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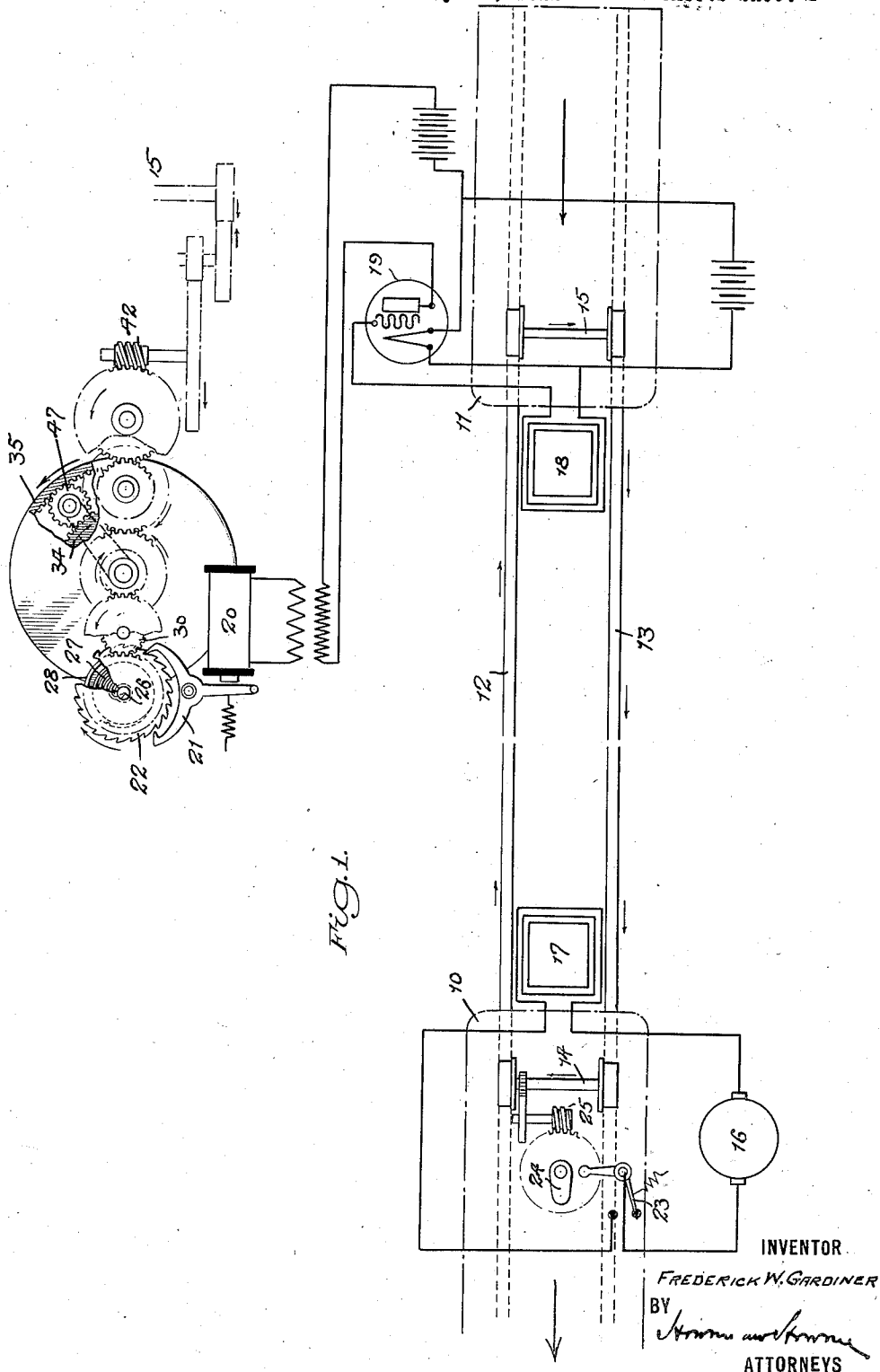
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METHOD AND SYSTEM FOR INDICATING OR CONTROLLING TRAIN SPACING

