For this reason, this bulletin covers only the outstanding points of difference, as compared to the other system mentioned above. The units necessary for a complete system are a master clock, master relay cabinet, secondary units and a source of commercial power. The battery and charging device have been eliminated.

MASTER CLOCK

The master clock is any of our master timepieces equipped with the necessary contacts as follows: The minute impulse and two second contacts which are located in their usual places. The advance contact, which is closed from 59' 10" to 59' 50", is placed on the contact block directly under the minute impulse contact. The stop contact is similar in design to the advance contact and is placed on the left side of front plate. This contact closes at 59' 52" and opens at 49' 10", thus being closed for 50 impulses each hour. Fig. 1 shows the contact arrangement of the master clock.

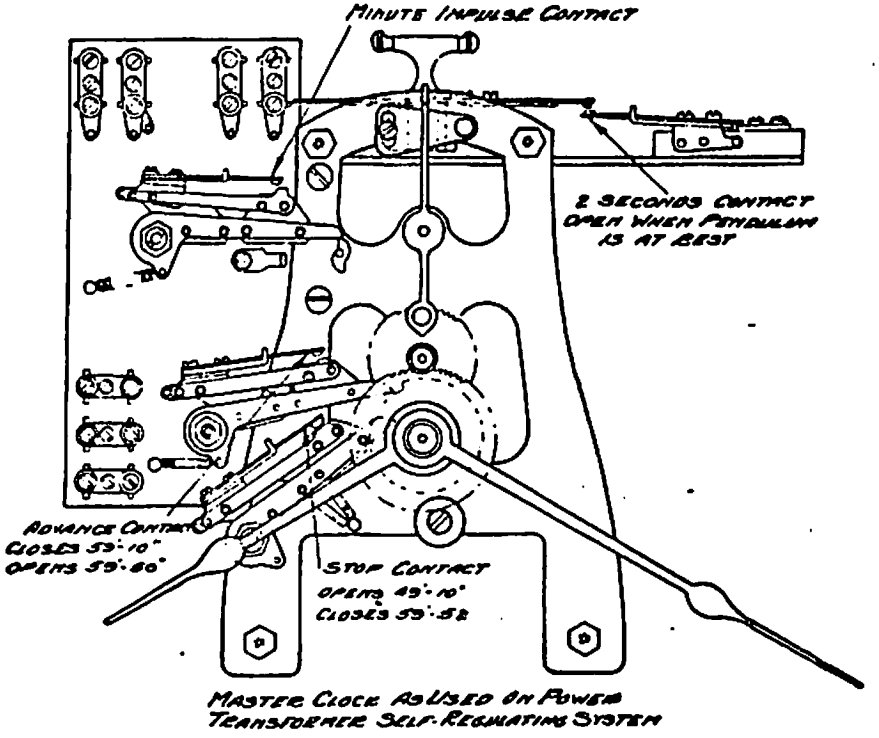


Fig. 1

SERVICE INSTRUCTIONS I.T.R. No. 230 April 1, 1938

SELF-REGULATING SYSTEM

The basic principle of electric clock systems is to have one clock, called the Master Clock, regulate or escape all other clocks in the system. This does away with having to regulate a pendulum in each clock, and it assures uniformity of time throughout the system. Power is supplied from the commercial current or a battery and this eliminates the necessity of having to wind a multiplicity of individual time units. In other words, when clocks are operated as individual key wound pendulum escaped units it is necessary to regulate the pendulums and keep up the spring tension in each individual clock, whereas, in an electric system there is but one pendulum to regulate and one source of power. This very much simplifies maintenance, and because the one pendulum escapes or regulates all the clocks, uniformity of time is assured throughout the system.

The International Business Machines Corporation furnishes three different arrangements for the control of a system of clocks from a central master clock and power supply. These three arrangements are known as the Plain Minute Impulse System, D. C. Self-Regulating System and A. C. Self-Regulating System. A brief explanation of these three methods of control follows:

Plain Minute Impulse System

The plain minute impulse system of operating an electric clock system was developed and put into use over 50 years ago. It consists of a master clock, battery, control relays and the secondary units. The master clock once each minute releases an electric power impulse from the battery through the control relays, to step the secondary units forward one minute. The secondary units contain no clock movement; only a magnet and ratchet, known as an Electric Drive. Such electric drive movements are very compact and rugged. They need no cleaning, oiling or periodical attention. The plain minute impulse electric drive system is used by practically all manufacturers of clock systems and every type of clock, program machine, recorder, time stamp, etc., manufactured by the International Business Machines Corporation can be furnished for operation in such a system.

D. C. Self-Regulating System

The D. C. Self-Regulating system is the same as the plain minute impulse except that a feature is added that corrects all secondary units and brings them into exact time with the master clock once each hour.

This is accomplished by operating the secondary clocks through a double control circuit, one side of which carries impulses all of the time and the other side for only 50 minutes of the hour.

The secondary clocks balance themselves between these two sets of impulses. If any secondary clock is thrown out of step with the master clock, either accidentally or intentionally, it will within an hour automatically come back to its normal balance between the two sets of impulses and again agree with the master clock. The range of correction covers 17 minutes slow or 10 minutes fast in one hour. The system will correct clocks that are as much as 45 minutes slow, but it requires three hours to accomplish this.

This system offers all the ruggedness and simplicity of a plain minute impulse control, together with the added advantage that it sets and runs all secondary units in exact unison with the master clock. It saves the time and trouble involved with a plain impulse system, of having to send a man around periodically to check the time of the secondary units to see that they agree with the master clock, and if any are found in error, to open them up and re-set them.

Every type of recorder, clock, program machine and time stamp manufactured by the International Business Machines Corporation, with the exception of the 3300 Recordolock, can be operated in a Self-Regulating electric system.

A. C. Self-Regulating System

The International A. C. Self-Regulating System is the same as the previously described D. C. Self-Regulating System with the single exception that the control relay equipment is arranged to take its power directly from the 110 or 220 volt alternating current electric power supply and transform same to a lower voltage, unidirectional impulse current suitable for operating our 24-volt or 12-volt electric drive units.

Each master relay and each distribution relay incorporates a power transformer consisting of a regular two-coil step-down transformer and a copper plate rectifier to change the alternating current to unidirectional impulse current. The rectifiers are connected up so as to give full wave rectification. 60-cycle alternating current will therefore be changed to current of 120 unidirectional impulses per second.

