

March 28, 1944.

H. W. GOFF ET AL

2,345,471

SPEED GOVERNOR FOR CALL TRANSMITTERS

Filed Oct. 19, 1940

FIG. 1

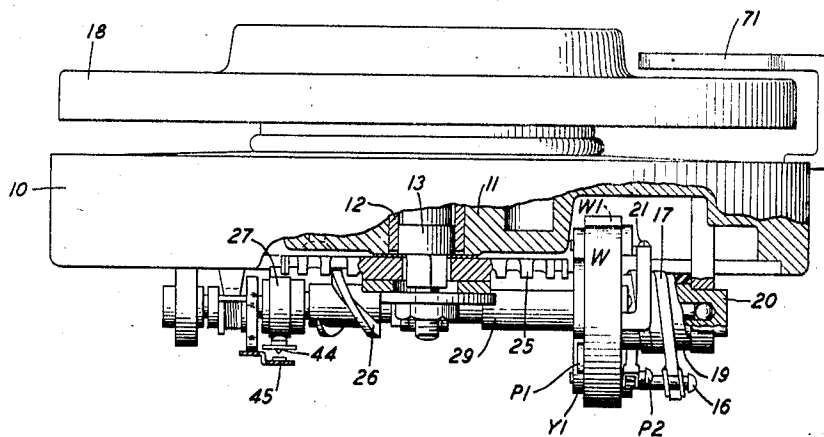
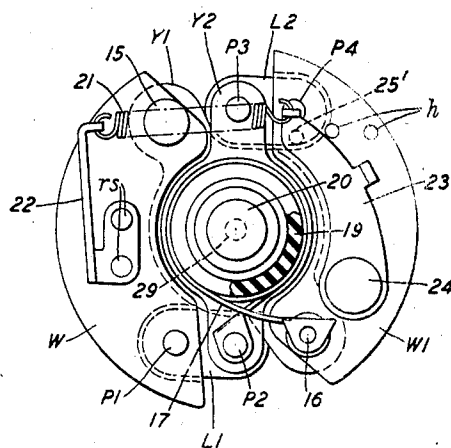


FIG. 2



H. W. GOFF
INVENTORS: C. R. MOORE
O. L. WALTER

BY *J. MacDonald*
ATTORNEY

UNITED STATES PATENT OFFICE

2,345,471

SPEED GOVERNOR FOR CALL TRANSMITTERS

Harold W. Goff, Manhasset, N. Y., and Charles R. Moore, Maplewood, and Orville L. Walter, East Orange, N. J., assignors to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

Application October 19, 1940, Serial No. 361,840

2 Claims. (Cl. 188—186)

This invention relates to call transmitters and more particularly to a speed governor mechanism for use in telephone call transmitters of the finger-wheel operated type.

The object of the invention is the provision of a governor mechanism which is simple in construction and efficient in operation.

Call transmitters of the type above referred to are of the electrical impulse type, i. e., they are used to open and close the circuit leading to the central office, a chosen number of times at the will of the user, such opening and closing of the circuit being known as pulsing, and the result of any particular choice being known as a train of pulses. These pulse trains operate suitable apparatus at the central office and the number of pulse trains necessary to a desired connection is determined by a code of letters and/or numbers, published for the convenience of the user. The letters and numbers that may be used by the subscriber are printed on a plate attached to the call transmitter in such a way that different numbers and letters appear below suitable holes in a wheel known as the finger-wheel that may be rotated by the user. By inserting a finger in the hole immediately over the code letter or number desired, the finger-wheel may be rotated to the finger stop and released. A driving spring in the device causes the finger-wheel to return to its original position. The first movement of the finger-wheel, i. e., pulling it around until the finger comes against the stop, prepares the subscriber's telephone circuit for the sending of pulses. On the return movement the desired number of pulses is impressed on the circuit.

Satisfactory operation of the central office apparatus requires that the pulse trains have certain characteristics, such as constancy of the number of pulses per second, uniformity of the percentage of the time of a single pulse the circuit is actually closed, and a certain minimum length of time between successive pulse trains. To attain these ends, call transmitters customarily are provided with fly ball governors. Other requirements are that the transmitter contact points should not open or close except as desired for proper pulsing, i. e., no chatter or preliminary opening of pulsing contacts should occur.

