INSTRUCTION BOOK

INTERNATIONAL BUSINESS MACHINES CORPORATION
INTERNATIONAL TIME RECORDING DIVISION
270 BROADWAY NEW YORK, N. Y.

INTERNATIONAL SERV(inued)

The priceless asset of any business is Goodwill. It cannot be valued in money. Ahead of organization plant and product must stand that bulwark of name and reputation which can only be built by service. This service must be continuous before and after the sale.

The International Business Machines Corporation maintains specially trained Time Specialists and Low Tension Engineers to assist in selecting the equipment best suited for any particular work. Wherever problems arise, for a better understanding of time and its effect on the economy of business or industry, the International Time Specialists are available to assist in solving them. Wherever special problems arise regarding low tension electrical equipment such as Time and Program Bell Systems, Fire Alarm Systems, Telephone Systems, Public Address and Announcing Systems, Laboratory Experimental Equipment, Signal Systems and Automatic Timing Devices, the International Low Tension Engineers are available and trained to give valuable assistance.

The International Business Machines Corporation maintains a corps of factory trained Mechanical and Electrical Servicemen, expert in their ability and knowledge, in every principal city of the world. These Servicemen are guided by a company policy which guarantees satisfaction to users of International equipment everywhere.

The purpose of this book is to supplement our Mechanical and Electrical Service Organization and give an added service to our customers.

Time Specialists, Low Tension Engineers, Mechanical and Electrical Servicemen are located at the cities listed on the following pages. They are available at any time without obligation, however, a nominal charge will be made for mechanical and electrical service after the guarantee expires.

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August 1, 193 4

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270 Broadway **New York, N**

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INTERNATIONAL Service is backed by a guarantee represented by a 40,000,000 organization.

The International Business Machines Corporation operates manufacturing and assembling plants at the following points:

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These tremendous resources and manufacturing facilities serve industry, business and educational institutions throughout the world.

INTERNATIONAL

MINUTE IMPULSE

SELF REGULATED SYSTEM

INTERNATIONAL BUSINESS MACHINES CORPORATION
INTERNATIONAL TIME RECORDING DIVISION
270 Broadway New York, N. Y.

INTERNATIONAL

MINUTE IMPULSE

SELF REGULATED SYSTEM

INTERNATIONAL BUSINESS MACHINES CORPORATION
INTERNATIONAL TIME RECORDING DIVISION
270 Broadway New York, N. Y.

No. 300

August 1, 1934

INTERNATIONAL SELF REGULATED SYSTEM

Electric self regulation of a variety of minute impulse secondary units by a Master Clock is the most modern and advanced improvement ever devised for commercial time keeping purposes. Each secondary unit regardless of whether it is a wall clock or a recording mechanism is individually regulated every hour so that the entire system is in agreement at all times.

If the system of secondary units is in step with the Master Clock, which generally is the case, no regulation is necessary, and the system operates the same as any straight minute impulse system, however, the regulation is in effect each hour whether required or not.

No mechanical or electrical piece of machinery is infallible and it is therefore subject to the possibility of trouble which may cause failure of operation. All International units are of correct design and substantially constructed and consequently are practically free from mechanical trouble. Electric power as supplied commercially is beyond our control and in order to take care of power failure and other troubles the regulation feature was incorporated into the system.

Self regulation is an electrical comparison of cams in the secondary units with cams in the Master Clock by means of switches operated by these cams. The Master Clock senses the time of the secondary units and thus keeps them in unison. The cams and switches in the Master Clock decide when power is available over the wires leading to the secondary units, and the cams and switches in the secondary units decide over which wires the secondary units will receive the impulses, each secondary unit acting independently.

The circuits of an electric self regulated clock system are analogous to the circuits where electric lights are arranged to be operated from two different points by the aid of three point switches.

Switches are located in the Master Clock and each secondary unit. These switches control the operation of the secondary units by transferring them from one wire to the other. In other words, any secondary unit may be started and stopped from two points, viz: its own individual switch, or the Master Clock switches, which control the entire system.

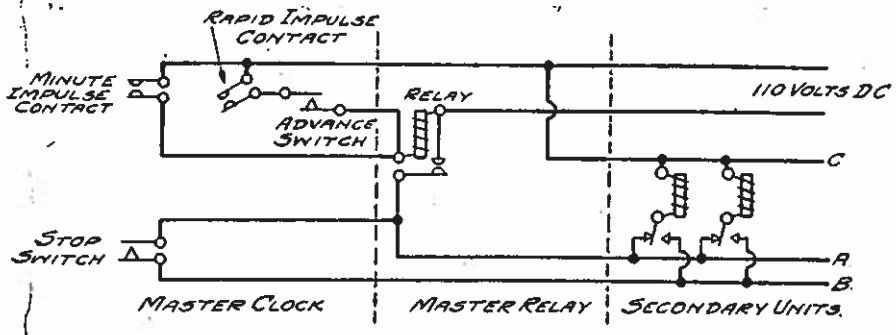


Fig I (D. C.)

The switches are arranged to regulate the secondary units at the 59th minute; that is, if any secondary unit reaches the 59th minute ahead of the Master Clock, the switch transfers it to the other wire where it cannot receive any more impulses until the Master Clock transfers to that wire. In this way, if the secondary unit is fast, it waits at the 59th minute until the Master Clock also reaches the 59th minute. Likewise, if a secondary unit is slow when the Master Clock reaches the 59th minute, rapid impulses are sent out from the Master Clock to advance all slow units. Each individual secondary unit takes only enough of the rapid, or extra impulses, to bring it to the 59th minute. At 50 seconds past the 59th minute the Master Clock shifts to the other wire and the 60th minute impulse starts all secondary clocks in unison.

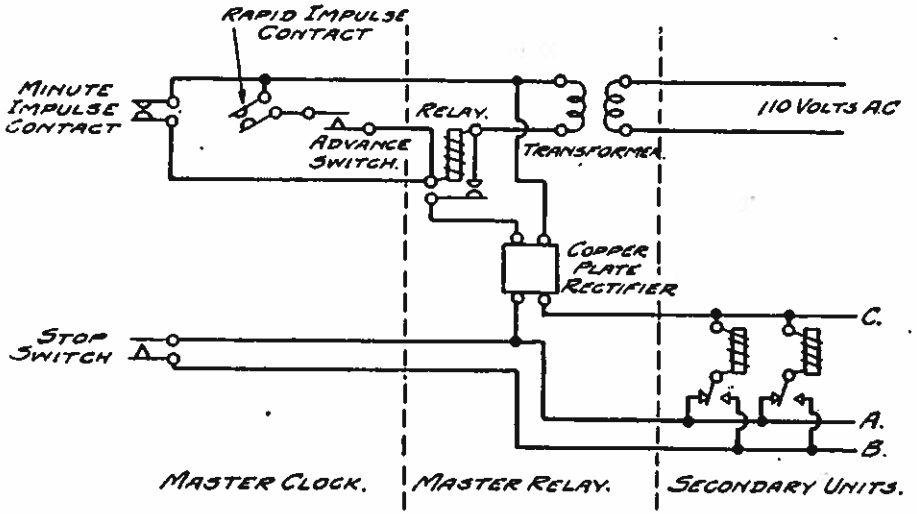


Fig. 2 (A. C.)