This unidirectional impulse current will energize our standard driving magnets perfectly, but due to its not being a smooth flowing current and

Printed in U.S.A.

With the new style self-regulating system, job time recorders, where time is eliminated, may be regulated at the hours they pass the regulating period (45th to 60th minute) in unision with the master clock.

The preceding is a complete wiring diagram of a self-regulating system where job time recorders, with less than a 24 hour wheel, are self-regulated. This diagram includes all the switches and is complete in every detail.

From studying the preceding diagram, it is easily seen how the job time recorders operate as straight impulse equipment, receiving sixty impulses each hour, when the armature of the No. 6103 relay in the program eliminating cabinet is not attracted. The circuit to the coils of this relay is completed through the contacts of the program device. By inserting pins in the program disc for several minutes preceding the hours at which regulation is desired, the armature of the No. 6103 relay will be attracted. This makes it imperative that the job time recorders run over the "A" wire as the "B" wire is broken by the lower contacts of the No. 6103.

When the job time recorders reach the 59th minute, they will wait for the master clock. When the No. 6103 armature is attracted, it connects the "A" wire leading to the job time recorders to the "A" wire over which the rapid impulses are being sent out. In this way, the job time recorders are set with the master clock whenever the job time recorders show zero on the minute wheel at the same time the master clock is at the hour.

When setting the time of a self-regulating master clock, it is very important that the minute hand coincide with the minute marker on the dial when the seconds hand is at the 58th second or when the minute impulse contact makes. The reason for this is that some cams are timed with the seconds hand and others with the minute hand. Therefore, they must position correctly in relation to each other.

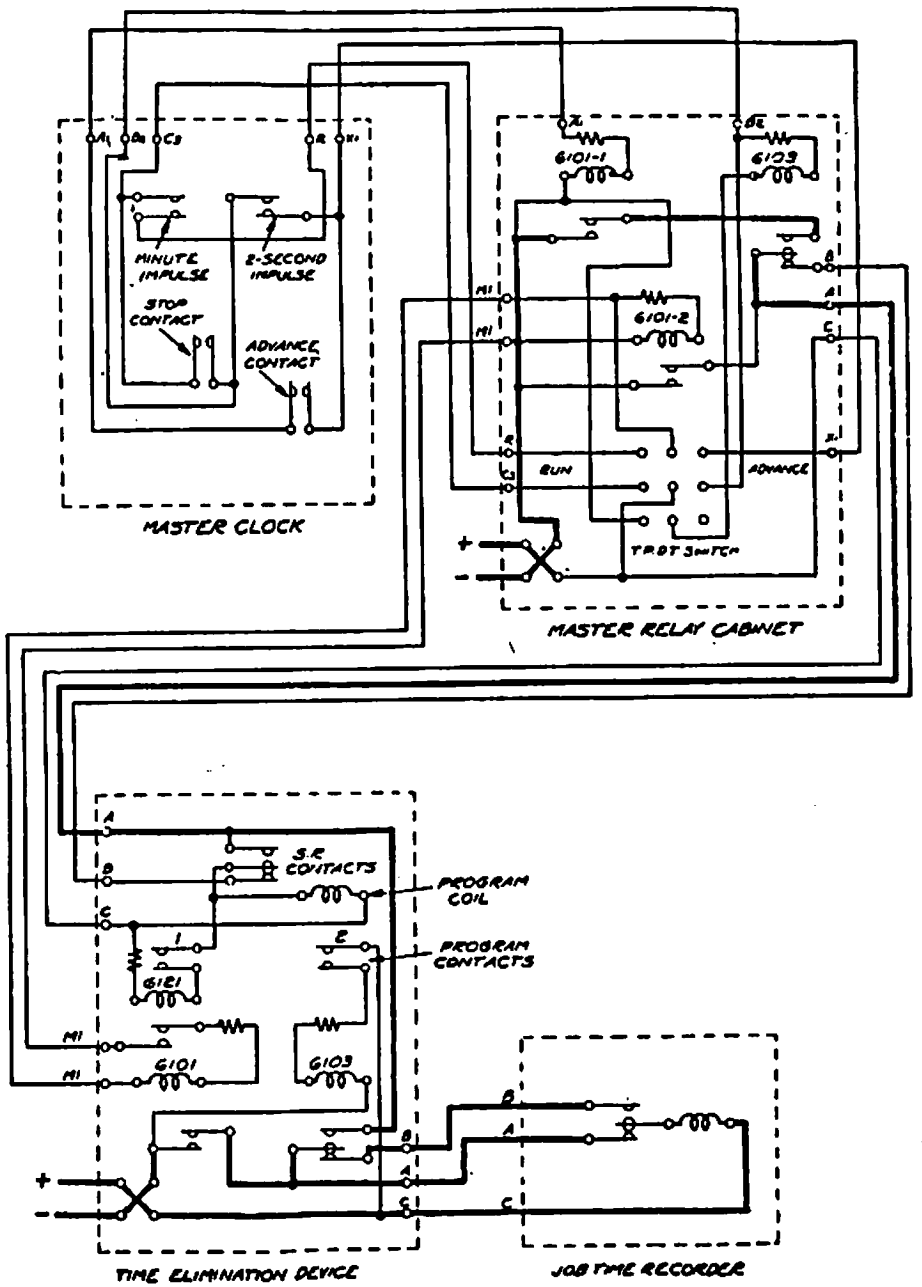
When replacing the dial on a self-regulating master clock, always be sure that the advance contact is riding on its cam and not locked back of the cam. It is good practice to turn off the battery before removing the master clock dial.

LATER DESIGN

Self-Regulating System with Power Transformer

The electric time system with which we use the power transformer is in many ways very similar to our self-regulating system explained previously.

Printed in U.S.A.



Printed in U.S.A.

also due to some inductance being developed in the clock magnets, its voltage must be somewhat higher than the nominal voltage of the clock magnets.

To prevent breakdown of the copper plate rectifiers by the inductive kick-back from the clock magnets, the rectifiers are incorporated as a permanent part of the clock circuits and all opening and closing of the circuits by the relays is done on the A. C. side of the rectifiers.

