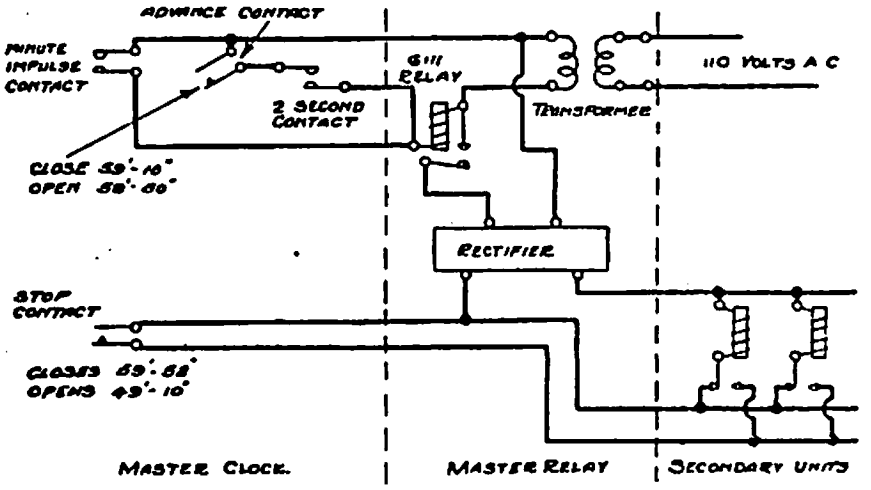
All magnet wound master clocks are connected so that the windi magnet will receive 80 impulses per hour. Then, if power is cut off fo as much as twenty minutes, full spring tension will be recovered the sar hour, whereas, our former models equipped with 59 tooth ratchet and re ceiving 60 impulses per hour would take approximately 20 hours to regai full tension.

MASTER RELAY CABINET

The master relay cabinet used with this system takes the place of th master relay cabinet, charging device and battery as used on our previo self-regulating systems. This is made possible thru the use of a trans former and rectifying unit which are placed in the master relay cabinet



SCHEMATIC WIRING DIAGRAM OF SELF REGULATING SYSTEM USING POWER TRANSFORMER

Fig. 2

This cabinet also contains a double pole double throw switch and on No. 6111 relay. A No. 6111 relay is used because it will operate equall well on alternating or direct current. In this case, it must operate c alternating current as the direct current is not available until after th relay has attracted its armature. The primary of the transformer is con nected to the commercial current thru the proper fuses. The secondary c the transformer is connected to the coil of the relay, thru the minute im pulse contacts. When this relay is energized, its contacts in turn clos a circuit from the transformer secondary to the alternating current terminal

Printed in U S A.

of the rectifier. The action of this rectifier is instantaneous and direct current at the proper voltage is available, as long as the contacts of the relay are closed, at the direct current terminals, which are permanently connected to the secondary circuit.

The double pole double throw switch performs the same duty as the triple pole double throw switch does on the self-regulating system. When closed on the left side it allows the system to run normally, while it will advance secondary units every two seconds if closed on the right side.

Wiring diagram below gives the circuits for the operation of a complete system as follows: First consider the case with the double pole double throw switch in the "run" position. The relay pickup circuit is as follows: One side of transformer secondary, thru coil of No. 6111 relay, center post of double pole double throw switch, wire No. 2 to master clock, minute impulse contact to post No. 1 master clock, wire No. 1 to master relay cabinet and back to opposite side of transformer secondary.

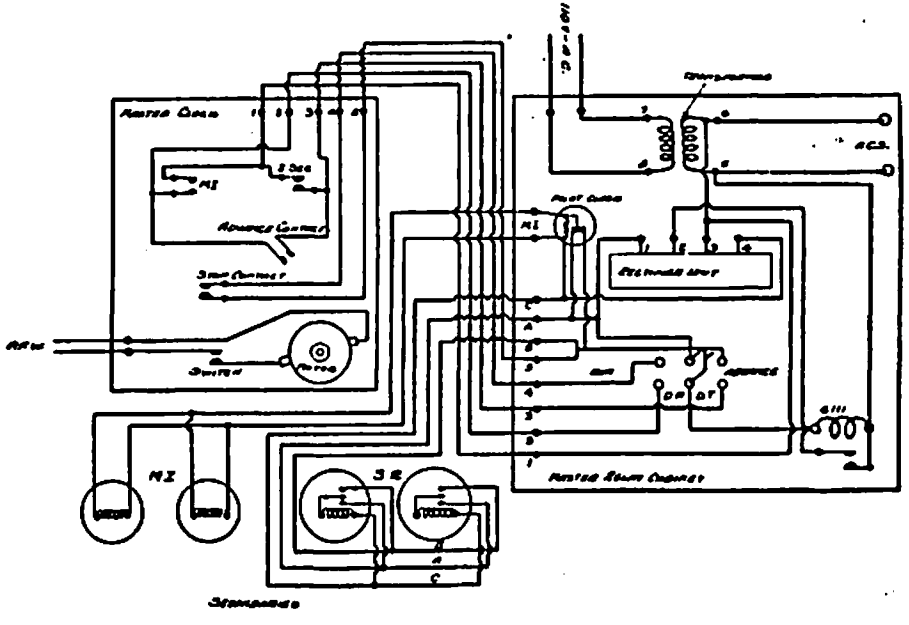


Fig. 3

The "A" wire circuit to secondaries is as follows: From terminal No. 4 of the rectifier unit out over the "C" wire, thru the coils of the secondary, thru the self-regulating contacts and back over the "A" wire to terminal No. 1 of rectifier unit.