One of the salient features of the system is that, if the regulation feature should fail to operate, the system will still operate as a straight minute impulse system. Stating it briefly the self regulated system is a standard straight minute impulse system, with the addition of a feature that will regulate all secondary units once each hour, and yet is so arranged that it is an independent feature and in no way interferes with the normal operation.

It is well to remember that all of our secondary units advance when the minute impulse releases, therefore, the opening and closing of all switches is done without current on the line. When the secondary electromagnet receives an impulse, it places tension on the driving spring. When the impulse is released, the driving spring advances the unit. In this way there is no electrical power in the secondary unit when it advances. This positively eliminates arcing or sparking at the switches in the secondary units.

The regulation feature will take care of discrepancies of ten (10) minutes fast and twenty (20) minutes slow in any or all secondary units each hour; however, it will take care of more than this amount in two hours.

A self regulated system consists of a Master Clock, control relays, secondary units, electrical power and wiring.

The wiring of any clock system is very important. It should be free from grounds at all times. It is advisable to check for grounds at frequent intervals as they are always a source of annoyance and may become a real menace if permitted to remain on the system. Three wires are necessary from the relay equipment to all secondary units. These wires should not be smaller than No. 14 N. E. C. standard, and, if the runs are long, they should be larger.

The source of power may be either 110 or 220 volts, direct or alternating current or a lower voltage battery. When commercial D. C. is used the electro magnets of the various secondary units are wound to operate at the prevailing voltage. If the commercial power is A. C., a transformer is used to reduce the voltage and a dry plate rectifier acts as a trap to let the current flow in one direction only, so that the current which reaches the secondary units is a pulsating direct current of 24 volts. A separate transformer and rectifier are used with each circuit of secondary units. The number of secondary units that may be placed on one circuit is limited only by the safe carrying capacity of the relay, transformer and rectifier. The circuit load should not exceed 1½ amperes. The transformer for the clock system should not be used for any other purpose. The regulation feature takes care of interruptions to the clock system caused by power failure or any other cause. All of the secondary units are synchronized at the end of each hour. If an impulse accumulator is included as part of the system the secondary units are advanced to correct time immediately after the power is restored at the rate of one minute every two seconds.

Relays are necessary because the contacts in the Master Clock must be of light construction, otherwise, they would affect the time keeping qualities of the Master Clock. The Master Clock contacts are used to close the circuit to the coils of the relay and the points of the relay in turn close the circuit to the secondary units. Where the commercial power is alternating current the Master relay always operates from this, a low voltage tap being taken from the transformer to supply the power. The points of the Master relay then close the circuit from the secondary of the transformer to the A. C. side of rectifier. This principle saves the rectifier, as it is in operation only when the system is receiving an impulse, which is approximately one-thirtieth (1/30) of the time. The secondary units are connected directly to the D. C. side of the rectifier. Therefore whenever the relay closes the circuit to the A. C. side of the rectifier, power is available at the secondary units.

The Master Clock may be either 60 or 120 beat and is equipped with two contacts and two switches, as follows: The minute impulse contact which closes for two (2) seconds each minute, closing at the 58th second and opens at the 60th second. This contact is operated by a cam placed on an auxiliary shaft near the escape wheel. The purpose of this contact is to send out the regular, minute impulses to the relay and thus to the secondary apparatus.

The stop switch, which operates once an hour, closes at 59′ 50″ past the hour and remains made for 50 minutes, opening at 49′ 10″ past the next hour. This switch is used for connecting the "B" wire in the system to the "A" wire

ıd thus makes impulses available over the "B" wire for 50 minutes each hour. his switch is operated by a cam placed on the center or minute hand shaft. It properly timed at the factory and should not require changing.

The advance switch is used for sending out the rapid impulses between ıe 59th and 60th minutes. It is timed to be made at 59′ 10″ past the hour ıd to break at 59′ 50″ past the hour. It is operated from a cam on the minute ınd or center shaft, and works in conjunction with the rapid impulse contact ı send out the rapid impulses.

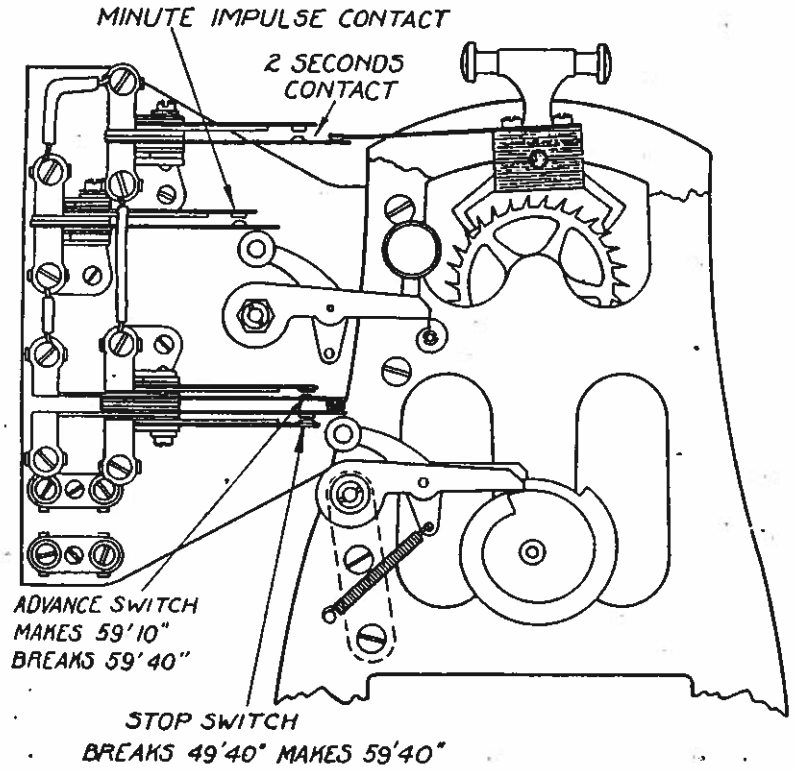


FIG. 3

The rapid impulse contact makes every two (2) seconds and is closed for proximately ½ a second. It is connected in the circuit in series with the vance switch, therefore, only comes into operation when the advance switch is ɔsed, or 40 seconds each hour. The contact and switch are connected in series d both are in parallel with the minute impulse contact and thus operate the ay 20 extra times between the 59th and 60th minutes.

The secondary unit may be a time piece, program device or recording ɛrument. In any case, it is a regular minute impulse movement with the ıdition of a three point switch. The switch is arranged to make on one wire when the secondary unit advances to the 59th minute and on the other wire when it advances to the 4th minute. From this it will be seen that the secondary unit receives its power over the common and A wire for 55 impulses of each hour, and over the common and B wire for 5 impulses each hour.

