

March 12, 1935.

E. D. MEAD

1,993,793

TIMING MECHANISM

Filed April 30, 1930

3 Sheets-Sheet 1

FIG. 1

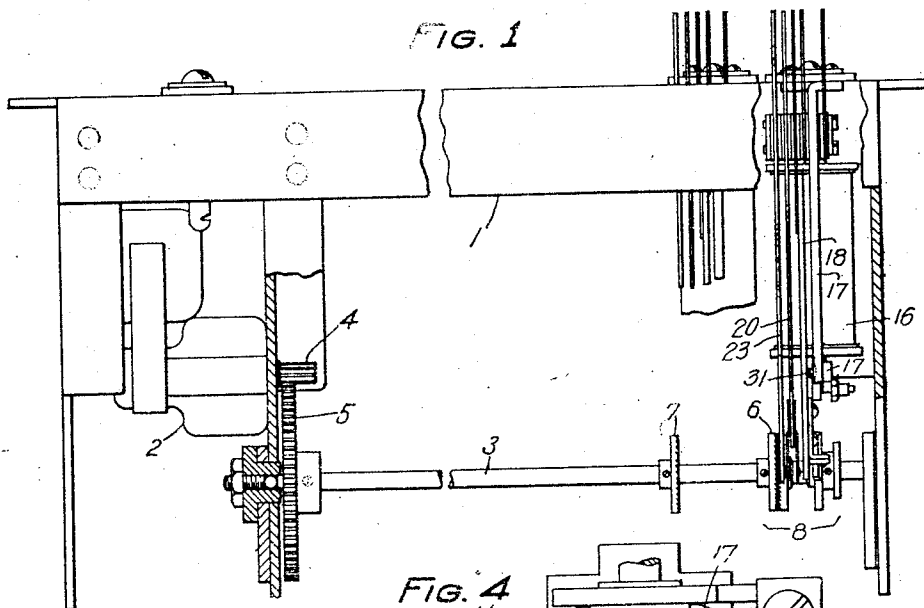


FIG. 4

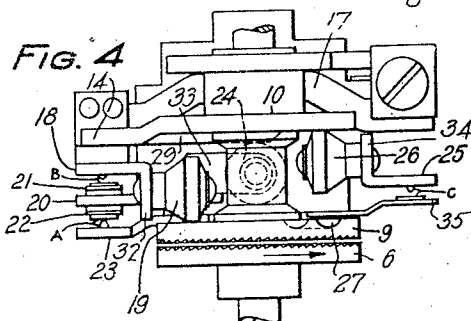


FIG. 2

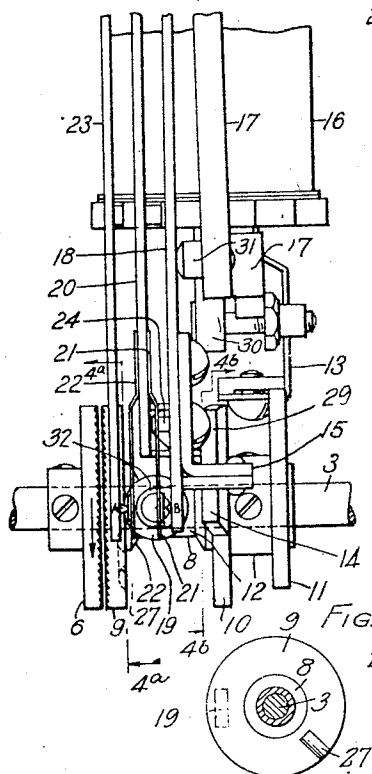
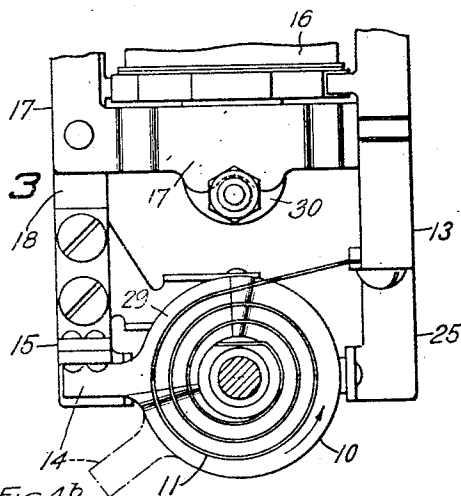