Printed in U.S.A.

At 5:30 A.M. all Job Time Recorders are operating and are receiving their impulses thru the circuit closing relay, the coils of which are connected in parallel with the coils of the program device. The operation is the same until the first pin is placed in the program disc that is used for operating the transfer relay, after which the transfer relay operates at the same time as the circuit closing relay. This prevents the impulses from going out over the "B" wire to the Job Time Recorders. The system operates in this manner until 5:59 when a pin is placed in the program disc that controls the elimination. When the program advances to the 59th minute a circuit is completed to the coils of the make and break relay but the impulse is completed before the program advances to complete the circuit. At the 59' 20" the rapid impulses start coming over the "A" and "C" wires. These impulses are also sent out over the "A" and "C" wires to the Job Time Recorders, as the program contacts controlling the transfer relay are closed, therefore, the relay operates each impulse. It will be noted that the circuit closing relay does not have to operate to send out the rapid impulses to the Job Time Recorders. Also it will be noted that the first rapid impulse advances the recorder to the 60th minute or until it shifts to the "B" wire. The 60th minute impulse then comes thru at the hour but this is not received at the Job Time Recorder. The transfer relay still operates on this impulse, the program contacts which control it not being opened until the impulse is completed. Nothing further takes place in connection with Job Time Recorders until 6:59 when a pin is placed to close the make and break relay contacts. This pin completes the circuit so that the 60th impulse is available to the coils of the make and break relay. The "make and break" relay completes the circuit on the release of its armature so that the 01 impulse is available to the Job Time Recorders.

Printed in U.S.A.

magnet and in series with the program contacts is the coil of the "Make and Break" relay. It is obvious that the "Make and Break" relay receives the regular supervised impulses whenever the program contacts are closed, thus it operates according to the schedule set up on that particular circuit. Also in parallel with the program magnet and in series with the contacts of the make and break relay is the coil of a circuit closing relay. This relay operates each minute that the contacts of the "make and break" relay are closed.

As the program device advances on the return stroke of the armature, the program contacts break after the impulse is completed. Likewise they make too late to send the impulse, which advances the program, out to the other apparatus. For this reason the pins for operating the make and break relay, are placed one minute before the desired time of operation, i.e. if the elimination time is from 6:00 to 7:00, the pins should be placed at 5:59 and 6:59.

The circuit that operates the relay for opening the "B" wire and connecting the rapid impulses to the "A" wire is thru the program contacts and the coils of a transfer relay. This circuit only comes into operation just before the regulating period. The transfer relay is energized each impulse from the 49th minute until the program contacts open as the program advances to the 60th minute, by pins being placed in the discs from the 49th to 59th minute inclusive.

It should be noted that the impulses coming over the "B" wire to the Job Time Recorders are provided for by the lower contacts of the transfer relay connecting the "A" and "B" wires together. This is possible because the regular hourly rapid impulses are prevented from going out over the "A" wire and "B" wire by the contacts of the circuit closing relay which only operates at minute intervals and only receives the rapid impulses when the program device does. This feature is desirable inasmuch as it takes care of power failures, advancing the Job Time Recorders, at the same rate the program device is advanced. It is likewise apparent that while supervising, the rapid impulses go out over the "A" and "C" wires to the Job Time Recorders without the aid of the circuit closing relay.

The following is a brief description of the operation of an entire system where time is eliminated from 6:00 A.M. to 7:00 A.M. and the supervision takes place at 6:00. Obviously the best time to regulate is just preceding an elimination. The events are explained in chronological order from 5:30 A.M. to past 6 o'clock.

Printed in U.S.A.

The "B" wire circuit to the secondaries is as follows: From termin No. 4 of the rectifier, out over the "C" wire, thru the coils of the se ondary, thru the self-regulating contacts and back over the "B" wire the master relay cabinet, out over wire No. 5 to the master clock, th the stop contact and back over wire No. 4 to the master relay cabine thru the double pole double throw switch and back to terminal No. 1 the rectifier.

Thus we see that current is available over the "B" wire to the se ondary for 50 minutes each hour, since the stop contacts in the mast clock are closed for that length of time. It will be noted that all the current required to operate the secondaries while on the "B" wire mu pass thru the stop contact in the master clock. Therefore, they are ma heavier than the other contacts as they must carry, but not break, a co paratively large current.

The rapid impulse control circuit is traced as follows: From o side of the transformer secondary, thru the relay coil, thru the doub pole double throw switch, out over wire No. 2 to the master clock, th the advance and two second contacts, back over wire No. 1 to the oth side of the transformer secondary. This energizes the relay each t seconds and sends out twenty impulses over the "A" and "C" wires betwe 59' 10" and 59' 50". No impulse is available over "B" wire at this ti because the stop contact is open.

Now consider the case if the double pole double throw switch thrown to the advance position.

The relay pickup circuit is as follows: From the transformer se ondary, thru the relay coil, thru the double pole double throw switc out over wire No. 3 to the master clock, thru the 2 second contact and ba over wire No. 1 to the master relay cabinet and thence to the transform secondary.

This energizes the relay and closes its contact every two seconds long as the switch is in the "advance" position. Each time the conta closes, the A.C. supply from the transformer secondary is thrown on t rectifier. This in turn gives us the required D.C. to operate seconda units.