From studying the schematic wiring diagram in connection with the timing of the switches and contacts, the operation of the entire system may be visualized. The following is a brief resume of the operation. All units start the hour in unison, and the minute impulse contact sends out impulses each minute. At this time these impulses are available over the common and both return wires. The secondary runs over what we will call the "B" wire until it reaches the 4th minute, at which time it transfers to the other wire, which we will term the "A" wire. The common wire will be called the "C" wire. The secondary unit runs in this manner and nothing takes place until 49′ 10″ past the hour, when the stop switch in the Master Clock opens. This opens the "B" wire and prevents the secondary units from running on that wire. Thus, if they are fast, they will transfer to the "B" wire ahead of time and wait for the Master Clock. The Master Clock continues to send out minute impulses until it reaches the 59th minute, but they are available over the "A" wire only. If the secondary units are on time or ahead of time, they will also be at the 59th minute, however, if they are slow, they will not have reached the 59th minute. At 59′ 10″ past the hour the advance switch closes, which cuts in the rapid impulses. This switch and contact, being in parallel with the minute impulse contact, operate the secondary units at two-second intervals. These rapid impulses always go over the "A" wire and advance any secondary units that are still on the "A" wire, or slow, until they reach the 59th minute and transfer to the "B" wire. Each secondary unit only uses enough rapid impulses to carry it to the 59th minute. At 59′ 50″ past the hour the advance switch opens, cutting out the rapid impulses. At the same time the stop switch closes which completes the circuit over the "B" wire, thus all secondary units receive their 60th impulse over the "B" wire and the entire system starts the hour in unison, and the cycle is repeated.

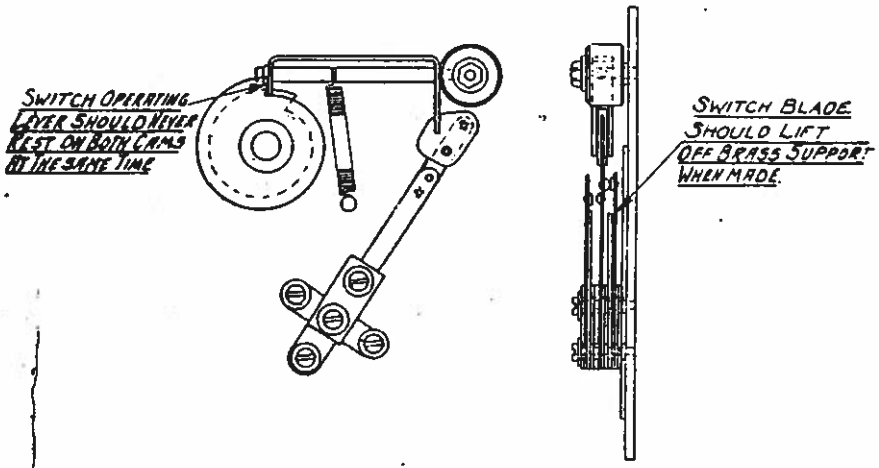


FIG. 4

INTERNATIONAL MASTER CLOCK

LIST NO. 13 or 17

INTERNATIONAL BUSINESS MACHINES CORPORATION

INTERNATIONAL TIME RECORDING DIVISION

270 Broadway New York, N. Y.

INTERNATIONAL MASTER CLOCK

LIST NO. 13 or 17

No. 105

May 1, 1934

INTERNATIONAL BUSINESS MACHINES CORPORATION

INTERNATIONAL TIME RECORDING DIVISION

270 Broadway New York, N. Y.

INTERNATIONAL MASTER CLOCK

LIST No. 13 or 17

The Master Clock, as its name implies, is the controlling element of the electric time system. It is the time pièce for the system and by means of its contacts, impulses are sent out and the secondary units are kept in agreement with it.

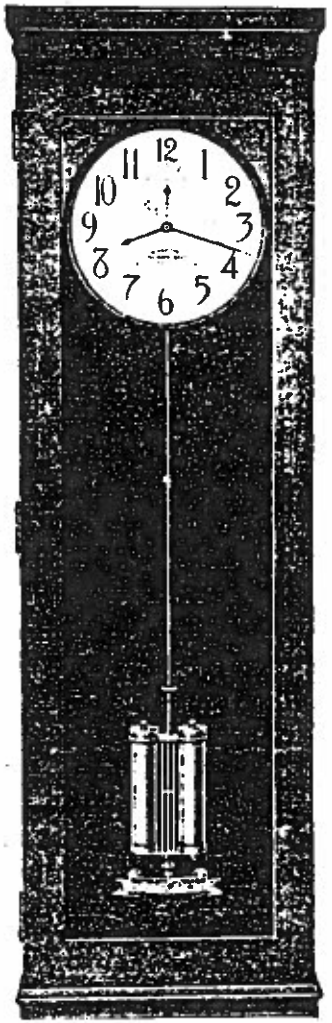


FIG. 1

The International spring driven, minute wind, Master Clock is a very high grade clock and will meet the most exacting commercial requirements.

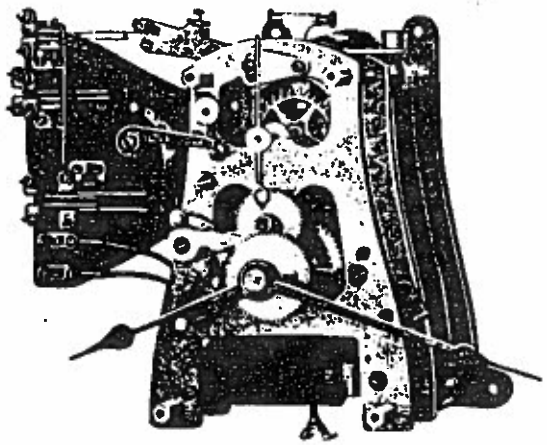


FIG. 2

INSTALLATION

In order to secure the maximum results from this Master Clock it should be carefully installed and properly maintained.

The Master Clock should always be installed on a substantial post or wall that is free from dust, moisture and vibration. Its location as a time piece is of secondary importance. Special treatment is used in manufacturing to prevent oxidation of the gears and other working parts, but a clean, dry place for the clock is almost essential to prevent oxidation, regardless of the treatment during manufacture.

The usual practice is to place the top of the Master Clock approximately eight (8) feet from the floor. This locates the hands within easy reach for setting and the pendulum in a convenient position for regulation. However, local conditions may necessitate placing the Master Clock at a different height. (See Fig. 3).

The Master Clock should be securely attached to the wall so that it will not move out of plumb even with a severe jolt. If the Master Clock is moved only slightly, it will throw it out of beat and thus effect its time-keeping, and may even stop it. The Master Clock is designed to be attached at four (4) points, viz: (1) The hanger, which may be a large screw in the wall, or the special International wall box for Master Clocks. This screw or bolt in the wall box is the main support for the weight of the Master Clock. (2) One screw is provided for the bottom center of the case. This prevents side sway of the bottom of the case and keeps the clock in beat. (3 and 4) Two (2) screws are provided for the top of the case at the sides of the dial. These screws prevent rolling on an uneven wall and hold the case rigidly against the wall.

When control and program equipment is mounted in the Master Clock case, some unit may be mounted directly over the screw hole and will have to be removed before the Master Clock can be properly attached to the wall.