To prevent heating of the copper plate rectifiers, all current is kept off them except during the duration of the minute impulse. This necessitates the use of A. C. relays wherever relays are required to operate at other times than during the regular impulse. Therefore in this system the minute impulse master relay, seconds beat master relay and all bell circuit relays operating from a duration contact or a timing relay, must be of the A. C. type.

The International Self-Regulating A. C. System is furnished in two voltages - 24-volt and 12-volt.

In the 24-volt system the master relay and the distribution relays are equipped with complete power transformers with 24-volt A. C. taps for the control of bell circuit relays. No bells can be operated from these transformers.

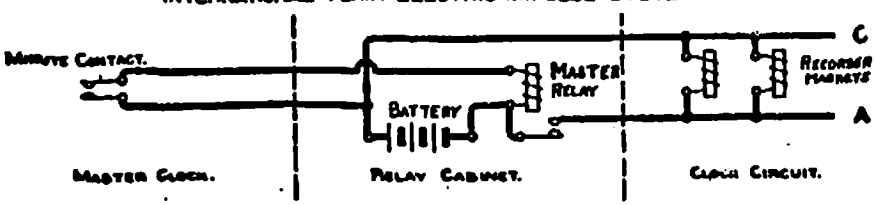
In the 12-volt system the master relay and the distribution relays contain only the copper plate rectifiers and a separate clock circuit transformer must be added to furnish 24 volts A. C. to the rectifiers. This transformer can then also be used for the ringing of bells.

Only half as many units can be carried on a 12-volt A. C. circuit as on a 24-volt A. C. circuit, and the circuit can be carried only one-half as far with the same size wire.

Electric Impulse Systems

In the following pages various typical layouts of electric impulse systems are illustrated and described. The purpose of the diagrams and

INTERNATIONAL PLAIN ELECTRIC IMPULSE SYSTEM.



Printed in U.S.A.

descriptions is to show how International control units relate to each other when actually installed in a clock system.

The preceding diagram illustrates the wiring and connections in a Plain Electric Impulse System. Some form of battery is essential on a plain impulse system as no provision is made for automatically setting the clock system after commercial power failures.

Operation

Master Clock minute contact closes once each minute, allowing master relay to be energized, which closes the circuit to wire "A" and allows current to momentarily flow through magnets of recorders, secondary clocks, etc.

Note that the system operates on two wires throughout. If the master clock is of the magnet wound type an extra pair of wires must be carried from wires "A" and "C" in the relay cabinet to the master clock for winding purposes.

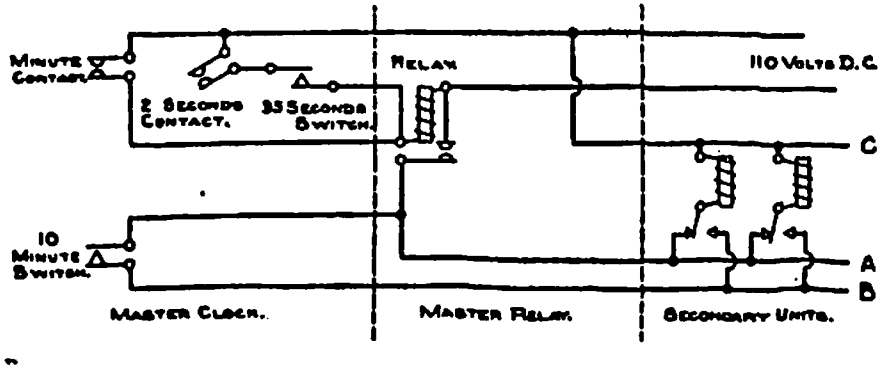
INTERNATIONAL D. C. SELF-REGULATING SYSTEM

Operation

Master clock minute contact closes once each minute, allowing master relay to be energized, which closes the circuit to wires "A" and "B" and allows current to momentarily flow through magnets of recorders, secondary clocks, etc.

The above is all that takes place so long as all secondary units are in unison with the master clock. If, however, for any reason a secondary unit gets thrown out of step with the master clock, either ahead or behind, it will within the hour be brought back into perfect unison with the master clock by one or the other of the two following actions:

INTERNATIONAL D.C. SELF-REGULATING SYSTEM



No. 6103 or transfer relay complete the circuit for the rapid impulses. If the armature of the No. 6103 is not attracted, the secondary apparatus will not receive the rapid impulses.

The wiring in the master clock has also been changed. The rapid impulse circuit is completed through the stop contact.

The single pole, double throw switch is now left out of the master clock. The same result is obtained from a triple pole, double throw switch in the master relay cabinet. Wiring the system in this manner requires five wires from the master clock to the master relay cabinet.

The circuit for energizing the coils of the master relay is as follows: One side of the battery, through the minute impulse contacts, through the coils of the master relay and back to the opposite side of the battery.

The circuit for energizing the coils of the No. 6103 relay is as follows: One side of the battery, through the stop contact, through the coils of the No. 6103 relay and back to the opposite side of the battery.