The circuits controlling the secondaries under the above conditio are: From terminal No. 4 of the rectifier, out over "C," thru the coi of the secondary, thru the self-regulating contacts, back over "A" to t master relay cabinet and rectifier. Also from the rectifier, out ov

Printed in U.S.A.

"C," thru the coils of the secondary, thru the self-regulating contacts, back over "B," thru the double pole double throw switch and to the rectifier. Therefore, one can easily see that current is available at the secondary over either "A" or "B" wires when the double pole double throw switch is in the "advance" position.

SECONDARIES

All secondary units are the same except for the self-regulating contacts and cams. This system will step up secondaries as much as 20 minutes or stop them for 10 minutes each hour. It is never found that secondaries are as much as 10 minutes fast unless some part of the system is radically wrong and needs more than mere regulation. The secondary cams are designed to make on "B" wire between the 58th and 59th minutes and to make on the "A" wire between the 4th and 5th minutes. This means that secondaries will run on the "B" wire only 5 minutes each hour instead of 15 minutes as formerly. The bushings for the contact fingers have been changed slightly to give them a larger and better bearing surface.

Also, all secondary units are wound to operate on 24 volts, except when used in connection with our 120 beat master clock. The system controlled by this master clock is known as the "Unit System" and operates on 6 volts.

Straight minute impulse secondaries may be connected to either of the above systems provided a pilot clock is mounted in the master relay cabinet. Then, the minute impulse leads may be taken direct from each end of the pilot clock coil, thus placing the minute impulse secondary coils in parallel with the pilot clock coil. Thus the pilot clock which is self-regulating and also the minute impulse secondaries receive their allotted 60 impulses per hour.

DISTRIBUTION CABINETS

When the current drawn by the system exceeds the capacity of the rectifier unit on the master relay panel used on this type self-regulating system, a special distribution panel is employed.

This panel contains its own transformer, rectifier unit and two No. 6101 relays. The commercial A.C. is connected to the primary of the transformer thru the contacts of the No. 6101-1 relay. The coils of this relay are connected to the incoming "A" and "C" wires, from the master relay cabinet. Then, every impulse the coils are energized and the contacts closed. This throws power on the transformer primary each impulse.

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

SUPERVISION OF JOB TIME RECORDER WHERE TIME IS ELIMINATED

Where time is eliminated on Job Time Recorders a program control cabinet is required as heretofore. One circuit of the program device is used to operate a transfer relay to cut out the "B" wire and cut in the rapid impulses. One or more circuits of the program device is used to control one or more circuits of Job Time Recorders. A "make and break" relay is necessary for each circuit of Job Time Recorders. If separate circuits of Job Time Recorders are supervised at different times, a transfer relay and disc to operate same will have to be supplied for each regulation. They may be supervised at any or all hours that the master clock and minute wheels are together or when the minute wheels are a predetermined number of minutes behind the master clock, due to elimination. However, if the Job Time Recorders are for daily periods and the type wheel come back to 00.00 each day, it is advisable to regulate only once per day. If the Job Time Recorders are of the 600 period type and the working schedule is irregular it may only be possible to regulate once per week. This depends entirely upon the schedule. The best practice is to supervise just prior to the time of starting work for the period as the all recorders start the period in unison and at the correct time.

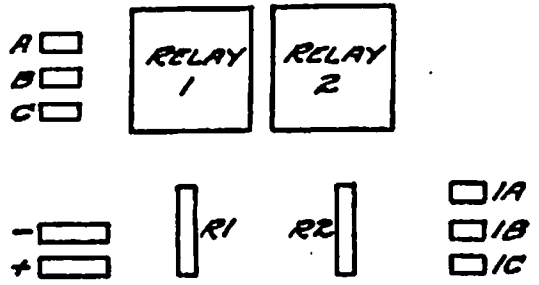
The Job Time Recorders are standard with the exception of the setting of the supervising cams. They are always set to change to the "B" wire one minute after the regulation period, i.e. if the regulation is standard or at the 59th minute the cams would be set to shift to the "B" wire at the 60th minute.

The reason for the late setting of the supervising cam is apparent when the wiring diagram is studied. The program contact controlling the transfer relay must be closed between the 59th and 60th minute in order to cut out the "B" wire and allow the rapid impulses to go out over the "A" wire. If this contact is to be made during the above time it must also be made during the 60th impulse as the program device does not advance until the impulse is completed. The Job Time Recorders are connected to the "B" wire at this time but as the transfer relay is energized they will not receive the even hour impulse. They have just previously been advanced to the even hour or transferred to the "B" wire by the first rapid impulse. They will receive the first impulse after the hour and stay in synchronism with each other and the master clock.