Filed May 19, 1922

2 Sheets-Sheet 1



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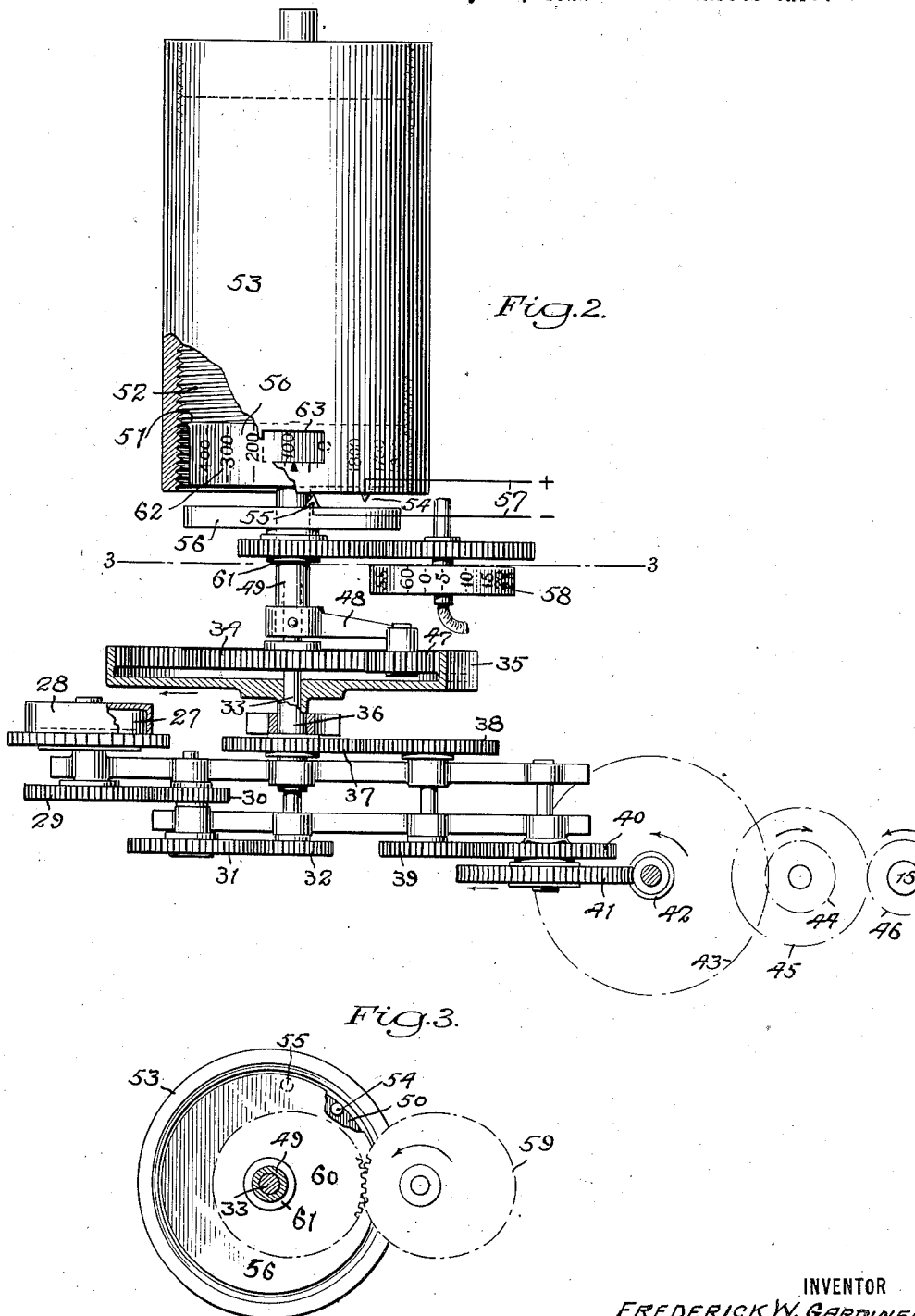
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2 Sheets-Sheet 2



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METHOD AND SYSTEM FOR INDICATING OR CONTROLLING TRAIN SPACING.

Application filed May 19, 1922. Serial No. 562,207.

To all whom it may concern:

Be it known that I, FREDERICK W. GARDINER, a citizen of the United States of America, residing at Yonkers, in the county of Westchester and State of New York, have invented certain new and useful Improvements in Methods and Systems for Indicating or Controlling Train Spacing, of which the following is a specification.

My invention relates to a method and system for indicating or controlling the spacing of trains, and my object is to provide a safety system which not only guards against collision, but also permits the operation of an increased number of trains with safety on a given length of track. Either signal or train control devices, or both, may be utilized as desired.

