometer it will be known that the first ink mark 80 is located in a space alloted to speed 55 and by counting backward five miles at a time it will be found that ink mark 76 corresponds to 35 miles per hour. The wind velocities 10 to 55 are marked on the drawings beneath the tape 71 but this is for the purpose of understanding the drawings, and they will not appear on the tape. Let us suppose that the wind changes between the zero points 0' and 0'' to 45 miles per hour There will then be only three ink marks preceding the zero mark 0''. By counting back this wind velocity at this instant is 45 miles per hour. Let it be supposed between the next two zero points the wind velocity drops to 20 miles per hour. This will mean that there will be eight

indicating marks preceding the zero 0''' and there will be only two blank spaces subsequent to 0''. An interpretation of the record at this point will be made as previously described.

It will be apparent that this anemometer will record the speed of the wind regardless of synchronization of any of the moving parts. It will make no difference whether the speed of the disc 35 between zero points 0 and 0' is the same as that between subsequent zero points because the zeros are automatically marked and the reader will interpret the markings and pay no attention to the spaces between these markings, that is, no matter how the velocity of the tape or the disc 35 varies there will be five speed indicating marks between zero 0 and 0', three marks between zero and points 0', and 0'' and eight marks between zero points 0'' and 0'''. This permits the placing of the tape 71 and the reel 73, 73, at a widely distant point in respect to the location of the anemometer disc 35 and no means need be provided for synchronization of these reels with the disc.

In Fig. 9 I have shown a modification of the anemometer wherein all the contacts on the disc 35 are eliminated except the contact 38, an insulation rim being omitted for clearness of illustration. In this modification the air relay closes the circuit of an additional heavier current relay 21, as in Fig. 1. When the air relay 33 is operated by the air pressure coming through the perforations it will energize the coil on core 20 and close the switch 21. This will send current through the coil 66 of the inker.

It will be at once apparent that the rotating contacts need not be fastened to the disc 35. They may be located at any other point on the shaft 36 without departing from the spirit of the invention. Also the same inker 67 need not be used for recording the zero marks and the wind velocity marks. If desired, a separate zero inker may be energized when the brushes 61 and 62 are closed by the contact 38. In other words, the system may be designed to have one brush such as 61 contact only with the velocity contacts 39 to 49 inclusive and another distinct pair of brushes may engage the zero contact 38. In that case the contact 38 could be displaced to one side of the other contacts.

It will be apparent that many other modifications may be made in the system without departing from the spirit of the invention.

Having described my invention, what I claim is:

1. In an electric switch, switch contacts, means for functioning said contacts by a predetermined force of air currents, and means to prevent said functioning from stray vibrations.

2. In an electric switch a pair of switch contacts, actuating means for each contact, said actuating means adapted to be moved in opposite directions by a predetermined force of air currents and to move in the same direction from stray forces.

3. In an electric switch, a pair of vanes anchored at one end and free at the other, contacts on said free ends, means for directing air currents against said vanes to move them in opposite directions to produce the desired movement thereof.

4. In an electric switch, a pair of vanes anchored at one end and free at the other, contacts on said free ends, and means located between said free ends to prevent engagement of said contacts except in the desired position.

5. In a breath relay, a pair of vanes anchored at one end and free at the other, contacts on said free ends, an abutment between said vanes adjacent the contacts adapted to prevent engagement of the contacts when they move in the same direction.

6. In a breath relay switch, a tube adapted to receive air currents from an outside source, vanes each having one end attached inside said tube and positioned to receive the force of said air currents and contacts on the other ends of said vanes in slightly separated position.

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