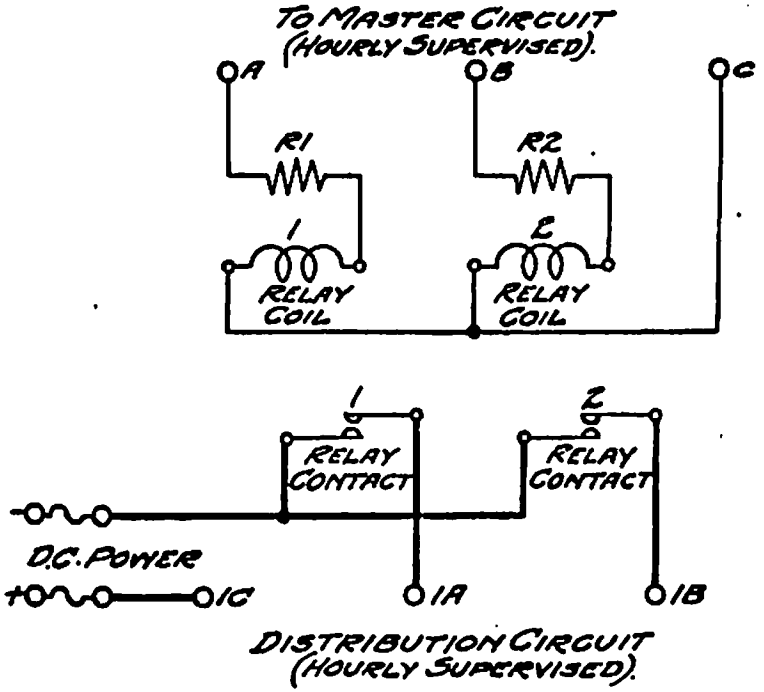
Figure following is a schematic wiring diagram of the program control cabinet used for one circuit of Job Time Recorders. The operation is as follows: The regular supervised impulses are received by the progr

Printed in U.S.A.

Below are Diagrams of D.C. Distribution Panel



ARRANGEMENT OF UNITS.



DISTRIBUTION CIRCUIT (HOURLY SUPERVISED).

WIRING DIAGRAM

DISTRIBUTION PANEL

FIG. 2

Printed in U.S.A.

The transformer secondary is connected permanently to the A.C. leads of the rectifier. The D.C. leads are connected to the "A" and "C" terminals of the distribution circuit.

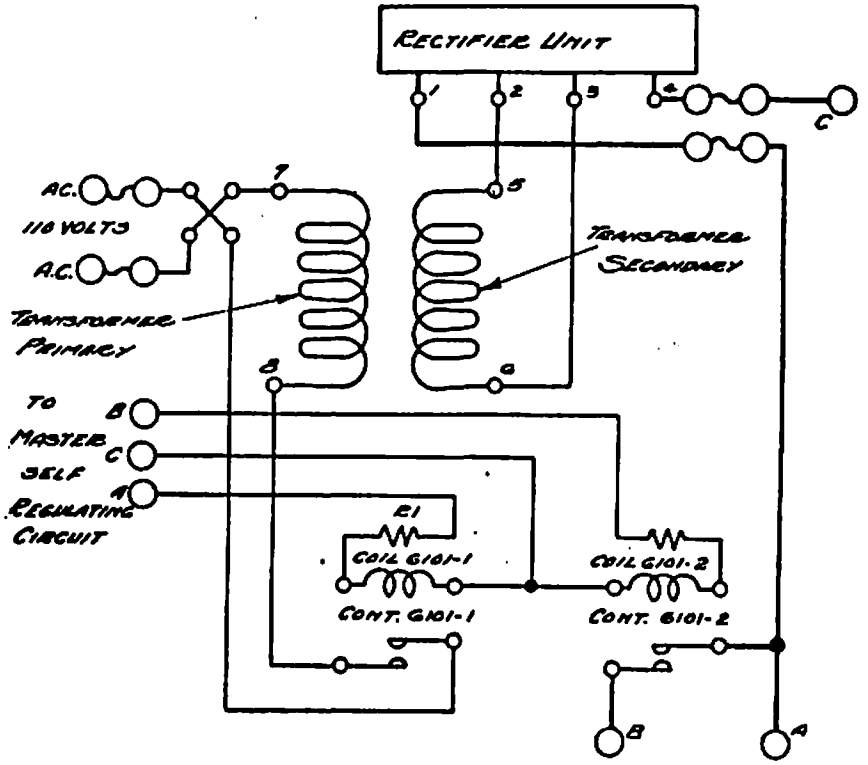


FIG. 4

One terminal of the No. 6101-a relay coil is also connected to the incoming "C" wire from master relay cabinet and the other terminal is connected to the "B" wire. Therefore, for 50 minutes per hour when impulses are available over the "B" wire at the secondaries, this No. 6101-a relay is being energized at each impulse. A circuit is completed from the "A" wire of the distribution circuit, thru the contacts of this relay which gives us the "B" wire. Therefore, all impulses from 59' 52" to 49' 10" go out over both "A" and "B" wires to the secondaries and for the remaining 10 minutes only over the "A" wire. By tracing thru the accompanying diagram (Fig. 4), a much clearer conception of the operation of this board may be secured.

Whenever three or more distribution boards are necessary on the same system, the master relay cabinet is only used to energize the relays of the distribution panels. No secondary circuits are connected to the master relay cabinet in this case.

When this system is operated from 110 Volts D.C., it is exactly identical with the 110 Volt A.C. system, except that the transformer and rectifier are eliminated. Secondary units and relays are arranged to operate on the commercial current.

RECTIFIER UNIT

The rectifier unit is of the dry plate type and incorporates the use of copper oxide as a means of changing alternating current to direct current. The rectifying properties of copper oxide were first made known thru the research of Professor Branley in 1874.

CHARACTERISTICS

This rectifier contains no acid, no oil or any other liquid. It is made throughout of solid metal plates and its rectification is due entirely to electronic action. There is no chemical action or pressure phenomena involved.

It is not affected permanently if it becomes wet. After it is thoroughly dried, its original properties are completely restored.