The invention contemplates as its underlying thought, a signal or train-control device carried by the oncoming train, and the operation of which is governed by the approach of the oncoming train toward the train ahead, through means actuated in part by the oncoming train, and in part from the train ahead. Various embodiments of this idea will occur to students of the problem, and for simplicity I have confined my exposition of the thought to a single embodiment more or less diagrammatically shown in the accompanying drawings, in which—

Fig. 1 is a diagrammatic plan of a system which illustratively embodies the invention; Fig. 2 is a broken vertical section through a combined indicator and control device carried by the oncoming train; and

Fig. 3 is a broken section on the line 3—3, Fig. 2.

The usual block signal systems commonly employed on railways seriously limit the track capacity—that is to say, the number of trains which may be operated with safety within given block limits. They have, moreover, certain objectionable features. They are dependent, for example, upon visibility from the engineer's cab, and at night upon the integrity of the signal lamps. In heavy fog, both are difficult to see, while the breakage of signal lamps is a common occurrence. In any event, constant watchfulness on the part of the engineer is essential, since the signal is located at a definite point along the trackway, and unless observed as approached, affords no indica-

tion of the approach of the oncoming train to the train ahead.

The present system may operate either a signal or an automatic train-control device, or both. It is self-contained by the trains affected, save so far as the track rails or their equivalent enter into the actuating circuit. Preferably the operation of the signal or train-control mechanism is varied with the speed of approach of the oncoming train.

In the illustrative lay-out of Fig. 1, the rear car of the train ahead is indicated at 10, while the forward car of the oncoming train is indicated at 11, both trains being headed in the same direction on the track rails 12, 13. It will be noted that the axles 14 and 15 of the two trains form, with the track rails 12 and 13, a closed circuit loop of varying length between the trains. In this loop I induce a secondary current from a source of current such as a high frequency generator 16 carried by the train ahead, and having associated therewith a primary coil 17 suitably disposed with respect to the track loop to induce current therein.

At the front of the car 11 of the oncoming train is a pick-up coil 18, which is suitably disposed with respect to the track rails 12 and 13 to derive current from the induced current in the track loop. Through the medium of a detector-amplifier 19, this derived current is stepped up to sufficient potential to operate a solenoid 20 which in turn operates the escapement 21 of a ratchet 22. In the circuit of the sending loop I arrange an interrupter 23 operated by any suitable connection from the running gear of the car 10 of the train ahead; for example, by means of a cam 24 connected through suitable gearing 25 with one of the car axles. It is thus obvious that when the circuit of the primary sending coil 17 is closed by the interrupter 24 and current is induced in the track loop, it will be picked up by the coil 18 of the following train and will be amplified sufficiently to operate the solenoid 20 and thus the escapement 21.

The ratchet 22 controlled by the escapement 21 is fast on a spindle 26, which is constantly subject to the stress of a coil spring 27 mounted in the drum 28. Fast on the spindle 26 is a gear 29, which, through the gear train 30, 31, and 32 drives a spindle

33 carrying the gear 34 of a differential. Associated with the latter is a cooperating gear 35 in the form of an internally toothed ring carried by a sleeve 36, which surrounds the spindle 33 and is driven by the train of gears 37, 38, 39, 40, 41, 42, 43, 44, 45, 46 from the axle 15 of the oncoming train. Interposed between the gears 34 and 35 is a planet pinion 47 carried by an arm 48 fast with the sleeve 49, to which is slidably keyed an indicator disk 50. The latter has a peripheral thread 51 which engages the internal threads 52 of a stationary casing 53, in which the indicator disk 50 rises or falls, through its threaded engagement, depending on the direction of rotation of the sleeve 49. On the lower face of the indicator disk 50 is a contact 54 adapted to engage a cooperating contact 55 mounted on a carrier 56. When the contacts 54 and 55 are in engagement they close a circuit 57 adapted to operate a train-control device (not shown), such as a brake system.

While the contact carrier 56 may be stationary, I prefer to subject it to the influence of a speedometer 58, for the purpose of advancing the engagement between the cooperating contacts 54 and 55, when the oncoming train approaches at high speed. The advance of the engagement between the contacts may be increased by arranging between the speedometer 58 and the contact carrier 56 a pair of eccentric gears 59 and 60, the former fast with the speedometer, while the gear 60 is fast with the hub 61 which carries the contact carrier 56.

The operation of this specific embodiment of my invention will be readily understood. Assuming both trains to be advancing at the same speed, and in the same direction, the rotation of the gears 34 and 35 of the differential in opposite directions, is at the same peripheral speed and the position of the planet pinion 47 will remain stationary. The indicator disk 50 therefore will not be rotated. It may be stated that the train of gears 37-46 is so predetermined that the speed of drive of the gear 35 is so harmonized with the drive of the gear 34 by the spring 27, (under the control of the escapement 21 operated through the track loop from the interrupter 23 of the train ahead) that when the trains are moving at the same speed, the gears are rotated at the same peripheral speed.