The wall upon which the Master Clock is to be mounted should be p pendicular and true. If not, care should be taken not to tighten the scre until the case is twisted, but block out the case where necessary.

It is advisable to use the pendulum as a plumb before installing any exce the top or hanger screw. The end of the pendulum screw should hang direc over the "0" position of the scale, and neither in front of, nor behind the sc (See following instructions for installing pendulum).

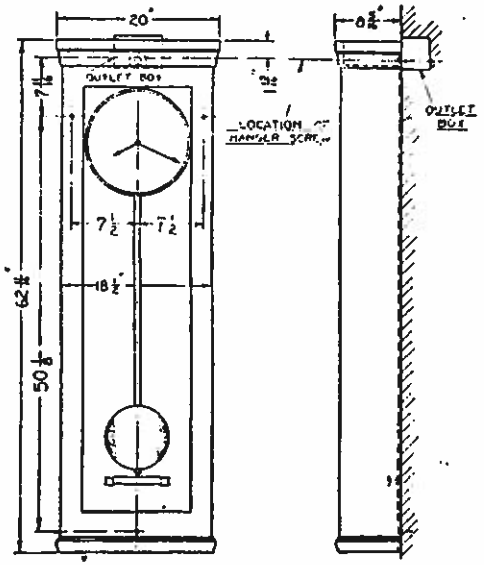


FIG. 3

INSTALLING PENDULUM

If the pendulum is of the lenticular brass bob type it is shipped with t bob removed from the pendulum stick. Insert the rod in the bob, with the ho on the top of the rod pointing to the lead side of the bob, and screw up on t nut that supports the bob until the top of the bob coincides with the pencil ma on the pendulum stick. A slot is cut in the back of the pendulum bob into whi the top portion of the regulating nut fits. This construction prevents the po sibility of friction holding the pendulum bob so that it will not follow the n when regulating the clock to run slower.

The mercurial compensating pendulum is shipped completely assembl with the mercury sealed in the jars. All that is necessary is to install it in t clock. If the mercurial compensating pendulum does not hang square with t case it may be adjusted by loosening the screw in the friction guide assemb (under top cross bar) and turning the jars slightly, holding the pendulum ro until they are square with the case.

Extreme care should be taken not to kink or crack the suspension spring while installing the pendulum. The suspension spring is located almost directly back of the seconds hand shaft. The hook on the top of the pendulum rod may be easily placed over the suspension spring pin by inserting the top of the rod up between the back plate of the clock movement and the back casting. After the pendulum is properly supported, adjust the verge wire to the pendulum. On the lenticular brass bob pendulum, the verge wire fits on a slot on the pendulum stick. On the mercurial pendulum, the verge wire straddles the pendulum rod.

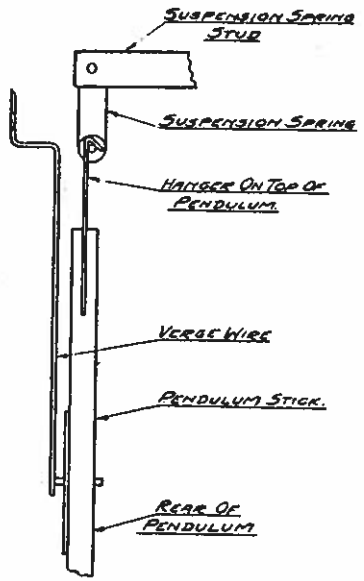


FIG. 4

CHECKING BEAT OF CLOCK

If the clock does not tick even, or if the seconds hand hesitates longer in one second than another, the clock is out of beat. The best method of accurately checking a pendulum clock to see if it is in beat is to watch the movement of the seconds hand when the pendulum is moved slowly by hand. The seconds hand should advance on any second when the pendulum is an equal distance each side of zero on the pendulum scale. In other words, the seconds hand should not be released when the pendulum is at II on one side of zero and 1½ on the other side. It is understood that the pendulum is exactly at zero when at rest. If the clock is out of beat, it may be adjusted by turning the small, knurled, thumb screws located on the verge which is above and just in front of the upper end of the pendulum. (See Fig. 5). If putting clock in beat is not thoroughly understood, it is advisable to call an International serviceman.

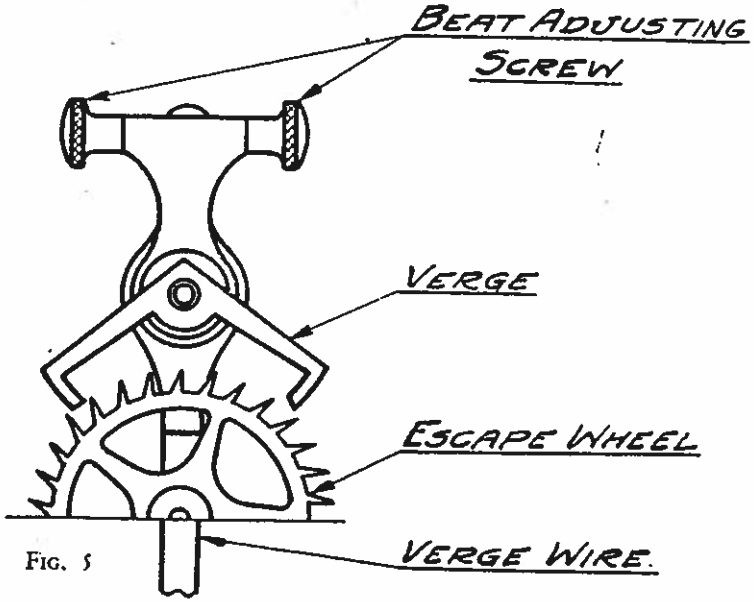


FIG. 5

CONNECTING MASTER CLOCK

The Master Clock must be connected to the system according to the wiring diagram which accompanies the system; that is, all terminals should be connected to the correspondingly marked terminals of the master relay cabinet, etc. (See Fig. 9).

WINDING

The Master Clock is spring driven and winds with an electromagnet at each impulse. A unique reverse winding mechanism insures constant tension and prevents overwinding. The principle of winding will be very easily understood by studying Figure 6, and the following description of the individual parts.

A.—Electromagnet.
B.—Electromagnet armature attracted each impulse.
C.—Lever attached to armature, advances feed pawl (D).
D.—Feed pawl, moves ratchet (E) one tooth each impulse.
E.—Winding ratchet.
F.—Detent pawl, hold ratchet (E) from turning backwards.
G.—Main driving gear.
H.—Winding spring, the tension of which balances through the winding ratchet (E) with the tension of the main driving spring attached to winding ratchet (E) and main driving gear (G).
I.—Adjustment for tension of winding spring (H).