FIG. 3



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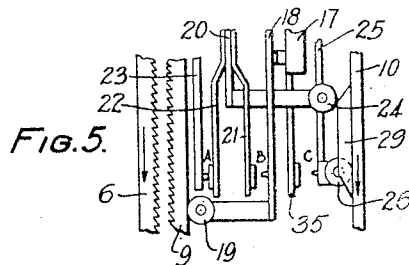
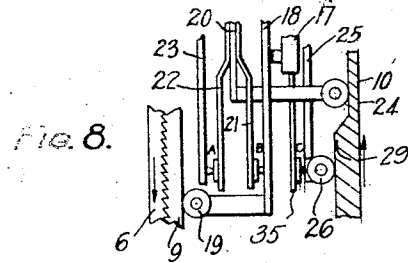
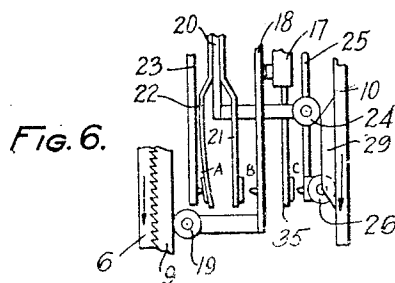
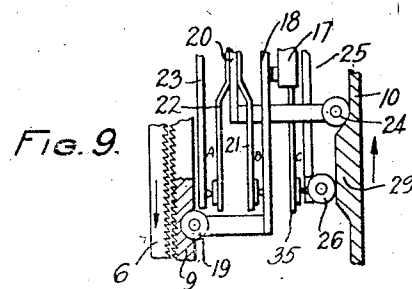
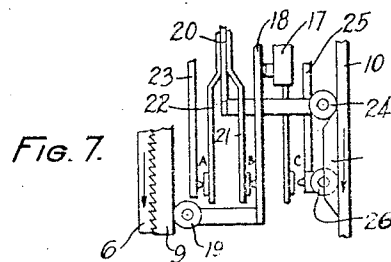
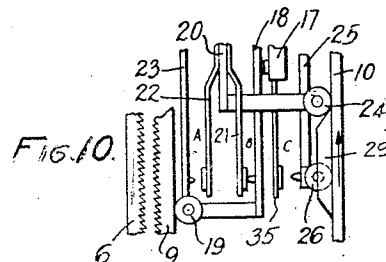
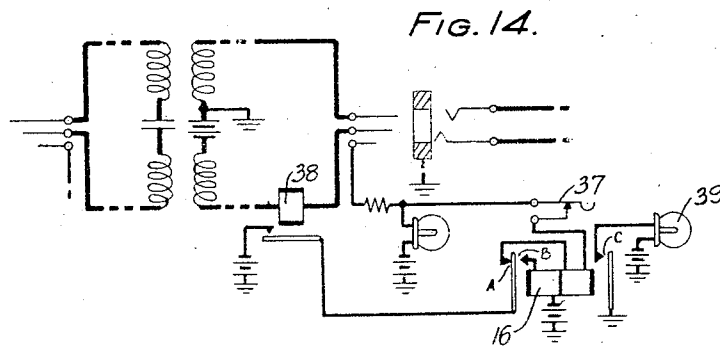
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Fig. 11.

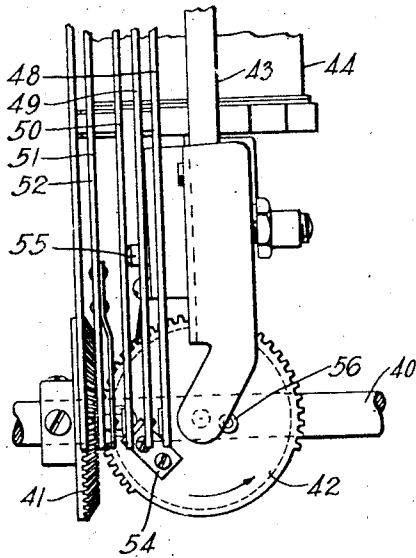


Fig. 12.