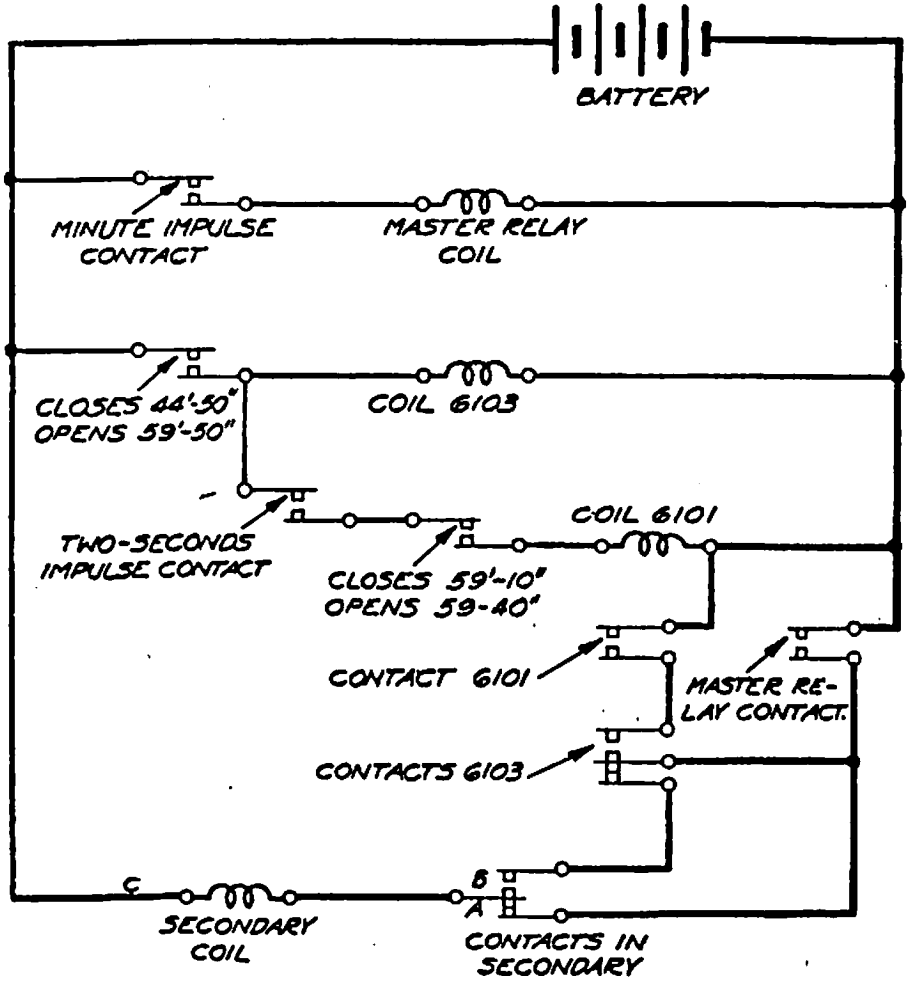
The circuit for energizing the coils of the rapid impulse relay is as follows: One side of the battery, through the stop contact, through the rapid impulse contact, through the advance contact, through the coils of the advance relay and back to the opposite side of the battery.

The regular minute impulse to the secondaries while on the "A" contact is as follows: One side of the battery, through the master relay contacts, over the "A" wire, through the lower contacts in the secondary, through the magnet coils of the secondary and back over the "C" wire to the opposite side of the battery. If the secondary is on the "B" contact, the circuit is as follows: One side of the battery, through the master relay contacts, through the lower contacts of the No. 6103 relay, over the "B" wire, through the upper contacts in the secondary, through the magnet coil of the secondary and back over the "C" wire to the opposite side of the battery. The rapid impulse circuit is as follows: One side of the battery, through the contacts of the rapid impulse relay, through the upper contacts of the No. 6103 relay and out over the "A" wire as before.

The distribution cabinet for the new style self-regulating system is the same as for the old style system.

The following is a scheratic wiring diagram of the new style system. The principle of operation is the same, but the method of arriving at the same results is somewhat different.

It will be noted that there is now one relay for the regular minute impulses and another for the rapid or two second impulses. It will also be noted that the No. 6102 or circuit opening relay has been changed to a No. 6103 or transfer relay. The lower contacts of the No. 6103 play the same part as the contacts of the No. 6102, namely, to open the circuit of the "B" wire between 44' 50" and 59' 50". The upper contacts of the



The preceding diagram illustrates the wiring and connections for an International D. C. Self-Regulating System.

1st - If Ahead

The 10-minute switch in the master clock disconnects the "B" wire for ten minutes once each hour from the 50th minute to the 59th minute inclusive. Therefore, if any secondary unit is ahead of the master clock it will cease to operate as soon as it reaches its own 59th minute where it transfers from wire "A" to wire "B." By this means all fast secondary units are lined up together at their 59th minute point where they wait for the master clock. Just before the master clock reaches its 60th minute point, the 10-minute switch reconnects the "B" wire to the impulse circuit and when the 60th impulse comes through, all secondary units receive it and step forward in unison with the master clock.

2nd - If Behind

The 35-seconds switch in the master clock closes once each hour for about thirty-five seconds, between the 59th and 60th minute impulses, and while the 10-minute switch is still open. This allows the 2-seconds contact to operate the master relay and send out about 17 rapid impulses over the "A" wire only. If any secondary units are behind the master clock and therefore still on the "A" wire, they will receive these rapid impulses until they reach their 59th minute points where they cut over onto the dead "B" wire in agreement with the master clock.

Note that so long as the secondary units are in unison with the master clock they receive only the regular minute impulses and are not affected by the Self-Regulating feature. The master clock opens wire "B" for ten minutes before the even hour whereas the secondary units receive their impulses over wire "B" only after the even hour. The secondary units are connected to the "B" wire only from the 59th to the 3rd minute points inclusive. At all other times they operate from the "A" wire.

INTERNATIONAL A. C. SELF-REGULATING SYSTEM

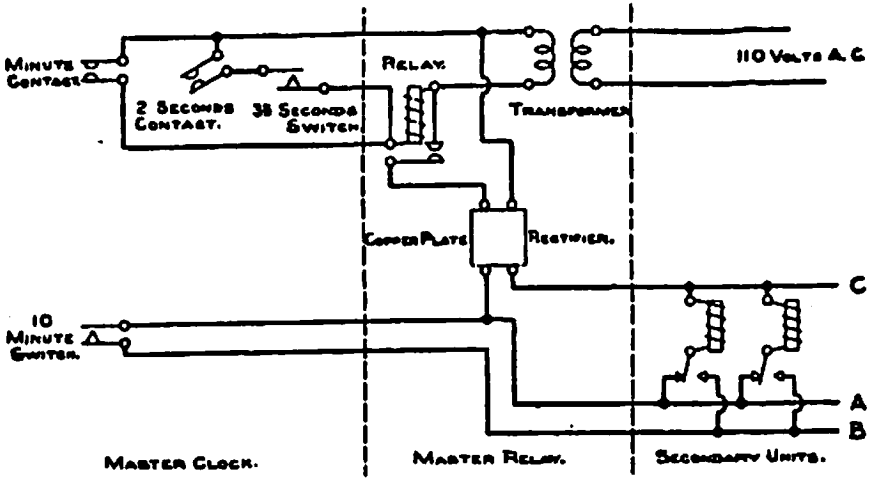
Operation

Master Clock minute contact closes once each minute, allowing master relay to be energized which closes the A. C. circuit to the rectifier. This A. C. in going through the rectifier is changed to unidirectional impulse current and as such flows out over wires "A" and

Printed in U.S.A.