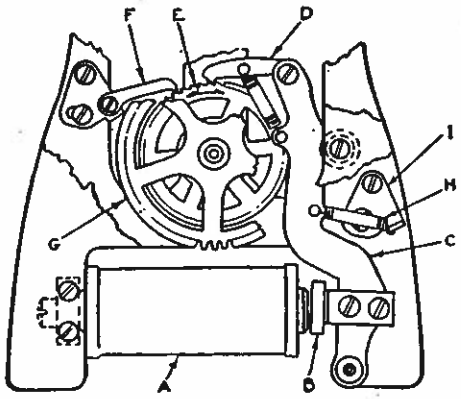


FIG. 6

REGULATING

The regulation of any pendulum clock is obtained by lengthening or shortening the pendulum. The longer the pendulum the slower the clock will run and vice versa. On lenticular brass bob pendulum clocks, one complete turn of the nut which supports the pendulum bob will cause a variation of approximately one minute per day. The screw on the pendulum rod is a standard right hand thread. Turning the nut to the right shortens the pendulum and vice versa.

Clocks equipped with mercurial compensating pendulums have two regulating mediums, each of which is graduated for two standard time regulations. The nut upon which the pendulum jars rest is for coarse regulation and one complete turn varies the rate of the clock approximately one second per hour and one division varies the rate of the clock approximately one second per day. The free running nut (located at lower end of rod) is used for fine regulation only. One complete turn causes a variation in the rate of approximately one second per week and one quarter turn a variation of approximately one second per month.

SETTING MASTER CLOCK

Never turn the clock hands backwards nor move the hour or seconds hand. If the Master Clock is fast, stop the pendulum and then start again when it is at the exact time.

If the Master Clock is slow, stop the pendulum just after any minute as indicated by the seconds hand. Move the minute hand until it is over the minute marker and so the Master Clock is just ahead of correct time, then start pendulum swinging again at the correct instant. Note that when the seconds hand points to 60 the minute hand points directly to a minute marker. (See Fig. 7). This is important as some cams are timed with the seconds hand and others with the minute hand. The hourly supervising feature takes care of setting the secondary units to correct time.

REMOVING DIAL

If it is ever necessary to remove the dial, it can easily be done by removing the hands and four screws. All of the hands are friction fit and may be easily removed by pulling and turning slightly in a clockwise direction after taking off the hand nut. It is advisable to replace the hands in the same position as that from which they were removed.

The seconds hand should be placed on its shaft so that the minute impulse contact will make at the 58th second and break at the 60th second. *Use extreme care to see that the hands do not interfere with each other or the dial holding screws.*

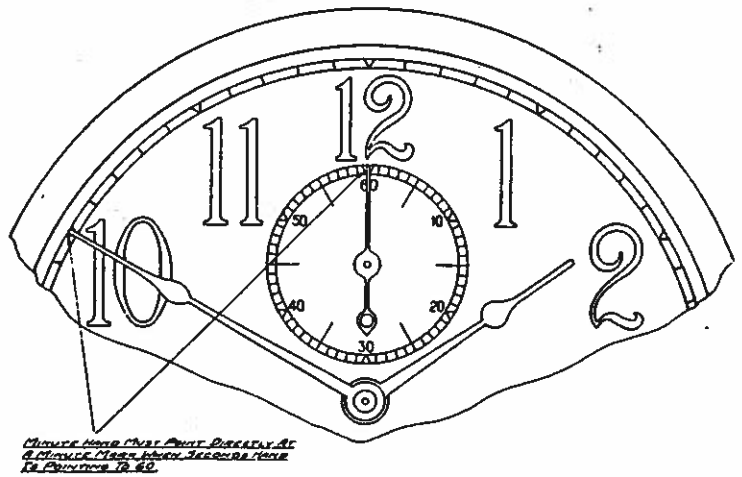


FIG. 7

CONTACTS AND SWITCHES

As stated in the instructions covering the hourly supervised system, the Master Clock is equipped with the necessary contacts and switches for sending out the minute impulses and for supervising the secondary units. (See Fig. 8). It may also be equipped with a duration contact for controlling the duration of signals such as bells, horns, etc.

The minute impulse contact is operated from a cam placed on an auxiliary shaft used solely for contact purposes and located to the left of the escape wheel. This contact makes for a period of two seconds each minute. It is timed to make on the 58th second and break on the 60th second of each minute. The contact has a positive make and break, and when properly adjusted the upper contact strap should be lifted 1/64" above its normal position when the contact is made. This contact is properly adjusted at the factory and will not need changing.

The rapid impulse contact makes every two seconds and is controlled by the swinging of the pendulum, that is, the contact operating lever is attached to the verge shaft and rocks when the pendulum swings. This contact has a positive make and is open when the pendulum is at rest. This contact alone does not have any effect upon the system, but working in conjunction with the advance switch, sends out the rapid impulses.

The advance switch is connected in series with the two seconds contact nd thus controls the operation of the latter. The advance switch is operated from cam placed on the center or minute hand shaft. This cam makes one revolution ich hour and is cut so as to operate the advance switch once an hour, viz: closes ime at 59′ 10″ past the hour and opens it at 59′ 50″ past the hour. The switch nly remains made for 40 seconds each hour, therefore, allows only 20 of the two conds or rapid impulses to be sent out to the system. The upper strap should raised 1/64″ above its normal position when made, and it also should have a ick break. This switch is properly timed and adjusted at the factory and ould not be changed.

The stop switch is used to open the circuit to prevent the impulses from ing out over the "B" wire to the secondary units between 49′ 10″ and 59′ 50″ st each hour. It is much heavier than the other switches, as it carries the current but does not break the circuit to the master circuit which controls the stribution relays or a single circuit of secondary units. This switch also operates om a cam placed on the center or minute hand shaft, and is timed to break at ′ 10″ past each hour and make at 59′ 50″ past each hour. It is very important at the adjustments are such that a good contact is made; that is, there should tension on the upper strap when made and also a good air gap when open.