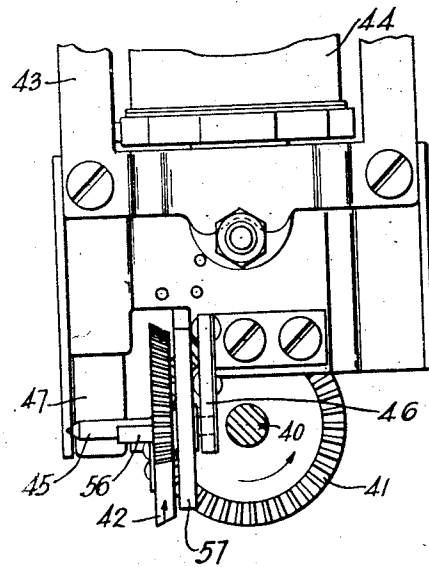
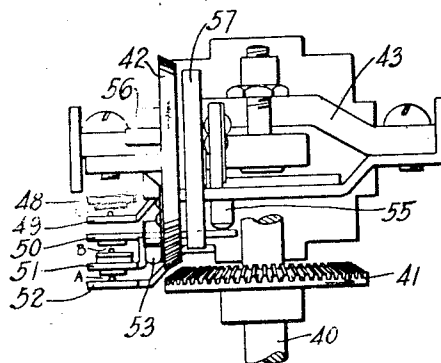


Fig. 13.



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1,993,793

TIMING MECHANISM

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Application April 30, 1930, Serial No. 448,515

13 Claims. (Cl. 161-19)

This invention relates to timing mechanisms and particularly to devices of this character used for measuring intervals of conversation in telephone systems.

The objects are to simplify devices used for measuring and indicating intervals of time, to render them more accurate and reliable in their operation, to reduce the cost of manufacture, and to secure other improvements therein.

It has been proposed heretofore to measure the lapse of a predetermined interval of conversation on a telephone connection and to give the operator a signal at the end of such interval in order that she may take such steps as are necessary to collect additional revenue or make further charges in case the conversation is to continue for another period of time. These various devices have usually involved complicated structures and switching apparatus. Another objection is that no provision has been made heretofore for guarding against conditions which cause the false starting of the timing devices.

According to the present invention, these objections are overcome by means of a timing device comprising a common driving shaft which is constantly operating at a definite rate and a number of electromagnetic devices having timing elements which are arranged to be engaged with and disengaged from the driving shaft by clutch members. These timing elements may be assigned to the cord circuits at an operator's position for measuring intervals of conversation for connections established through said cords. Each timing unit comprises an electromagnet having an armature which when actuated moves a normally disengaged clutch element into engagement with a corresponding clutch member on the rotating shaft. The energization of the magnet may occur when the called subscriber answers, but, to guard against starting the timing device in response to a false signal, the mechanism is so arranged that a preliminary interval (say of 15 seconds) is introduced to insure that the signal is the result of the called subscriber having actually answered. At the end of this 15-second interval, cam controlled contacts are closed to lock the magnet circuit, thus insuring that the device will continue its operation until it has measured a full period. At the end of the period, other contacts are completed to close a signal circuit to operate a lamp, advising the operator that a full period of conversation has been completed on that particular circuit. Also the timing element will have rotated to a position where a clutch roller engages a depression,

allowing the clutch member to become disengaged from the driving shaft, thus preventing further movement of the timing element.

A feature of the invention is a timing device of the character described in which the element driven by the driving shaft reaches the declutching position shortly after it has completed the signal circuit, thus insuring that the device will be disconnected from the driving shaft should the operator fail to take action promptly after receiving the signal.

Another advantage of this device resides in the simplicity of its construction and economy in space requirements. In construction, the timing element is similar to an ordinary relay, having a winding with the armature and contact springs arranged parallel to the axis of the winding and extending into operative engagement with the clutch member, which is moved in and out of clutching engagement with the driving shaft.

According to a modification of the invention, the timing element is supported by the armature of the electromagnet so as to be moved by said armature in and out of clutching engagement with the driving shaft.