It will stand a great amount of rough handling and excessive vibration. However, bending the plates causes the oxide layer to break off and reduces the rectifying area which will reduce the capacity of the unit.

Heat or cold does not affect the properties of this rectifier within a reasonable range. It should not be operated at a temperature exceeding 85° F. Rectifiers for use above this limit should be especially ordered to agree with the conditions occurring.

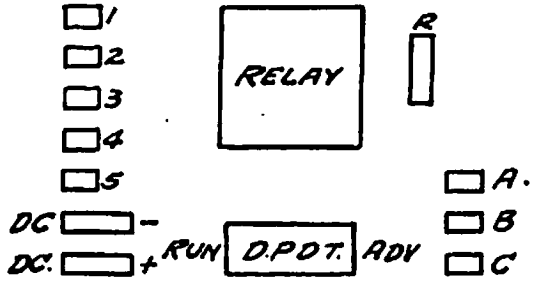
The rectifier, after it is assembled, is given a coating of acid-proof and water-proof.

THEORY OF OPERATION

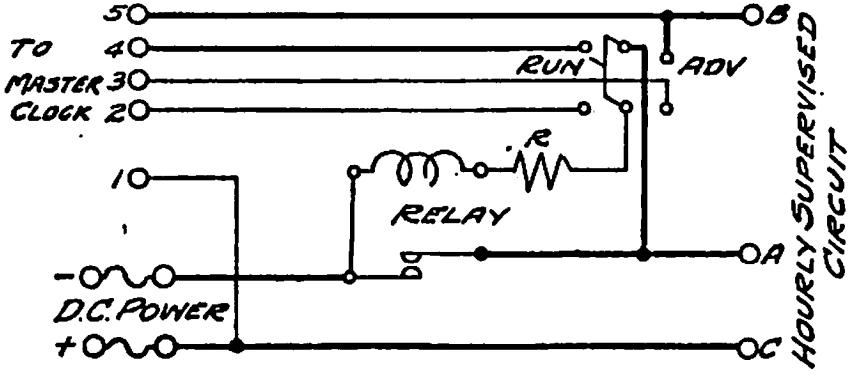
The principle upon which it is founded is that copper oxide offers a very high resistance to a flow of negative (-) current and very little to a positive (+) flow. This is known as the "point to plate" theory. The copper plate is the "plate" and the corners of the individual copper

Printed in U.S.A.

Below are Diagrams of D.C. Master Relay Panel



ARRANGEMENT OF UNITS



NOTE:-
ON SYSTEMS INCLUDING IMPULSE ACCUMULATOR DO NOT CONNECT #3 TERMINAL TO MASTER CLOCK

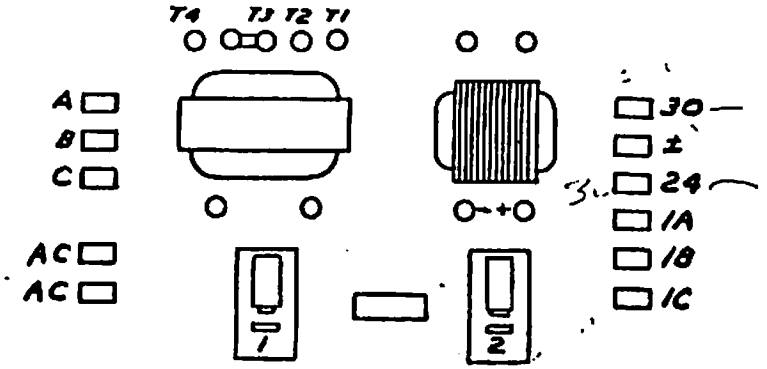
WIRING DIAGRAM

MASTER RELAY PANEL

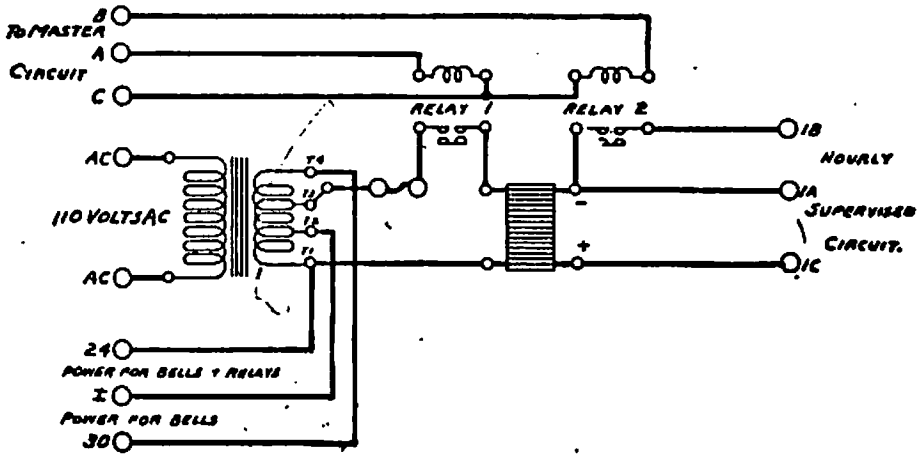
FIG. 2

Printed in U.S.A.