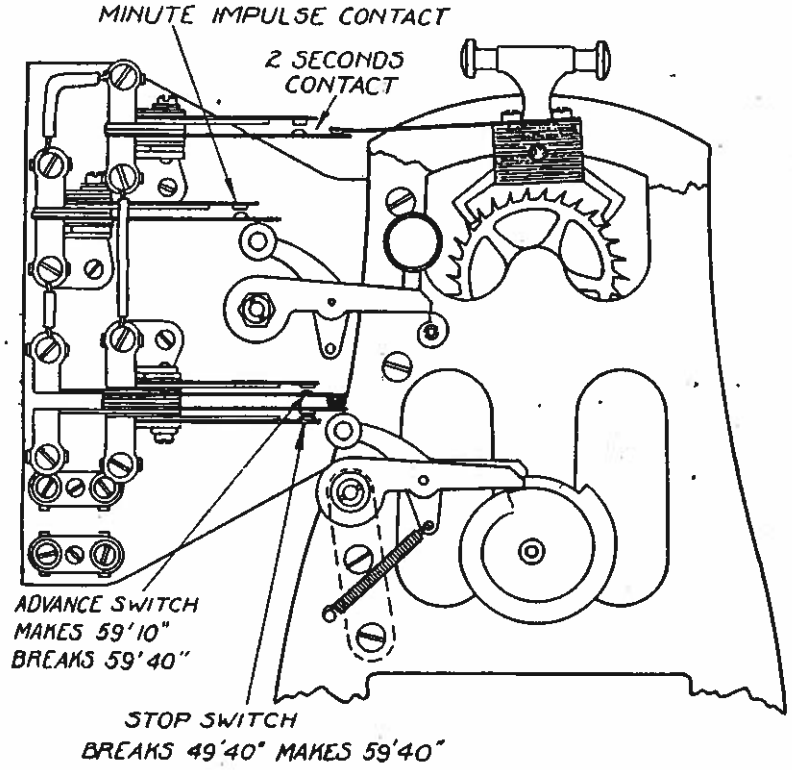
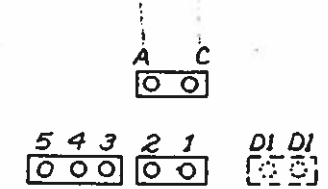
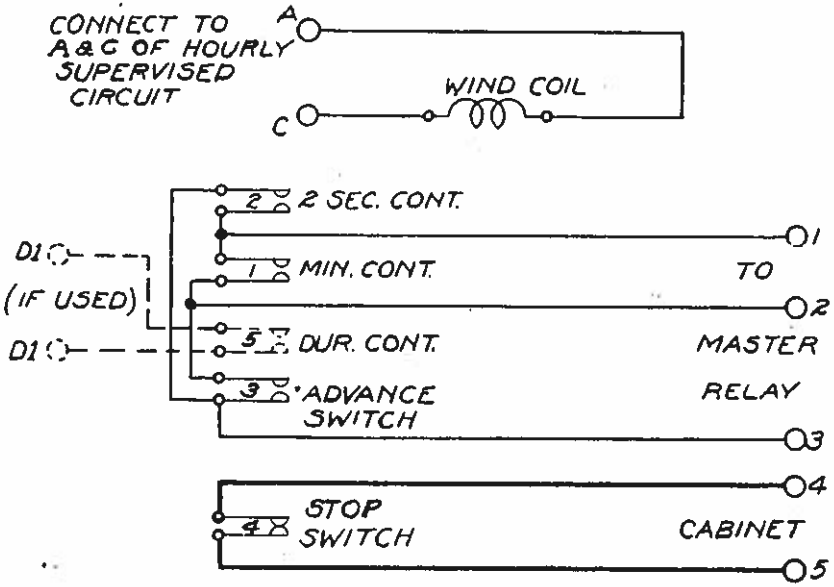


FIG. 8



TERMINALS ON TOP OF CLOCK CASE



WIRING DIAGRAM

CONTACT #1 CLOSES EVERY MINUTE (IMPULSE)
CONTACT #2 CLOSES EVERY 2 SECONDS
SWITCH #3 CLOSES 59'10" OPENS 59'45" (35 SEC'S.)
SWITCH #4 CLOSES 59'45" OPENS 49'45" (50 MIN'S.)
CONTACT #5 CLOSES EVERY MINUTE (DURATION)

#13 & #17 MASTER CLOCKS

FIG. 9

The timing of the switches is not critical as 18 or 22 of the rapid impulses will serve equally as well as 20. However, the advance switch must be open before the stop switch closes.

If the Master Clock is equipped with a duration contact, it is operated from cams placed on the auxiliary cam shaft and normally makes a second or two after the minute impulse contact breaks. The cams for a duration contact are placed between the clock plates, whereas the cam for the minute impulse contact is placed on the outside of the front plate. Two cams are used for each duration contact to permit changing the length of duration of the signals. Turning the cams on the shaft so that the faces or points are farther apart increases the duration, and vice versa. The adjustments of the duration contact are exactly the same as for the minute impulse contact.

Sometimes a seconds beat contact is used for special purposes. When this is the case, the contact is a double rapid impulse contact, that is, one contact spring operates between two contact points. When the pendulum is at rest, both contacts should be open.

OILING

The oiling of the Master Clock is very important. It does not need frequent oiling, but, when it does need oiling, it should be done properly. The pallets and all bearings should be oiled, the gear teeth never. Too much oil is more harmful than not enough. Only a good grade of clock oil should be used, such as can be obtained from any clock and watch makers' jobbers. Enough oil for each bearing can be applied by means of a wire the size of a common pin, dipped into a reservoir to the depth of about a quarter of an inch.

INTERNATIONAL MASTER CLOCK

LIST No. 11 and 12

INTERNATIONAL TIME RECORDING DIVISION

Division of

INTERNATIONAL BUSINESS MACHINE CORPORATION

270 Broadway **New York, N. Y**

INTERNATIONAL MASTER CLOCK

LIST No. 11 and 12

The Master Clock, as its name implies, is the controlling element of the electric time system. It is the time piece for the system and by means of its contacts, impulses are sent out and the secondary units are kept in agreement with it.

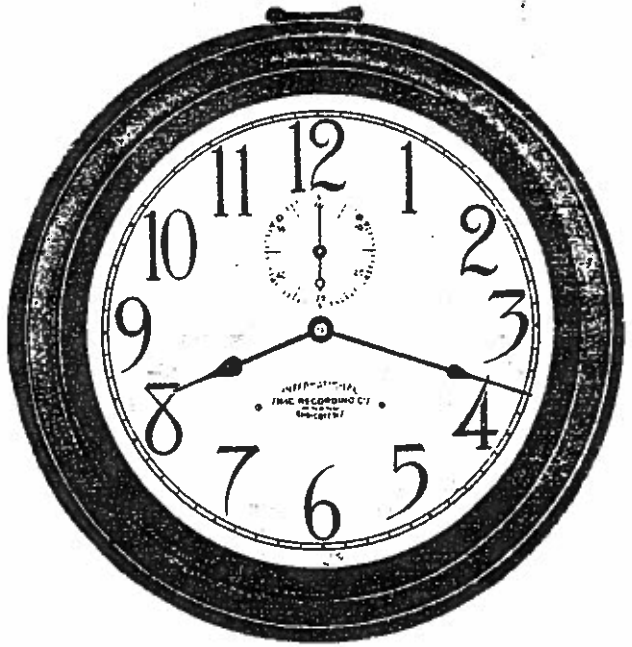


FIG. 1

The International spring driven, minute wind, Master Clock is a very high grade clock and will meet most commercial requirements.

INSTALLATION

In order to secure the maximum results from this Master Clock it should be carefully installed and properly maintained.

The Master Clock should always be installed on a substantial post or wall that is free from dust, moisture and vibration. Special treatment is used in manufacturing to prevent oxidation of the gears and other working parts, but a clean, dry place for the clock is almost essential to prevent oxidation, regardless of the treatment during manufacture.

The usual practice is to place the center of the clock approximately eight (8) feet from the floor. This locates the dial in an easy readable position, and

he hands and pendulum within easy reach for setting and regulating. However, cal condition may necessitate placing the Master Clock at a different height. See Fig. 2).

The Master Clock should be securely attached to the wall so that it will not move out of plumb even with a severe jolt. If the Master Clock is moved only slightly, it will throw it out of beat and thus effect its time keeping and may even stop it.

The wall upon which the Master Clock is to be mounted should be perpendicular and true. If not, care should be taken not to tighten the screws until the case is twisted, but block out the case where necessary.