In the drawings, Fig. 1 is an assembly view of the timing mechanism illustrating the driving shaft and the manner in which the several timing units are mounted. Fig. 2 is a top view of one of the timing units. Fig. 3 is a side view, and Fig. 4 is an end view of one of these units. Figs. 4-a and 4-b show details of a timing element; namely a clutch member taken on the line 4a-4a of Fig. 2 and a disc member taken on the line 4b-4b of Fig. 2, and in dotted lines, the positions of rollers in relation to a notch in the clutch and to a cam surface in the disc. Figs. 5 to 10 inclusive are schematic drawings illustrating the timing device in its various stages of operation. Figs. 11, 12 and 13 are different views of a modified form of timing unit. Fig. 14 shows a portion of an operator's cord circuit and illustrates the circuits for operating the timing device.

A detailed description will first be given of the device shown in Figs. 1 to 10 inclusive. This device comprises a mounting frame 1 on which is supported a driving motor 2 and also a shaft 3. The motor 2 is connected to the shaft 3 by means of a pinion 4 and gear wheel 5. The motor 2 is arranged to operate at a constant speed so that the rotation of the shaft 3 serves accurately to measure intervals of time. The frame 1 also supports a series of timing units, one of which is shown in full, another of which is partially

illustrated. The driving shaft 3 is equipped with a series of clutch members 6, 7, etc., one for each of the timing units. These clutch members are secured to the shaft and rotate constantly therewith. Cooperating with each of the clutch members on the shaft 3 is a clutch member associated with the corresponding timing unit.

The individual timing unit, the details of which are shown more clearly in Figs. 2, 3 and 4, comprises a timing element 8, which is loosely mounted on the shaft 3 for relative rotation with respect thereto. The timing element 8 includes the clutch member 9, which cooperates with the rotating clutch member 6 on the shaft 3. This clutch member 9 has a depression or notch 27 shown in detail in Fig. 4—*a*, the purpose of which will be explained more fully hereinafter. The timing element also has a disc 10, the inner side of which is shaped to present a raised cam surface 29 shown in Fig. 4—*b* the purpose of which will be explained more fully hereinafter. The clutch 9 and disc 10 are mounted on and connected together by means of the hub portion 12 which in turn is loosely mounted on the shaft 3. To the right of the disc 10, the timing element is equipped with a coil spring 11, one end of which is attached to the hub portion 12 on the timing element and the other end of which is attached to a stationary clamping piece 13. The spring 11 serves to maintain the timing element in its normal position such as shown in Figs. 1 to 4 and also illustrated in Fig. 5. The normal position of the timing element is determined by a stop finger 14, which is an integral part of the disc 10 and which engages the stop bracket 15 under the tension of the retractile spring 11 as shown in Fig. 3.

The timing unit also includes an electromagnet 16 having a U-shaped armature 17 straddling with its lower portion the projection 30 of the core of electromagnet 16. This armature 17 when attracted by the magnet is moved towards the projection 30 and in so doing controls the spring member 18 to move it to the left through the medium of the knob 31 as shown in Fig. 2. Spring member 18 which is mounted in the frame 1 adjacent to the armature 17 is bent at right angles at its free end into an extension 32. This extension carries a roller 19 shown clearly in Fig. 4. The roller 19 bears against the rear surface of the clutch 9. Movement of the spring 18 to the left urges the roller 19 against the clutch 9 to thereby move the complete timing element 8 longitudinally on the shaft 3 to cause engagement of the clutch members 6 and 9.

Two other spring members 20 and 23 are mounted in the frame 1 adjacent to the spring member 18 and extend parallel thereto. The member 20 is equipped at its free end with two flexible contact springs 21 and 22, each carrying an electrical contact. The contact on spring 21 cooperates with an electrical contact on the spring member 18. This set of contacts is designated as the contact set B in Figs. 4 to 10 and 14. The contact on spring member 22 coacts with an electrical contact on spring member 23. This set of contacts is designated as the contact set A in Figs. 4 to 10 and 14. The middle spring member 20 is bent at right angles at its free end into an extension 33 which carries the roller 24. It is shown in Fig. 4 particularly how this roller 24 bears against the inner raised cam surface 29 of disc 10.