Assuming that the train ahead, 10, slows down or stops, while the oncoming train 11 continues to approach, the gear 34 of the differential is now halted, or rotates at slower speed by reason of the slower operation, or the cessation, of the interrupter 23 which controls the escapement 21. Since the gear 35 continues to be rotated by the oncoming train, the planet pinion 47 is rolled around the gear 34, and through the arm 48 ro-

tates the sleeve 49, and the indicator disk 50, thus causing the contact 54 to approach the contact 55 and eventually bringing them into engagement when a dangerous spacing of the trains has been reached.

If the oncoming train should pick up speed as it approaches the train ahead, 10, its speedometer 58 will rotate the gears 59 and 60 and will thus advance the contact 55 toward the approaching contact 54, so that the operation of the automatic train stop mechanism will occur at a spacing between the trains which is sufficient to insure the halt of the oncoming train at a safe distance from the train ahead.

If the oncoming train 11 should halt while the train ahead proceeds, the gear 35 is stationary, while the gear 34 is rotated with the result that the planet pinion 47 now runs around in the opposite direction and consequently shifts the contact 54 away from the contact 55. At the same time the indicator disc 50 rises in its casing 53 through its engagement with the threads of the latter, and the indicator 50 may make complete revolutions in this direction without bringing the contacts 54 and 55 into engagement.

The indicator 50 may be of any suitable type. I have shown it in the form of a screw ring or disk having a peripheral face bearing legends 62, which are visible through the sight hole 63 in the casing 53. It is of course immaterial whether or not the engineer of the oncoming train shall observe the spacing between the trains when they are far apart, and it is only when the trains approach each other that the legends on disk 50 become visible through the sight hole 63 in the casing 53.

Of course both the indicator and the contact mechanism are subject to various modifications. It is possible to utilize other circuits between the trains than the track loop, and I do not limit my invention to this particular means for establishing electrical communication between the trains. The function of the connection is merely to control the rotation of the gear 34 of the differential carried by the oncoming train, and any suitable arrangement for this purpose may be utilized to carry out my purposes.

In order to properly set the indicator or control device of an outgoing train with respect to a train preceding it on the line, various expedients are obviously available. For example, at a predetermined distance or distances from the terminal from which the trains start, signal stations may be placed which notify the terminal of the arrival of the train at that point. The indicator of the outgoing or following train will then be set to a corresponding position and the train dispatched.

Even greater accuracy in the location of the position of the train ahead is readily secured by providing at the dispatching terminal a receiving instrument of the general character of that installed at the head of the following train, said receiving instrument being connected to a receiving coil located in fixed position between the track rails and preferably slightly in advance of the dispatching point of the outgoing train. This instrument receives the current impulses from the preceding train on the line and operates the dispatching station indicator which thus shows the distance which that train has advanced on the line. When the next train departs its indicator is set to correspond with the dispatching station indicator. Thereafter the departing train receives its impulses directly from the train ahead and operates in the manner set forth.

These expedients form obvious measures for the initial setting of the indicators at the train dispatching station. Other means will readily occur to those dealing with the problem which do not affect the underlying principles of the invention.

It will be obvious furthermore that when a train is not in service, its signal or control mechanism may be readily cut out if desired, by operating a clutch in the drive connection from the train axle and a switch in the control circuit 57.

The system outlined is particularly valuable for railways in which trains are run close together, for example in suburban traffic, or in subway or elevated systems in which increased track capacity combined with safety is a problem not hitherto solved.

Attention may be drawn to the fact that should there be any failure in the control of the gear 34 of the differential governed by the train ahead, so that this gear is not rotated, although the train ahead advances, the following train will advance only a limited distance before the contacts 54-55 are brought into engagement by the rotation of the gear 35 incident to the travel of the oncoming train. Since the drive of the gear 35 by the oncoming train is positive, there is little danger of failure. Should the latter break down, however, danger would result; but this is unlikely—and moreover, it may be readily indicated by some signal device or the like which notifies the engineer that the gear 35 is not rotating. For example, series of contacts (not shown) may be arranged around the periphery of the gear and contacting with a brush (not shown) in a signal circuit. If the gear 35 should fail to rotate, this signal circuit would notify the engineer, or operate some safety device in a manner readily understood by those skilled in the art.