"B", through the magnets of secondary units and back over wire "C." Note that the rectifier is integral with the clock circuit and is energized only during the duration of the minute impulse.

INTERNATIONAL A.C. SELF-REGULATING SYSTEM



The above diagram illustrates the wiring and connections for an International A. C. Self-Regulating System.

The above is all that takes place so long as all secondary units are in unison with the master clock. If, however, for any reason a secondary unit gets thrown out of step with the master clock, either ahead or behind, it will within the hour be brought back into perfect unison with the master clock by one or the other of the two following actions:

1st - If Ahead

The 10-minute switch in the master clock disconnects the "B" wire for ten minutes once each hour from the 50th minute to the 59th minute inclusive. Therefore, if any secondary unit is ahead of the master clock it will cease to operate as soon as it reaches its own 59th minute where it transfers from wire "A" to wire "B." By this means all fast secondary units are lined up together at their 59th minute point where they wait for the master clock. Just before the master clock reaches its 60th minute point, the 10-minute switch reconnects the "B" wire to the impulse circuit and when the 60th impulse comes through, all secondary units receive it and step forward in unison with the master clock.

Printed in U.S.A.

is again completed at 59' 50". Each slow secondary, therefore, utilizes only enough rapid impulses to bring it to the 59th minute, or rather to shift it to the "B" wire. At 59'50", the system is cleared for the 60th or hour impulse which occurs ten seconds later, with all units uniform.

The preceding diagram gives the complete circuits of a master clock, master relay, distribution cabinet and secondaries. The single pole, double throw switch in the master clock is for the purpose of stepping up the secondaries, should the power be off for any great length of time. The switch can be thrown to the "advance" position until the secondaries are within fifteen minutes of the master clock and then the self-regulating feature will take care of the last fifteen minutes.

It will be noted that the double throw switch is connected so that when it is thrown to the "advance" position, it opens the circuit to the stop contact. If this circuit were not opened, the secondaries would stop at the 59th minute if the master clock happened to be between 44' 50" and 59' 50". This is not desirable when the system as a whole is stepped up. The single pole, double throw switch also shunts the rapid impulse contact around the advance contact, thus closing the circuit to the master relay every two seconds.

This diagram also shows the method of operating straight impulse equipment from a self-regulating system. By studying the diagram, it is easily seen how the rapid impulses are prevented from going to the straight impulse equipment.

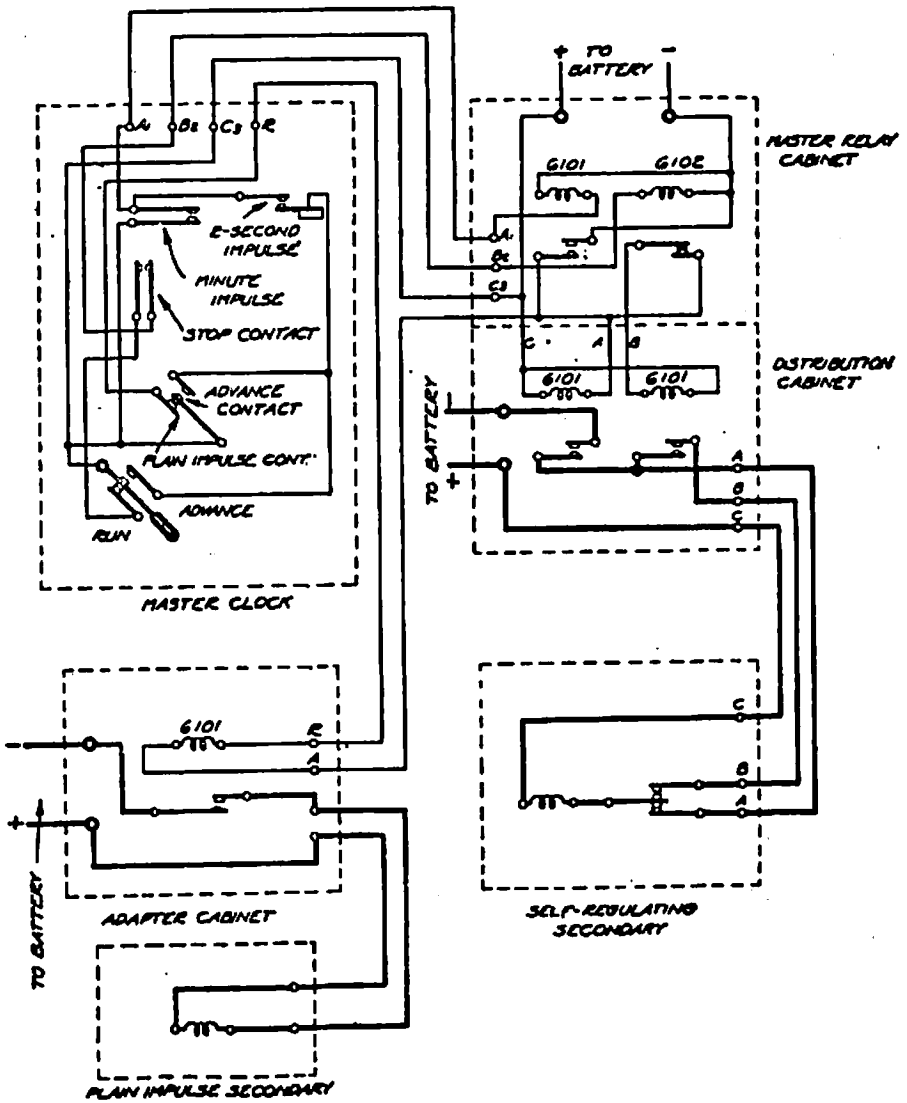
In the distribution cabinet are two No. 6101 or circuit closing relays. The one relay operates 75 times an hour as before and the other relay completes the circuit to the "B" wire when it receives an impulse. It receives impulses whenever the No. 6102 relay contacts are closed or for forty-five minutes out of each hour. The secondaries connected to the distribution cabinet receive impulses in the same manner as those connected to the master relay cabinet.

IMPROVED DESIGN OF SYSTEM

The type of self-regulating system described above is now obsolete. The new style system has several advantages, the more important ones being that if anything ever goes wrong with the self-regulating feature in the master clock, the system will run the same as a straight impulse system and neither send out rapid impulses nor hold up any secondaries. Another very important feature of this system is that it is now possible to regulate job time recorders where time is eliminated. This will be fully explained later.