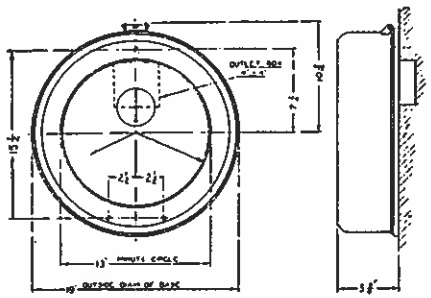


FIG. 2

The Master Clock movement and all of the system control equipment are mounted on a heavy cast metal back plate which holds all mechanism in perfect alignment. The back plate is provided with three holes for mounting screws. The top screw, which is larger than the other two is the main support and the two lower screws hold the plate rigidly to the wall and prevent side sway, thus keeping the clock in beat. The three point suspension is ideal for a clock of this size and shape.

It is advisable to use the pendulum as a plumb before either of the two lower screws are installed. The end of the pendulum screw should hang directly over the center of the case catch and approximately one (1) inch from the back casting. It is important that the pendulum swings entirely free otherwise the clock will not regulate satisfactorily and may not even run.

INSTALLING PENDULUM

The pendulum is of the lenticular cast metal type and is shipped completely assembled. All that is necessary is to hang the pendulum over the suspension spring pin and insert the verge wire into the slot in the pendulum stick. Care should be taken not to kink or crack the suspension spring. The suspension spring is located almost directly back of the seconds hand shaft. The hook on the top of the pendulum stick may be easily placed over the suspension spring pin by inserting the top of the rod up between the back plate of the clock movement and the back casting. After the pendulum is properly supported, insert the verge wire in its slot. (See Fig. 3).

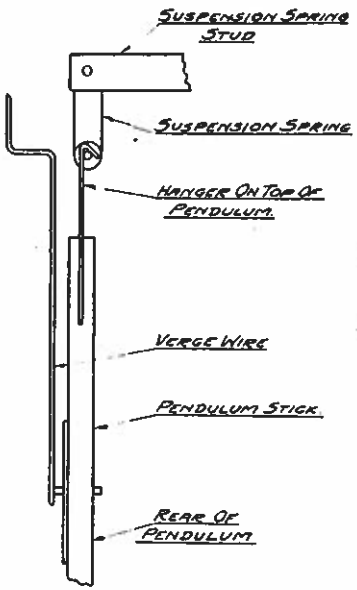


FIG. 3

CHECKING BEAT OF CLOCK

If the clock does not tick even or if the seconds hand hesitates longer on one second than another, the clock is out of beat. The best method of accurately checking a pendulum clock to see if it is in beat is to watch the movement of the seconds hand when the pendulum is moved slowly by hand. The seconds hand should advance on any second when the pendulum is an equal distance each side of its dead center position. In other words the seconds hand should not be released when the pendulum is one (1) inch one side of its dead center position and one half ($\frac{1}{2}$) inch on the other side of dead center. If the clock is out of beat, it may be adjusted by turning the small, knurled thumb screws, located on the verge which is above and just in front of the upper end of the pendulum. (See Fig. 4 It is always advisable to check the beat of the clock by moving the pendulum slowly to the right until the escape wheel is released and then release the pendulum to see if its momentum will carry it far enough to the left to allow the escape wheel to be released on the reverse side. Then try moving the pendulum to the left and check alternately until this condition is obtained.

All Master Clocks are adjusted in beat at the factory but if it is not installed in exactly the same position as in the factory test it will be out of beat and adjustment is necessary. If putting the clock in beat is not thoroughly understood it is advisable to call an International serviceman.

ESCAPEMENT

The escapement of the List 11 and 12 Master Clocks has a large 30 tooth ·ffset escape wheel and standard 60 beat verge which avoids close adjustments, ıd permits rugged construction. Fig. 4 shows the construction and principle of ›peration for this type of escapement.

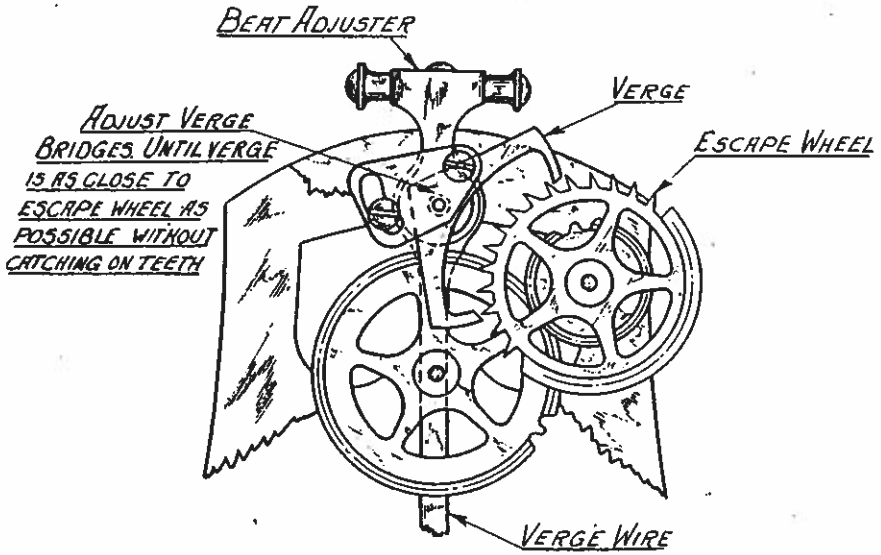


FIG. 4

WINDING

The Master Clock is spring driven and winds with an electromagnet at each impulse. A unique reverse winding mechanism insures constant tension and prevents overwinding. The principle of winding will be very easily understood by studying figure 5, and the following description of the individual parts.

A.—Electromagnet.

B.—Electromagnet armature attracted each impulse.

C.—Lever attached to armature, advances feed pawl (D).

D.—Feed pawl, moves ratchet (E) one tooth each impulse.

E.—Winding ratchet.

F.—Detent pawl, holds ratchet (E) from turning backwards.

G.—Main driving gear.

H.—Winding spring, the tension of which balances through the winding ratchet (E) with the tension of the main driving spring attached to winding ratchet (E) and main driving gear (G).

I.— Adjustment for tension of winding spring (H).

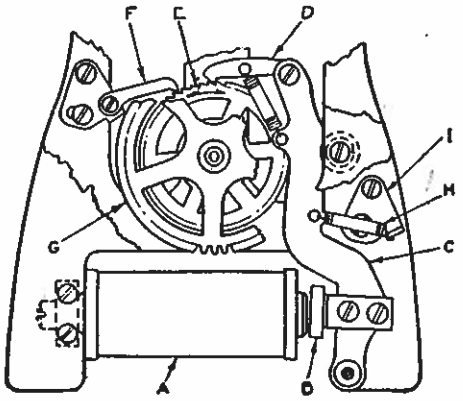


FIG. 5

CONNECTING MASTER CLOCK

The Master Clock contains all the control equipment for the system and all wiring is incorporated therein. All the connections that are necessary are the commercial power line, A. C. for List 11 Master Clock and D. C. for List 12 Master Clock and two or three wires to the secondary equipment, three (3) wire being required for a supervised system and two (2) wires for a straight impulse system such as a door recorder. (See Figs. 8 and 9).