It is to be understood that the word "train" is used in the specification and claims in a sense broad enough to include a single car. It is of course obvious that in a complete railway system, each of the trains will carry both receiving and transmitting elements, one at the front and the other at the rear of the train. It will further be obvious that if the control of the oncoming train is not desired, the braking circuit connections may be omitted, and dependence placed wholly on the indicator or signal device; or vice versa, although I prefer the double protection illustrated and described.

The gear connection for operating the high frequency circuit closer 24 and contact maker 23 is such that the escapement 21 is operated at suitable intervals, so as to permit the ratchet 22 to rotate one complete revolution to every 240 revolutions of the axle of the train ahead. Similarly the train of gears for operating the gear 41 of the train which drives the gear 35 of the differential from the axle 15 of the oncoming train is such as to operate the gear 41 a complete revolution for every 240 revolutions of the axle 25. As above stated, the gear train operating the gears 34 and 35 is such that they are operated at the same peripheral speed in opposite directions when the spaced trains are traveling at the same speed.

With the understanding that the foregoing is merely an illustrative exposition of my invention, without being in any way limitative as to physical embodiments thereof, I claim—

1. The method of indicating or controlling the spacing of trains which comprises establishing a circuit between adjacent trains, and controlling an operating device in part directly by the oncoming train and in part by the train ahead through the intermittent interruption of the circuit between the trains.

2. The method of indicating or controlling the spacing of trains which comprises governing a differential control carried by the following train, in part from the running gear of the latter, and in part from the running gear of the train ahead through the intermittent interruption of an electric circuit between the trains.

3. The method of indicating or controlling the spacing of trains which comprises governing a differential control carried by the following train, in part from the running gear of the latter, and in part from the running gear of the train ahead through an electric current induced in the track rails.

4. In a system for indicating or controlling the spacing of trains, an operating member carried by the following train, actuating means therefor, and means governing

said actuating means, said governing means being operatively responsive to the movements of the spaced trains and electrically controlled from one of said trains through
5 a current induced in the track rails.

5. In a system for indicating or controlling the spacing of trains, a differential, means directly controlled by the running gear of one of said trains for driving one
10 element of the differential, and means controlled from the other of said trains through an electric circuit for driving the other element of the differential in accordance with the speed of the latter train, together
15 with an operating mechanism actuated by the differential.

6. In a system for indicating or controlling the spacing of trains, a differential, means controlled by the running gear of the
20 spaced trains for driving respective elements of the differential, and an operating mechanism actuated by the differential.

7. In a system for indicating or controlling the spacing of trains, a differential
25 carried by the following train, means operated by the running gear of the latter for driving one element of the differential, means electrically controlled from the train ahead in accordance with its speed for driving
30 another element of the differential, and operating means actuated by the differential.

8. In a system for indicating or controlling the spacing of trains, a receiving device at the forward end of a train for establishing
35 electrical communication with the train ahead, in combination with a means carried by the train ahead for inducing current in the track rails between the trains.

9. The method of indicating or controlling the spacing of trains which comprises governing a differential control carried by
40 the following train, in part from the running gear of the latter, and in part through a circuit interrupter operated by the running gear of the train ahead.
45

10. The method of indicating or controlling the spacing of trains which comprises governing a differential control carried by

the following train, in part from the running gear of the latter, and in part from
50 the running gear of the train ahead, through a current imposed upon the rails between the juxtaposed trains.

11. In a system for indicating or controlling the spacing of trains, an operating
55 member carried by the following train, actuating means therefor, and means governing said actuating means, said governing means being operated responsive to the movements of the spaced trains, and being
60 independent of each other, one of said governing means being responsive to the intermittent interruption of current between the trains, such interruption being dependent
65 upon the speed of one of said trains.

12. In a system for indicating or controlling the spacing of trains, an operating
member on the following train, and means governed by the running gears of the spaced
70 trains for actuating said member, together with operating means controlled at least in part by a current induced in the track rails between the spaced trains.

13. In a system for indicating or controlling the spacing of trains, a trackway, a
75 series of trains headed in the same direction on said trackway, means carried by the several trains for inducing independent electric currents in the track rails between
80 each train and the one following, and operating means governed at least in part by said currents.

14. In a system for indicating or controlling the spacing of trains, an indicator or
85 control device carried by the following train, means positively driven by the advance of said train for actuating said device in proportion to the advance of said train regardless of speed, and means associated with
90 the train ahead and operated regardless of its speed of advance for varying the drive of said device in accordance with the advance of said train ahead.

In testimony whereof I have signed my name to this specification.

FREDERICK W. GARDINER.