Printed in U.S.A.

At 59' 10" past the hour, the rapid impulses are released over the "A" wire, thus stepping the secondary ahead once every two seconds until it reaches its 59th minute, at which time the selector contact shifts it from the "A" to the "B" wire. It will then wait in this position like all the other secondaries, for the 60th impulse which is available over either wire as the No. 6102 contacts are again closed and the "B" circuit



Printed in U.S.A.

2nd - If Behind

- The 35-seconds switch in the master clock closes once each hour for about thirty seconds, between the 59th and 60th minute impulses, and while the 10-minute switch is still open. This allows the 2-seconds contact to operate the master relay and send out about 17 rapid impulses over the "A" wire only. If any secondary units are behind the master clock and therefore still on the "A" wire, they will receive these rapid impulses until they reach their 59th minute points where they cut over onto the dead "B" wire in agreement with the master clock.

Note that so long as the secondary units are in unison with the master clock they receive only the regular minute impulses and are not affected by the Self-Regulating feature. The master clock opens wire "B" for ten minutes before the even hour whereas the secondary units receive their impulses over wire "B" only after the even hour. The secondary units are connected to the "B" wire only from the 59th to the 3rd minute points inclusive. At all other times they operate from the "A" wire.

DESCRIPTION OF EARLY DESIGNS

Secondary Equipment

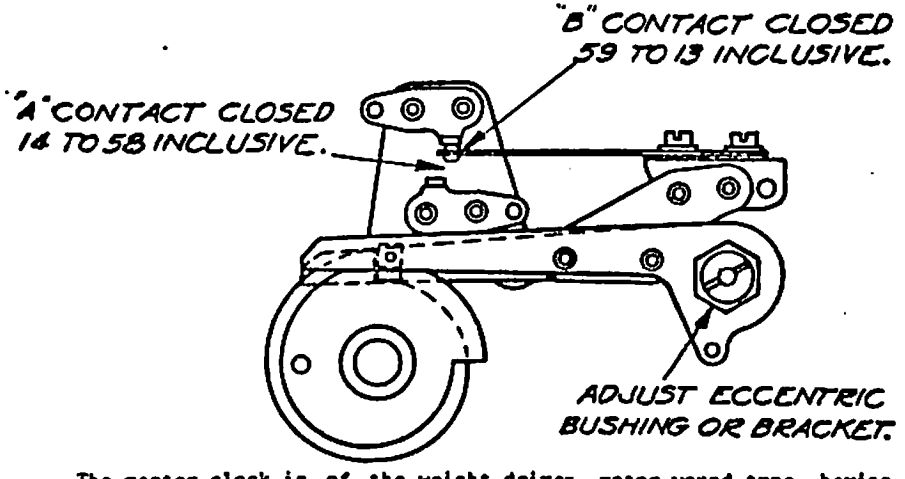
The secondary apparatus is equipped with a set of cams and switches on the minute shaft. The cams operate these "selector" switches in such a manner that at certain periods of the hour, the driving magnet is connected to the proper pair of the three wires to correct any difference that the secondary may have from the master clock. It is a simple, single pole, double throw arrangement which transfers from one leg to another, the third leg being common to all units. The switch is closed on the upper contact point for fifteen minutes of every hour (from the 59th to the 13th minute inclusive) and on the lower contact point for forty-five minutes of every hour (from the 14th minute to the 58th minute inclusive).

The change from one contact point to the other occurs as the secondary advances from 58 to 59 and from 13 to 14. As the movement (spring action) of the secondary occurs after the current is off the magnet, the make and break of these contacts occurs on a dead line, therefore, the contact cannot spark. This same combination of cams and contact fingers is used on all recorders and secondary units, the method of mounting them and the location being adapted to the various units.

These selector contacts should be adjusted so that they have 1/32" air gap when broken and 1/64" tension on the contact finger when made.

Printed in U.S.A.

This 1/64" tension insures good contact. Adjust the eccentric bushing in the contact fingers or the position of the contact bracket until the contacts shift between the 58th and 59th minute and the 13th and 14th minute.



The master clock is of the weight driven, motor wound type, having the regular plain impulse contact and the additional cams and contact to control the functions of the regulating system, as follows:

1. The regular minute impulse contact operates in the usual manner from a two point cam placed on the usual auxiliary shaft.

2. Mounted on the verge shaft and rocking with the verge is another contact which closes each time the pendulum swings to the left, or every two seconds. This contact supplies the necessary rapid impulses to correct slow units.

3. Placed on the center or minute hand shaft is a cam which operates the third contact. This contact is closed for only a short period (30 seconds) each hour, i. e., from 59' 10" to 59' 40". The cam is a large single point one and makes one complete revolution each hour. This contact releases the rapid impulses during the above thirty second interval. It is connected in series with the "rapid impulse" contact and is called the "advance contact."

There is also another cam on the center or minute hand shaft. This cam is in two sections and also makes one complete revolution each hour, causing its contact to be made for fifteen minutes or from 44' 50" to 59' 50". We will call this the "stop contact" as its function in the system is to cut out impulses from any secondaries should they arrive at the correction point ahead of the master clock.

the secondary will run on the "B" wire, because of the selector contact, until it reaches the 14th minute.

This circuit is from one side of the battery through the contacts of the No. 6101 relay, through the contacts of the No. 6102 relay, over the "B" wire, through the upper contact in the secondary, thence through the magnet coil and back over the "C" wire to the opposite side of the battery.

Between the 13th and 14th minute, the selector contact in the secondary shifts the circuit to the "A" wire. The secondary then runs over this wire and nothing takes place in the entire system until just before the master clock reaches the 45th minute. This "A" wire circuit is as follows: From one side of the battery, through the contacts of the No. 6101 relay, over the "A" wire through the lower contacts in the secondary, through the magnet coil and back over the "C" wire to the opposite side of the battery.

At 44' 50" past the hour, the stop contact in the master clock closes, completing the circuit to the coils of the No. 6102 relay. This opens the "B" wire to the secondary and makes it imperative that the secondary run on the "A" wire from the 45th to the 60th minute of the master clock if it is to get any impulses.