A fourth spring member 25, as seen in Figs. 3 and 4, is likewise secured to the frame 1 and extends parallel to the springs 18, 20, and 23, but on the opposite side of the electromagnet 16. Spring member 25 is provided with an extension 34 bent at right angles to the spring. On this extension is mounted a roller 26. It is shown in Fig. 4 how the roller 26 bears against the inner surface of the disc 10. Spring 25 is normally tensioned in such a manner that the roller 26 is constantly urging the timing element 8 out of clutching relation with the driving shaft 3. Spring 25 carries an electrical contact which coacts with a similar contact 35. This set of contacts is designated as the contact set C. The contact sets A, B, and C in Figs. 4 to 10 and 14 serve to control certain circuits which will be described in detail hereinafter.

A description will now be given of the operation of the timing mechanism shown in Figs. 1 to 4 inclusive, and reference will be made to the diagrammatic illustrations in Figs. 5 to 10 inclusive for the purpose of explaining more clearly the various steps in the cycle of operation. Assume, for example, that an operator has established a telephone connection between two subscribers' lines by means of her cord circuit shown in Fig. 14 and that it is desirable to attract her attention when a definite interval of time such as a five-minute period has elapsed. When the called subscriber answers, the supervisory relay 38 energizes and closes a circuit from battery through the contacts of said relay, contacts A, right winding of the magnet 16, key 37, to ground through the sleeve of the plug and jack. The magnet 16, being energized by current flowing through its right winding, attracts its armature 17, moving the spring member 18 and roller 19 to the left as seen in Fig. 6, and sliding the timing element 8 on the shaft 3 into clutching engagement with said shaft through the medium of the clutch members 9 and 6.

The normal positions of the elements are illustrated in Fig. 5 with the clutch members 6 and 9 disengaged, with the armature 17 and the spring 18 in their normal positions, with the spring element 20 in its normal position, and with contacts A closed and contacts B and C open. At this time the roller 24, which is carried by the spring member 20, rests on the sloping portion of the raised cam surface 29 on the inner surface of the disc 10. Fig. 6 illustrates the relative position of the different parts after the magnet has been energized and the armature 17 attracted. The movement of the disc 10 to the left by the armature 17 applies a tension to the spring member 20, which, through the contact spring 22, increases the pressure on the contacts A. The contacts B, however, maintain the same relation as in Fig. 5 since both springs 18 and 20 have been moved to the left.

As soon as the timing element 8 is engaged with the clutching member 6, said element commences to rotate, the direction of rotation being illustrated by the arrows in Figs. 5 to 10 inclusive. It will be noted in Figs. 5 and 6 that the roller 24 rests on the sloping portion of the raised cam surface 29 a small distance from the edge of the cam surface. This distance is such that the roller is maintained out of contact with the lower surface of the disc 10 for a definite interval of time, say 15 seconds, after the timing element commences to rotate. At the end of the measured preliminary interval, the roller 24 rides down on the lower surface of the disc as seen

in Fig. 7. This releases some of the tension on the spring member 20 and permits it to move to the right sufficiently to close the contacts B. Spring member 20, however, does not move to the right sufficiently to cause the opening of contacts A. With contacts A and B both closed, a circuit is now completed from battery through the left winding of the magnet 16, as seen in Fig. 14, contacts B, contacts A, right winding of said magnet, key 37 to ground on the sleeve of the plug and jack. Thus the magnet is locked in its energized condition for the remainder of the time interval independently of the supervisory relay 38. Contacts C still remain in their open condition.

The timing element 8 continues to rotate until the five-minute interval has elapsed, at which time it will have reached a point where the roller 26 rides up onto the cam surface of the disc 10. This moves the spring member 25 a sufficient amount to the left to cause the closure of contacts C. The closure of contacts C results in the lighting of the signal lamp 39 to attract the operator's attention. Contacts A and B remain closed. The operator on seeing the lamp 39 lighted knows that the conversational period has expired and takes such action as is necessary either to make additional charges or to request the deposit of another coin.