Present designs of call transmitters are subject to variation in all these respects. The pulsing rate may vary from one transmitter to another and in a given transmitter from time to time. Even an impatient subscriber may change

the pulsing rate by aiding the free return of the finger-wheel. The composition of the pulses varies in current designs. Any mechanical condition that causes the speed to vary must necessarily produce this result. Furthermore, in many transmitters the mechanical design is such that the first pulse is longer than any other pulse of the train, and finally, current devices are subject to contact chatter and preliminary or secondary openings and generally do not guard against excessively short times between pulse trains.

The invention described herein eliminates effectively the difficulties enumerated above.

The use of the speed governor mechanism of this invention can be shown to improve the transmitter in the following way. It can be shown mathematically that the ratio of the speed change to a change of torque for the fly ball governor such as is commonly used in call transmitters at the present time, is

$$\frac{d\phi_f'}{dG} = \frac{1}{2\phi_f'^2 M \mu} \quad (1)$$

and for the type herein disclosed and which for convenience will be referred to as the "band type" is

$$\frac{d\phi_b'}{dG} = \frac{1}{2\phi_b'^2 N (e^{\mu\alpha} - 1)} \quad (2)$$

where

ϕ_f' = speed of fly ball type rad./sec.

G = torque in cm.-dynes

μ = coefficient of friction

M = a constant depending on design

ϕ_b' = speed of band type rad./sec.

N = a constant depending on design

e = 2.7183 base for Napierian logarithms

α = angular span of band, radians

One comparison of the functioning of the two types may be made by taking the ratio of these two ratios, thus

$$R = \frac{\frac{d\phi_f'}{dG}}{\frac{d\phi_b'}{dG}} = \frac{\phi_b'}{\phi_f'} \cdot \frac{N(e^{\mu\alpha} - 1)}{M\mu} \quad (3)$$

If now both be operated at the same speed we have

$$R = \frac{N(e^{\mu\alpha} - 1)}{M\mu} \quad (4)$$

Suitable designs of call transmitters are limited as to space and it can be demonstrated that

for practical purposes values of R easily exceed 70. That is to say, a given change in torque (dG) will cause a speed change in a band type governor only one seventieth as much as it would cause in a fly ball type. Therefore, any change in driving torque due to weather, temperature or accumulation of dirt or even due to wilful interference with the free running of a call transmitter will produce much less change in speed when a band type governor is used than when the usual fly ball type is used.

If instead of assuming equal governor speeds ($\phi'_B = \phi'_F$) equality of regulation

$$\frac{d\phi'}{dG}$$

is assumed, it will be evident from the above that the speed of the fly ball type must be of the order of 70 times that of the band type. This would involve speeds so high as to be impractical in a call transmitter. Obviously, then a second advantage in the band type governor is that it permits designing the transmitter for low speed rotating parts which is advantageous from the standpoint of wear, vibration and simplicity of mechanism.

A third advantage in the band type governor as a part of a call transmitter has to do with the effect of variation of friction resulting from variations in temperature, humidity and the degree of roughness of the friction surfaces. It can be shown mathematically that for the band type governor

$$\frac{d\phi'_B}{d\mu} = -\frac{1}{2\phi'_B} \frac{G\alpha e^{\mu\alpha}}{N(e^{\mu\alpha}-1)^2} \quad (5)$$

and for the fly ball governor

$$\frac{d\phi'_F}{d\mu} = -\frac{1}{2\phi'_F} \frac{G}{M\mu^2} \quad (6)$$

where the nomenclature used has the same significance as in Equations 1, 2 and 3.

$$\frac{d\phi'}{d\mu}$$

is obviously the rate of change of governor speed for variation in coefficient of friction. Assuming equal speeds and dividing Equation 5 by Equation 6 we arrive at the relation

$$R' = \frac{\frac{d\phi'_B}{d\mu}}{\frac{d\phi'_F}{d\mu}} = \frac{M}{N} \cdot \frac{\mu^2 \alpha e^{\mu\alpha}}{(e^{\mu\alpha}-1)^2} \div \frac{M}{N} \frac{\mu^2 \alpha}{e^{\mu\alpha}} \quad (7)$$

This shows that the band type governor speed varies less with variation in coefficient of friction than does the fly ball governor. Referring to practical dimensions we find the following values to be representative of the two designs of governors for call transmitters:

$\alpha = 18.75$ radians	μ (Aver.) = .2
$M = 7$	μ (Min.) = .1
$N = 2$	μ (Max.) = .4

The above values of μ represent the average, minimum and maximum that are apt to be encountered from time to time. Substituting these values in Equation 7, we arrive at values for R' of .1, .06 and .006 as the relative rates of change of speed for the band type governor as compared with the fly ball governor for values of μ of .1, .2 and .4 respectively. This indicates that in a practical device the change in speed for variation in coefficient of friction will be from .6 per cent to 10 per cent as much when a band type governor is used as when a fly ball governor is

used. Obviously, such a reduction in speed variation is an important improvement in a call transmitter.