Below are Diagrams of A.C. Distribution Panels



ARRANGEMENT OF UNITS

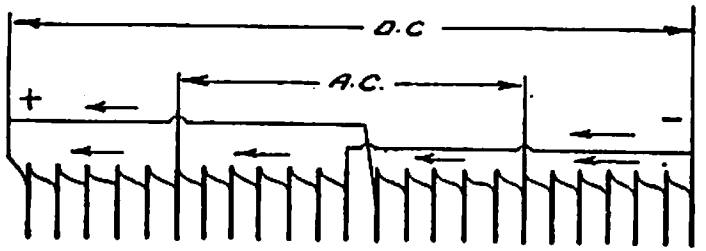


WIRING DIAGRAM

Printed in U.S.A.

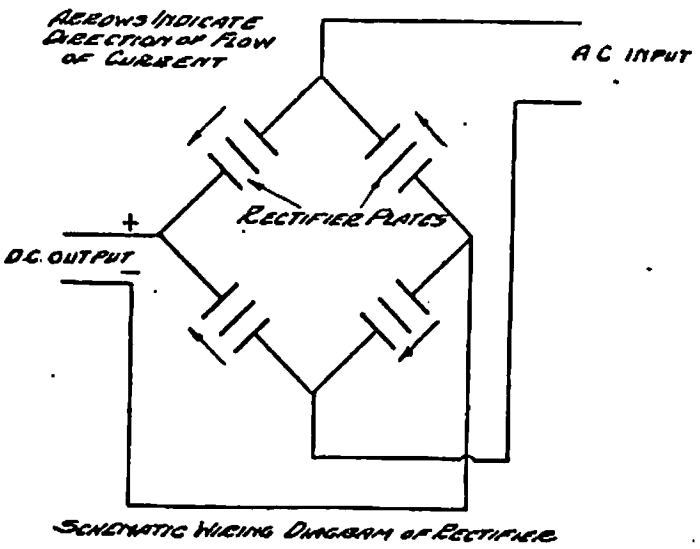
oxide grains are the points. A fine point very near, but not in contact with a conductive plate of larger size tends to pass current very freely from the point to the plate, but offers high resistance to a flow from plate to point. This acts as a valve and allows current to flow in one direction only. These electric "valves" are of atomic size. There are billions of them per disc, each allowing a current flow in only one direction.

By studying figures 5 and 6, which are schematic wiring diagrams of this rectifier, it will be readily understood how current flows from the



Rectifier Unit Showing Connections And Direction of Current Flow

Fig. 5



Schematic Wiring Diagram of Rectifier

Fig. 6

Printed in U.S.A.

D.C. terminals in only one direction and that both the positive and negative portions of the A.C. cycles are used.

Rectification is entirely electronic and unless heated to a temperature that would permit a rearrangement of the molecular structure, there is no deterioration and the rectifier will function indefinitely.

APPLICATION

This rectifier is the one incorporated in the self-regulating system with power transformer, as explained in the first part of this bulletin. It is rugged and simply built, is able to stand up under rough treatment and will give good service for an indefinite length of time. In case the trouble on a system is traced to it, the serviceman can do little toward repair of the unit proper. He should check all connections and wiring for possible shorts, grounds, or loose connections. From the following paragraphs, one may get a true insight into the application of the dry plate rectifier to electric clock systems.

Alternating current is applied to the primary side of the rectifier whenever the master clock contacts close. The closing of the master clock contacts provides a circuit for energizing the coils of the master relay. This causes the contact points of the master relay to close, and makes available the alternating current at the primary side of the rectifier.

Instantaneous with the applying of the alternating current to the primary of the rectifier, direct current is available at the secondary side of the rectifier which is permanently connected to the secondary circuits. This arrangement causes direct current to be applied to secondary circuits whenever the master relay contact points are closed. It will also be noted that the master relay breaks an alternating current circuit. The arc caused by breaking alternating current is not nearly as destructive as the one caused by breaking direct current. This prolongs the life of the relay.

Each unit has marked on it the number of amperes of current it will deliver. It should deliver this amperage easily at the desired voltage. If the total current consumption of the circuit exceeds 2 amperes as given in the table on page 3, section 233 of the Mechanical Service Manual, put in a distribution cabinet and be safe.

When a system of this type is being installed, always be sure to check the voltage under full load. Under no conditions should the voltage drop below 24 volts. Extreme care must be taken to have the voltage checked at full load.

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

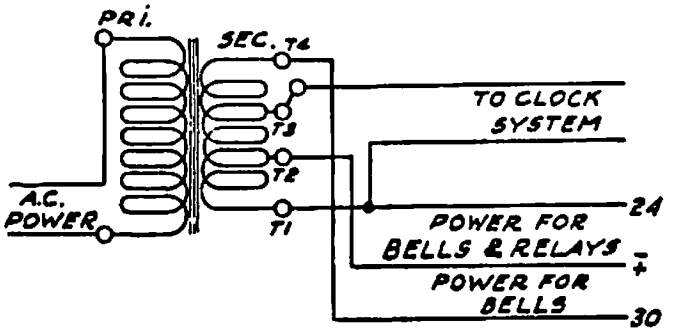


FIG. 3

Figure 3 is a schematic wiring diagram of the transformer with the connections marked the same as on the terminal block of the transformer. Changing the connections from one post to another changes the number of turns in the secondary that are in use, thus changing the voltage. As the primary voltage is practically constant, the secondary voltage will be either higher or lower according to the revised ratio of turns.