When the secondary reaches its 59th minute, the selector contact shifts it to the "B" wire, but this circuit is open at the contacts of the No. 6102 relay until the master clock reaches 59' 50". The rapid impulses are sent out over the "A" wire between 59' 10" and 59' 40". The secondary being on time, has transferred to the "B" wire before the rapid impulses start. Therefore, it is not affected by these impulses. Also if the secondary is fast, its performance is similar.

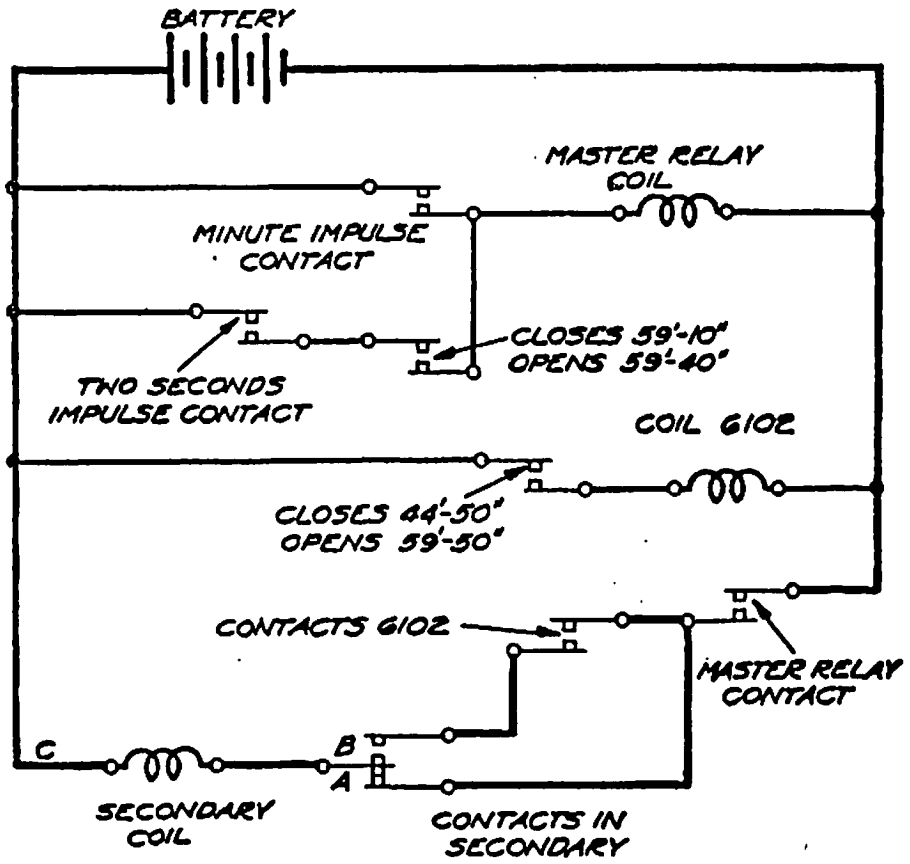
For example, suppose the secondary is five minutes fast. It will run as before until it reaches the 59th minute when the selector contact shifts it over to the "B" wire. The master clock, at 44' 50" will have closed the circuit to the coils of the No. 6102 relay and the impulses must then go out only over the "A" wire. The secondary will then wait at the 59th minute for five minutes as the "B" wire circuit is broken by the No. 6102 relay. The rapid impulses, not being needed, are lost as they are always sent out over the "A" wire.

Now consider the case when the secondary is five minutes slow. The secondary will run five minutes slow until the master clock reaches the 59th minute as impulses are available over the "A" wire to which the secondary is still connected. The secondary is now at its 54th minute.

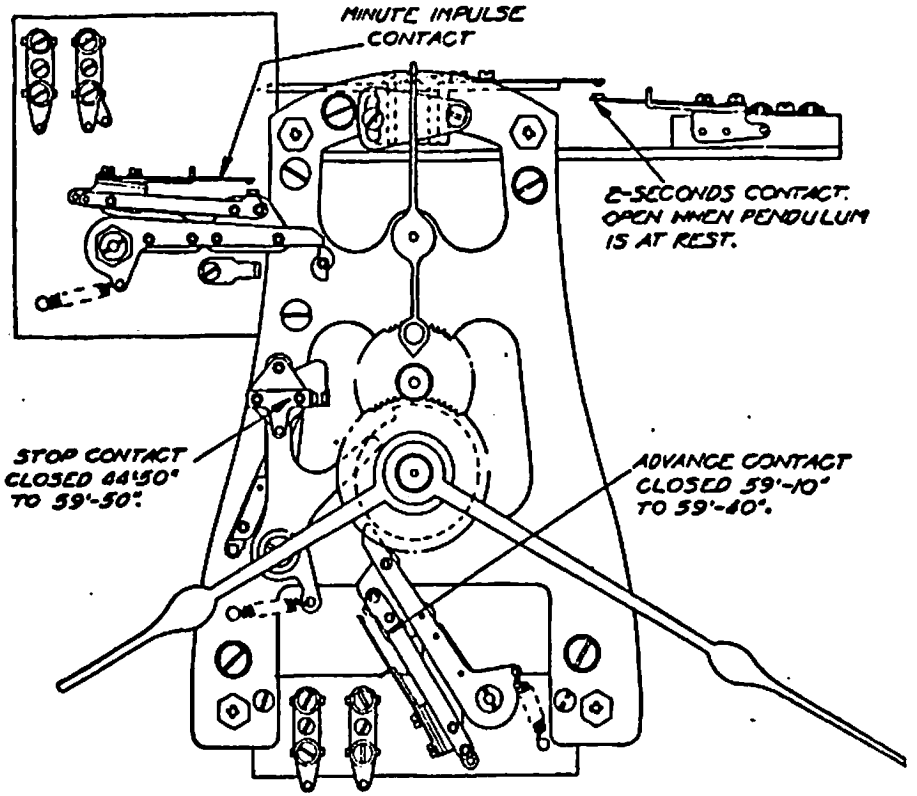
The contacts in the secondaries determine over which wire each individual secondary will receive its impulses. It should be remembered that the secondary's contact finger is touching the upper contact or connected to the "B" wire from the 59th to the 13th minute inclusive, and on the lower contact or connected to the "A" wire from the 14th to the 58th minute inclusive. Therefore, each individual secondary must receive its impulses over the "A" wire from its 14th to its 59th minute and over the "B" wire from its 59th to its 14th minute.