In the drawing:

Fig. 1 is a view showing the governor mechanism of this invention in position on the pulsing shaft of a call transmitter, a number of operating parts of the call transmitter and of the governor mechanism being shown with portions cut away; and

Fig. 2 is a plan view of the governor mechanism shown with the friction drum partly in section.

As shown in Fig. 1 of the drawing, the telephone call transmitter to which the speed governor of this invention is particularly well adapted for use consists, for example, of a circular mounting 10 having a centrally disposed hub portion 11 provided for receiving a bushing 12 in which is journaled a shaft 13. At the upper end of this shaft is secured a finger wheel 18, the clockwise movement of which to a finger stop 71 secured to the casing 10 is effective to tension a motor spring (not shown), the function of which is to return the finger wheel to normal position while actuating a pulsing mechanism consisting of a gear 25 secured to the lower end of shaft 13 and engaging the worm 26 formed on a shaft 29 adjacent a pulsing cam 27 keyed on the shaft and provided for actuating the pulsing springs 44 and 45 upon the return movement of the finger wheel 18 to normal position under the tension of the motor spring.

The governor mechanism of this invention consists of a yoke Y1, keyed on the shaft 29 and on the diametrically opposite ends of this yoke are mounted, as on pivots 15 and 16, the weights W and W1 respectively. A second yoke Y2 shown in Fig. 2 is mounted for free rotation on the shaft 29 and is connected at one of its ends to the free end of weight W by the link member L1 and pivots P1 and P2, while the opposite end of yoke Y2 is connected to the free end of weight W1 by a link member L2 and pivots P3 and P4, so that the movement of weights W and W1, due to centrifugal action, collectively imparts a small angular movement to their connecting yoke Y2 on shaft 29 relative to yoke Y1 for a purpose which will be hereinafter described in detail.

On pivot P2 which connects the link L1 to yoke Y2 is attached one end of a metallic band 17 wound around a drum 19 of composition material secured against rotary movement on a metallic bushing 20 serving, as shown in Fig. 1, as a bearing for this end of shaft 29 while the opposite end of metallic band 17 is attached to pivot 16 serving for mounting the weight W1 on yoke Y1 secured to shaft 29.

A tension spring 21 has one end secured to a bracket 22, secured on weight W as by rivets 23 and the opposite end of this spring is hooked to a lever member 23 mounted on weight W1 as on a pivot 24 and having at its free end a pin 25' provided for engaging either one of the holes h for holding this lever and thereby the spring 21 in different adjusted tensions.

In the operation of this governor mechanism the rotation of shaft 29 and the yoke Y1 keyed thereon and therefore the rotation of weights W and W1 is effective due to centrifugal action to cause a movement of these weights on their pivots 15 and 16 which movement is imparted to yoke Y2 through links L1 and L2 and thereby causes a tightening of the metallic band 17 around the drum 19 for controlling the speed of shaft

29 operating by the tension of the motor spring which, as above-mentioned, is tensioned by the clockwise manual operation of finger wheel 18 by the operator.

The controlling effect of the governor mechanism may be adjusted by changing the tension of spring 21 through the movement of lever member 23 in position where the pin 25' carried thereby engages one of the holes *h* in the weight W1.

What is claimed is:

1. A speed governor for a signal transmitting device, said governor comprising a rotatable supporting member a yoke free on said member, a pair of weights each having an end connected to said yoke by a link member, a second yoke secured to said member to which the other end of each weight is pivoted, and a brake-band passing around a fixed drum and connected at its opposite ends to said yokes, respectively.

2. A speed governor for a signal transmitting 20

device, said governor comprising a shaft, a yoke keyed on said shaft, fly-weights pivotally mounted at the ends of said yoke, a bushing mounted for free rotation on said shaft, a second yoke 5 keyed on said bushing, link members connecting said fly-weights to the last-mentioned yoke to cause the pivotal movement of said fly-weights on the first-mentioned yoke simultaneously, a stationary drum member, a helically wound 10 spring placed concentric to said drum and having one of its ends secured to the pivot of one of said links and the other end to the pivot of said one of said fly-weights, whereby the movement of said fly-weight due to centrifugal force is effective 15 to close said band on said drum to cause a braking effect thereon for controlling the operation of said transmitter.

HAROLD W. GOFF.
CHARLES R. MOORE.
ORVILLE L. WALTER.