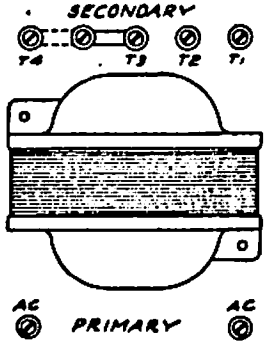
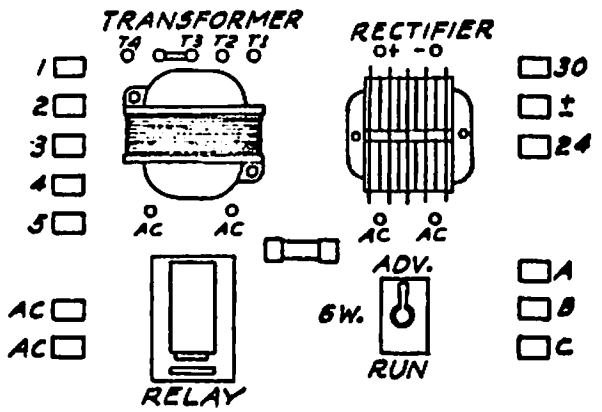


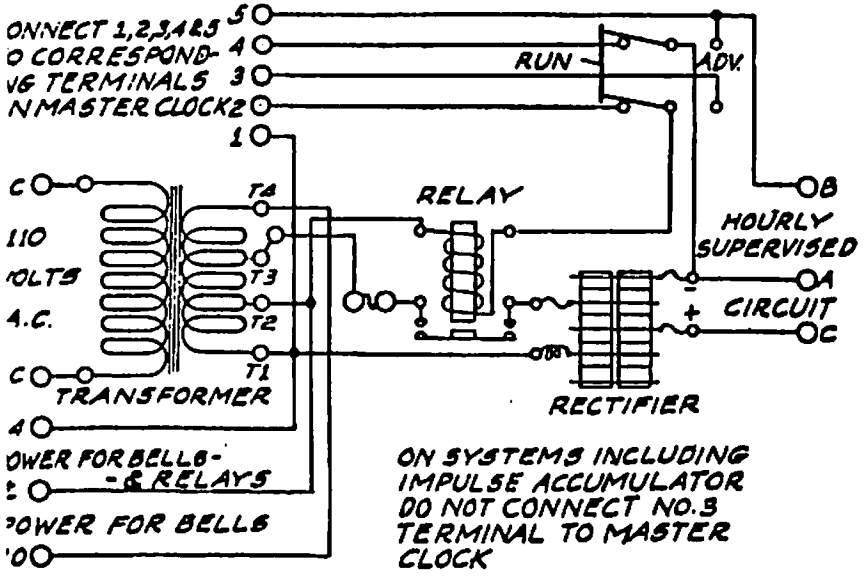
FIG. 4

Figure 4 is a drawing of the transformer and terminals showing how the terminal strip may be connected to obtain high and low voltage at the secondary of the transformer. Other things being equal, the greater the load or the longer the lines to the secondary apparatus, the higher the transformer secondary voltage should be. If only one or two secondary units are in use, the connection that will give the lower secondary voltage should be used

Printed in U.S.A.



ARRANGEMENT OF UNITS



WIRING DIAGRAM
Master Relay Cabinet

This rectifier may be used in connection with straight impulse equipment, such as the class No. 3300 Door Recorder systems. In such instances, the transformer primary is connected permanently to the A.C. supply. The transformer secondary is connected to the coils of the relay thru the minute impulse contacts. When the relay attracts its armature, its contacts close a circuit from the transformer secondary, thru the A.C. side of the rectifier, thru the relay contacts and back to the opposite side of transformer secondary. The D.C. side of the rectifier is permanently connected to the straight impulse equipment (See Fig. 7).