CYCLE OF OPERATION

Assuming that the secondary starts the hour in unison with the master clock, the impulses will be available over both the "A" and "B" wires but



On some of the first self-regulating systems, the advance contact was of the two way type. That is, one of its two contacts was made at all times. One contact was used when it was desired to operate straight impulse equipment from a self-regulating system. The purpose of this contact was to separate the rapid or speed-up impulses from any straight minute impulse equipment operating from the system. This requirement was later taken care of by a relay arrangement.



ADJUSTMENTS OF MASTER CLOCK

1. Adjust the minute impulse contact in the usual manner as explained in the bulletin on master clocks.

2. Adjust the rapid impulse contact to remain made as long as possible and yet be open when the pendulum is at rest.

3. Adjust the advance contact to make at 59' 10" past the hour and break at 59' 40" past the hour. This contact should have 1/32" air gap when broken and 1/64" tension on upper strap when made.

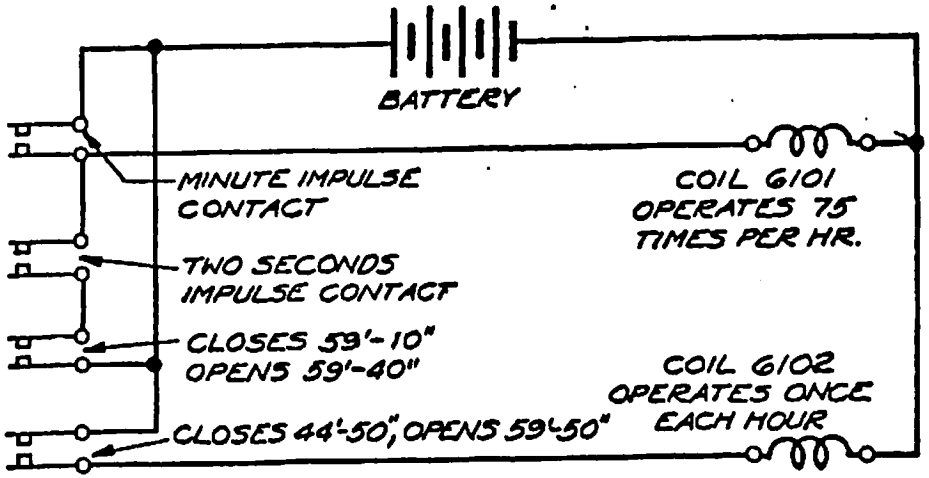
Printed in U.S.A.

4. Adjust the stop contact to make at 44' 50" past the hour and break at 59' 50" past the hour. When made, the cam wiper should lack 1/64" from bottoming on the cam. When open, there should be 1/32" air gap.

EARLY DESIGN OF SYSTEM

The master relay cabinet on the first self-regulating system consisted of two relays and the necessary switches, fuses, etc. One relay was the circuit closing type or No. 6101 and was used to send out all the impulses (both regular and rapid) to the secondary apparatus. The other relay was of the circuit opening type of No. 6102 and was operated by the "stop contact" and opened one leg of the secondary circuit, thus providing the means of cutting out impulses to secondaries that were fast.

The following diagram gives the circuits for the operation of the relays in the master relay cabinet. All switches, fuses and accessory parts are omitted on the diagram. We will call it the "control circuit" as it covers only the circuits to the controlling relays.



From studying the above diagram, it will be apparent that each time the minute impulse contacts in the master clock close, the circuit to the coils of the No. 6101 or master relay will be completed. As the minute impulse contacts close each minute, the master relay will operate 60 times an hour by this circuit.

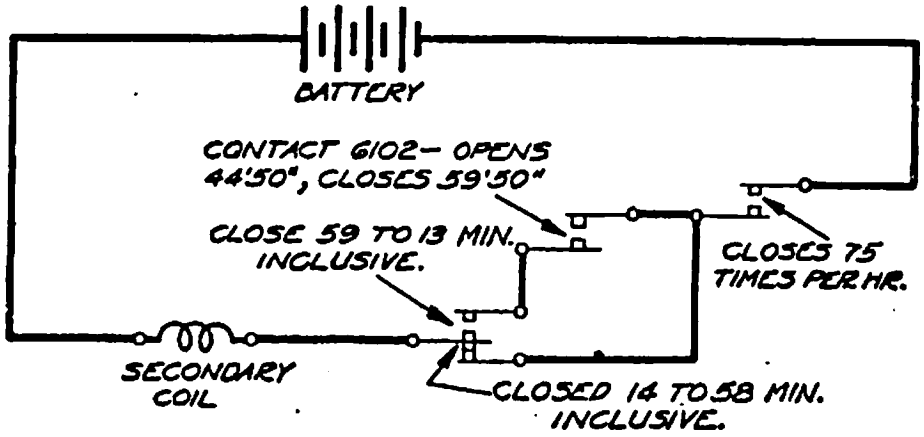
Further study of the diagram will show that the rapid impulse contact is in series with the advance contact and both are in parallel with the minute impulse contact. Therefore, the master relay will also operate

Printed in U.S.A.

when both the rapid impulse contact and the advance contact are closed together. From studying the timing of all these contacts, we find that the advance contact is only closed for thirty seconds each hour or from 59' 10" to 59' 40", therefore, the circuit will be completed only long enough for fifteen of the rapid impulses to go out. These contacts in series provide means each hour for operating the master relay fifteen extra times between the 59th and 60th minutes of the master clock. It will now be seen that the master relay operates seventy-five times an hour; once each minute when the regular minute impulse contact closes and fifteen extra times between the 59th and 60th minutes or every two seconds when the advance contact is closed.

It will further be apparent that when the stop contact is closed or between 44' 50" and 59' 50", a circuit will be completed to the coils of the circuit breaking or No. 6102 relay. This relay is only energized once an hour but stays energized for fifteen minutes at that time.

The following diagram gives the circuits from the control cabinet to the secondaries. As all power for driving the secondary apparatus must go over these wires, we will call this circuit the power circuit.



POWER CIRCUIT

It will be apparent that when the master relay contacts are closed, battery power will be thrown on the "A" wire at all times, but on the "B" wire only when the No. 6102 relay contacts are closed, which is for forty-five minutes out of every hour. (They are open for 15 minutes between 44' 50" and 59' 50").

Printed in U.S.A.