The timing element 8 continues to rotate, and, should the operator fail to take action promptly, said timing element is automatically deenergized from the driving shaft. After a small interval has expired following the closure of contacts C, the clutch member 9 rotates to a position where the notch 27 in its inner surface registers with the roller 19. This is plainly shown in Fig. 9. Inasmuch as the armature 17 is fully operated and rests against the stop member 30 of the core, it cannot move further to the left. Therefore, when the notch 27 registers with the roller 19, the timing element 8 is moved slightly to the right under the influence of the tensioned spring 25 and roller 26. This movement is sufficient to disengage the clutch members 6 and 9. The movement, however, is not sufficient to disturb the contacts A or the contacts C. Although the timing member 8 is now free from the driving shaft 3 and is under the influence of its retractile spring 11, it does not restore to normal due to the fact that it is held in its operated position by the pressure of the armature 17 exerted through the roller 19 resting in the notch 27 of the clutch member 9.

The operator finally attends to the lighted lamp 39 and depresses the key 37. This opens the energizing circuit of the magnet 16, which permits the armature 17 to restore to its normal position. The movement of the armature 17 to the right removes pressure from the roller 19 permitting the spring 25 to slide the timing member 8 to its extreme right-hand position. This releases the timing member, and the retractile spring 11 rotates said member back to its normal position where the stop finger 14 engages the stop bracket 15. The movement of the timing device 8 to the right releases the tension on spring member 20 sufficiently to permit the opening of contacts A. This position of the elements is shown in Fig. 10. The opening of contacts A insures that the magnet cannot be operated until the timing device has been fully restored to its normal position as shown in Fig. 5, thus preventing the starting of the device at some position other than normal. The contacts C are also opened when the arma-

ture 17 is released. As the timing device 8 reaches its normal position as illustrated in Fig. 5, the roller 24 rides up onto the raised cam surface 29 and contacts A are reclosed.

A detailed description will now be given of the modification shown in Figs. 11, 12 and 13. In this device, the driving shaft 40, like the driving shaft 3, is equipped with a plurality of beveled gears such as the gear 41. The timing member consists of a gear wheel 42, which is mounted on the armature 43 of the electromagnet 44 in such a way that the movement of the armature carries the wheel 42 into and out of engagement with the gear member 41. The timing wheel 42, as best seen in Fig. 12, is mounted on a spindle 45, which has one bearing in the bracket 46 and another bearing in the piece 47, both of which are attached to the armature 43. The spring members 48 to 52 inclusive are suitably mounted on the frame and project in parallel with one another as illustrated in Fig. 11. The spring 52 carries a contact which cooperates with an adjacent contact on the spring 51. These constitute the contact set A best seen in Fig. 13. Spring 51 also carries a contact which coacts with the adjacent contact on spring 50 to constitute the contact set B. Contact set C comprises a contact on the spring 49 and the adjacent contact on spring 48. The timing wheel 42 is equipped with a stop piece 54, which, when the wheel is in its normal position, rests against a roller 53 carried by the spring 51. The pressure of the stop piece 54 against the roller 53 maintains the contacts A closed and contacts B open.

A detailed description will now be given of the manner in which the device operates. When one winding of the magnet 44 is energized as explained in connection with Fig. 14, the armature 43 is attracted to advance the wheel 42 into engagement with the gear member 41. The armature also carries a pin 55 which tensions the spring 50 but does not close the contacts B. The wheel 42 commences to rotate, and, after it has rotated for a small interval, such as 15 seconds, the stop piece 54 disengages the roller 53, relieving the tension on spring 51 and causing the contacts B to close. This energizes the second winding of the magnet.

The timing wheel 42 continues to rotate until the five-minute interval has expired, at which time the projecting pin 56 engages the spring 48 and closes the contacts C to light the lamp. If the operator does not attend to the call immediately, the wheel 42 rotates to a point where the smooth portion of its periphery encounters the teeth on the gear member 41. This prevents further rotation of the timing wheel.

When the operator actuates the key to deenergize the magnet, the timing wheel disengages from the gear member 41 and restores to normal under the influence of a retractile spring 57. The contacts A are maintained open until the wheel 42 reaches its normal position when the stop piece 54 reengages the roller 53 and closes said contacts.