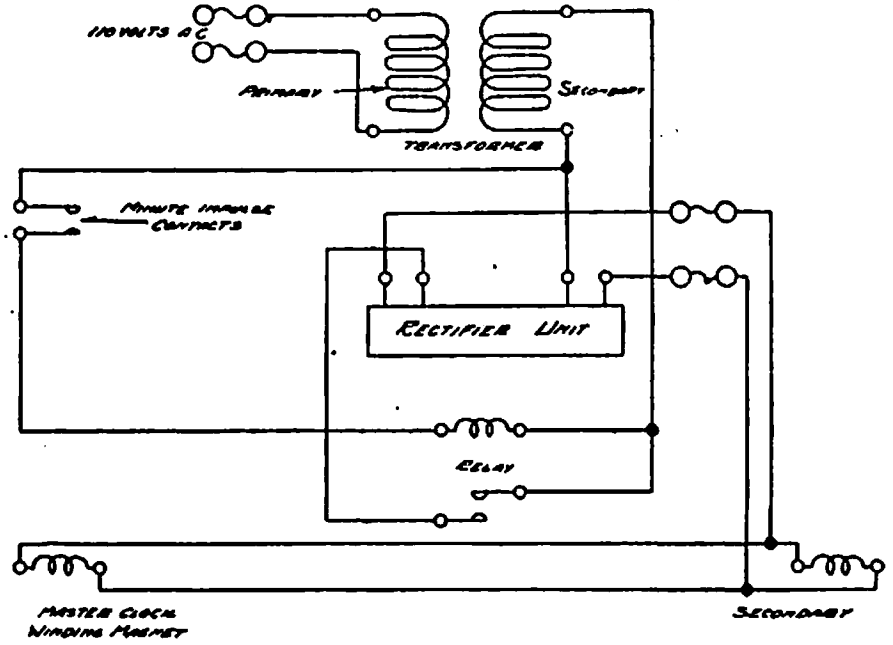


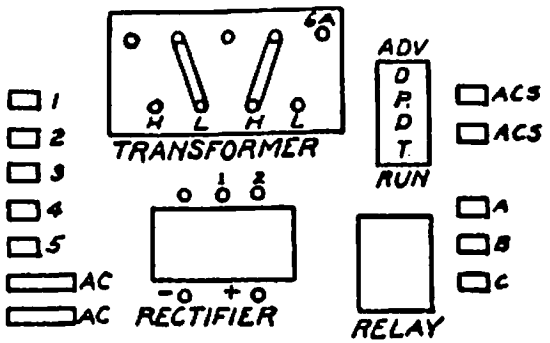
Fig. 7

LATE DESIGN

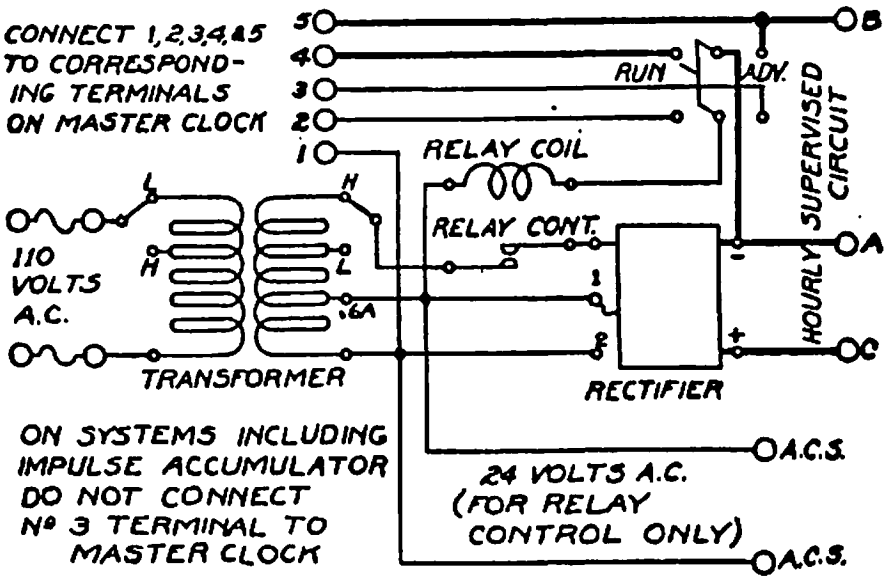
The principle is the same as previously described. The change in contact design and operation of the master clock and secondary switches has been previously discussed.

CONTROL CABINETS

Late Design



ARRANGEMENT OF UNITS



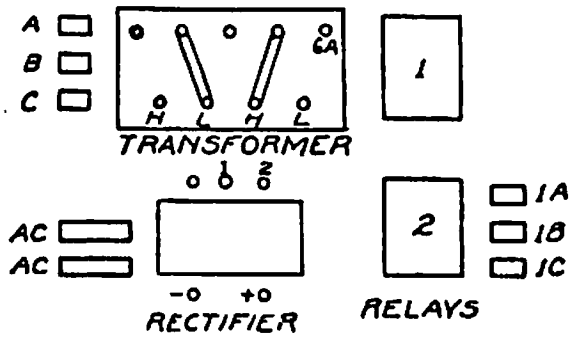
WIRING DIAGRAM

NOTE:- BE SURE TRANSFORMER TAPS ARE ADJUST-ED TO FOLLOWING LOAD CONDITIONS

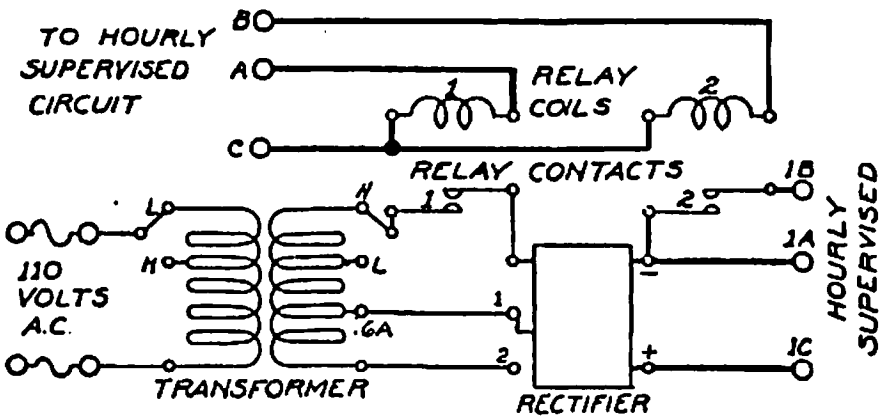
AMP LOAD	PRIMARY	SECOND.	RECT TERM.
.2 TO .6	L	H	1
.6 TO 1.2	H	H	1
1.2 TO 1.5	L	L	2

MASTER RELAY CABINET

Printed in U.S.A.



ARRANGEMENT OF UNITS



WIRING DIAGRAM

NOTE ÷ BE SURE TRANSFORMER TAPS ARE ADJU-ED TO FOLLOWING LOAD CONDITIONS.

AMP LOAD	PRIMARY	SECOND.	RECT. TERM.
.2 TO .6	L	H	1
.6 TO 1.2	H	H	1
1.2 TO 1.5	L	L	2

DISTRIBUTION CABINET

Printed in U.S.A.