While the invention has been illustrated in connection with two specific embodiments, it is to be understood that it is not so limited but may be applied to other structures.

What is claimed is:

1. The combination in a timing device of a driving member, a normally disengaged driven member, an electromagnet having an armature which when attracted moves said driven member into engagement with said driving member, a cir-

cuit for said magnet, contacts closed in response to the advance of said driven member through a definite distance from normal for closing the circuit of said magnet, other contacts closed in response to the advance of said driven member through a predetermined greater amount, a signal operated by the closure of said latter contacts, means effective in response to the advance of said driven member a still greater amount for disengaging it from the driving member and for holding it in its advanced position, and means rendered effective by the release of said armature for restoring said driven member to normal position.

2. The combination in a timing device of a driving member and a driven member, an electromagnet having an armature which when attracted engaged the driven member with the driving member, an energizing circuit and a holding circuit for said magnet, means for closing the energizing circuit of said magnet to attract the armature, means responsive to the advance of the driven member through a predetermined initial amount for closing said holding circuit, a signal circuit, and means responsive to the advance of said driven member through a predetermined distance for closing said signal circuit, means responsive to the advance of said driven member to a position beyond the point where said signal circuit is closed for causing the disengagement of the driven member from the driving member and for holding said driven member in its advanced position without deenergizing the magnet, and means responsive to the deenergization of the magnet for restoring said driven member to its normal position.

3. The combination in a timing device of a constantly operating driving shaft, a normally disengaged driven member, a clutch for engaging the driven member with the driving shaft, an electromagnet having an armature which when operated by the magnet moves the driven member into engagement with said shaft, a spring element tending to disengage the driven member, a collar upon said driven member having a depression therein, and means including a roller arranged to enter said depression when the driven member has advanced a definite amount to permit said spring element to disengage the driven member, and means responsive to the deenergization of said magnet for restoring the driven member to its normal position.

4. The combination in a timing device of a driving member, a rotatable driven member having two opposing collars thereon, one of said collars having a depression therein, two rollers co-operating respectively with said collars, an electromagnet having an armature which when attracted exerts a pressure on one of said rollers to move the driven member into engagement with the driving member, a spring element acting upon the other roller and tending to disengage the driven member from the driving member, said first roller arranged to enter said depression when the driven member has moved through a given distance to permit said spring element to disengage the driven member and to hold said driven member in its advanced position, and a spring for releasing said driven member to its normal position when said armature releases.

5. In combination, a constantly operating driving shaft, a plurality of driven members associated with and normally disengaged from said driving shaft, individual electromagnets for said driven members, each having an armature which when attracted moves the corresponding driven

member into engagement with the driving shaft, energizing circuits and holding circuits for said magnets, means for closing said energizing circuits, means responsive to the advance of a driven member through a predetermined initial distance for closing the corresponding holding circuit, individual signal circuits for said driven members, means responsive to the advance of a driven member through a predetermined distance for closing the corresponding signal circuit, means effective when a driven member has moved beyond the point where the corresponding signal circuit is closed for disengaging it from the driving shaft without the release of the armature, means for opening the holding circuit to permit the release of said armature, and a spring for restoring an advanced driven member to its normal position when the armature is released.

6. The combination in a timing device of a driving member and a driven member, a magnet having an armature, said armature serving when attracted by the magnet to move said driven member into engagement with said driving member, a set of contacts controlled by said driven member for closing an energizing circuit for said magnet, a second set of contacts responsive to the movement of said driven member through a predetermined distance for closing a locking circuit for said magnet, a third set of contacts responsive to the movement of said driven member through a greater predetermined distance, a signal controlled by said third set of contacts, means for restoring said driven member to its normal position, and means for controlling said first set of contacts by said driven member for maintaining them in an opened condition during the restoration of said driven member.

7. In combination, a driving member, a circular driven member having a notch on one of its faces, a magnet and an armature therefor having a roller attached thereto, said armature roller serving when the armature is attracted by the magnet to move said driven member into engagement with the driving member, means for energizing said magnet to attract the armature, a tension spring and a roller attached thereto effective when said driven member has been moved through a certain distance determined by the engagement of the roller on the armature with the notch in the driven member to disengage the driven member from the driving member independent of the armature being in its attracted position.

8. In combination, a driving member, a circular driven member having a notch on one of its faces, a magnet and an armature therefor having a roller attached thereto, said armature roller serving when the armature is attracted by the magnet to move said driven member into engagement with the driving member, means for energizing said magnet to attract the armature, a tension spring and a roller attached thereto effective when said driven member has been moved through a certain distance determined by the engagement of the roller on the armature with the notch in the driven member to disengage the driven member from the driving member independent of the armature being in its attracted position, and means for restoring said driven member to normal operation when the magnet deenergizes.

9. In combination, a driving member, a circular driven member having a notch on one of its faces, a magnet and an armature therefor

having a roller attached thereto, said armature and roller serving when the armature is attracted by the magnet to move said driven member into engagement with said driving member, means for energizing said magnet to attract the armature, a tension spring and a roller attached thereto effective when the driven member has been moved through a certain distance determined by the registration of the roller on the armature with the notch in the driven member to disengage the driven member from the driving member, said tension spring and the roller attached thereto and the roller on the armature cooperating with the notch in the driven member serving to hold the driven member in its advanced position, and means effective in response to the retraction of said armature for restoring the driven member to normal.

10. In combination, a driving member, a circular driven member having a notch on one of its faces, a magnet and an armature therefor having a roller attached thereto, said armature and roller serving when the armature is attracted by the magnet to move said driven member into engagement with said driving member, means for energizing said magnet to attract the armature, a tension spring and a roller attached thereto effective when the driven member has been moved through a certain distance determined by the registration of the roller on the armature with the notch in the driven member to disengage the driven member from the driving member, said tension spring and roller attached thereto and the roller on the armature cooperating with the notch in the driven member serving to hold the driven member in its advanced position, means effective in response to the retraction of said armature for restoring the driven member to normal, and circuit contact means closed by said driven member.

11. The combination in a timing device of a driving member and a rotatable driven member, an electromagnet having an armature which when attracted moves the driven member into engagement with the driving member, means for energizing the magnet, a set of contacts closed by the driven member a short interval after its engagement with the driven member, circuit means controlled by said set of contacts for holding said electromagnet energized, a set of contacts closed by said driven member at the end of a predetermined longer interval following engagement with said driving member, a signal circuit closed by said latter contacts, a spring element tending to disengage the driven member from the driving member, a collar upon said driven member having a depression therein, means including a roller arranged to enter said depression when the

driven member has been engaged a still longer predetermined interval to permit said spring element to disengage the driven member from the driving member, and means for restoring said driven member to normal.

12. A combination in a timing device of a driving member and a driven member, an electromagnet having an armature which when attracted engages the driven member with the driving member, an energizing circuit and a holding circuit for said magnet, means for closing the energizing circuit of said magnet to attract the armature, means responsive to the advance of the driven member through a predetermined initial distance for closing said holding circuit, a signal circuit, means responsive to the advance of said driven member through a predetermined distance for closing said signal circuit, a spring element tending to disengage the driven member, a collar upon said member having a depression therein, means including a roller arranged to enter said depression when the driven member has advanced to a position beyond the point where said signal circuit is closed to permit said spring element to disengage the driven member from the driving member and for holding said driven member in its advanced position without deenergizing the magnet, and means responsive to the deenergization of the magnet for restoring said driven member to its normal position.

13. The combination in a timing device of a driving member and a driven member, a magnet having an armature, said armature serving when attracted by the magnet to move said driven member into engagement with said driving member, a set of contacts controlled by said driven member for closing an energizing circuit for said magnet, a second set of contacts responsive to the movement of said driving member through a predetermined distance for closing a locking circuit for said magnet, a third set of contacts responsive to the movement of said driven member through a greater predetermined distance, a signal controlled by said third set of contacts, a spring element tending to disengage the driven member, a collar upon said driven member having a depression therein, means including a roller arranged to enter said depression when the driven member has moved to a still greater predetermined distance to permit the spring element to disengage the driven member from the driving member, means for restoring said driven member to its normal position, and means for controlling said first set of contacts by said driven member for maintaining them in an open condition during the restoration of said driven member.

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