REGULATING

The regulation of the Master Clock is obtained by lengthening or shortening the pendulum. The longer the pendulum the slower the clock will run and vice versa. One complete turn of the nut which supports the pendulum bob will cause a variation of approximately 3 minutes per day. The screw on the pendulum rod has a right hand thread. Turning the nut to the right shortens the pendulum and vice versa.

SETTING MASTER CLOCK

Never turn the clock hands backwards nor move the hour or seconds hand. If the Master Clock is fast, stop the pendulum and then start again when it is at the exact time.

If the Master Clock is slow, stop the pendulum just after any minute as indicated by the seconds hand. Move the minute hand until it is over the minute marker and so the Master Clock is just ahead of correct time, then start pendulum swinging again at the correct instant. Note that when the seconds hand points to 60 the minute hand points directly to a minute marker. (See Fig. 6). This is important as some cams are timed with the seconds hand and others with the minute hand. The hourly supervising feature takes care of setting the secondary units to correct time.

Where the Master Clock operates door recorders no provision is made for ıtomatically setting the door recorder with the Master Clock and it will neces- ırily have to be done manually. However a special feature is provided which ivances the door recorder to correct time after power failures.

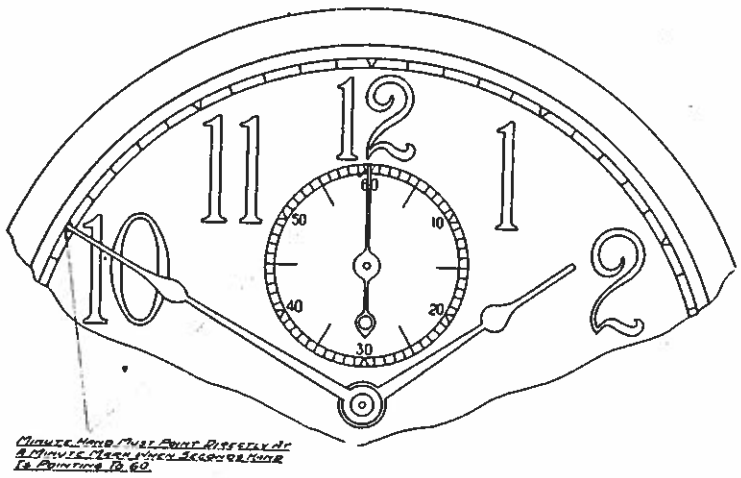


Fig. 6

REMOVING DIAL

If it is ever necessary to remove the dial, it can easily be done by removing ıe hands and four screws. All of the hands are friction fit and may be easily ımoved by pulling and turning slightly in a clockwise direction after taking off ıe hand nut. It is advisable to replace the hands in the same position as that ɔm which they were removed.

The seconds hand should be placed on its shaft so that the minute impulse ɔntact will make at the 58th second and break at the 60th second. *Use extreme ıre to see that the hands do not interfere with each other or the dial holding ɔrews.*

CONTACTS AND SWITCHES

As stated in the instructions covering the hourly supervised system, the laster Clock is equipped with the necessary contacts and switches for sending out ıe minute impulses and for supervising the secondary units. (See Fig. 7). It ıay also be equipped with a duration contact for controlling the duration of ɔnals such as bells, horns, etc.

The minute impulse contact is operated from a cam placed on an auxiliary ıft used solely for contact purposes and located to the left of the escape wheel. ɔis contact makes for a period of two seconds each minute. It is timed to make ı the 58th second and break on the 60th second of each minute. The contact has a positive make and break, and when properly adjusted the upper contac strap should be lifted 1/64" above its normal position when the contact is made This contact is properly adjusted at the factory and will not need changing.

The rapid impulse contact makes every second and is controlled by the swinging of the pendulum, that is, the contact operating lever is attached to the verge shaft and rocks when the pendulum swings. This contact has a positive make, and is open when the pendulum is at rest. This contact alone does not have any effect upon the system, but working in conjunction with the advance switch, sends out the rapid impulses.

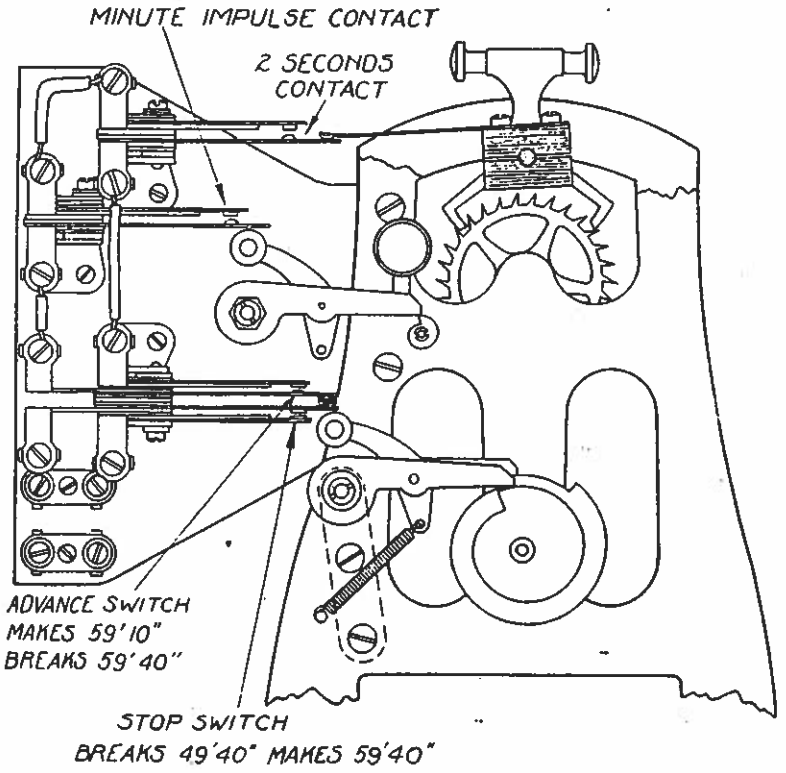
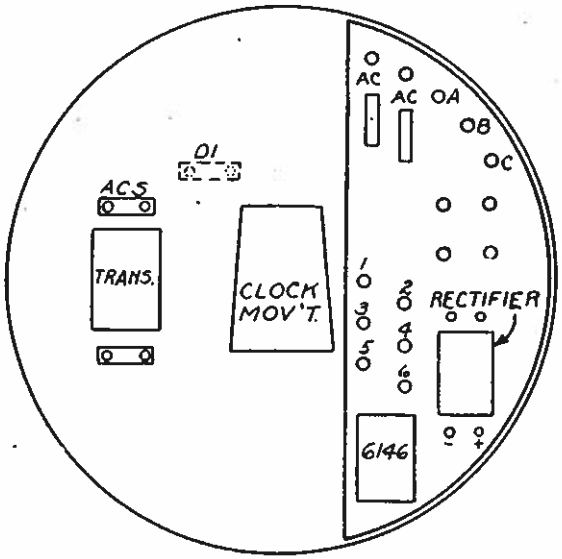
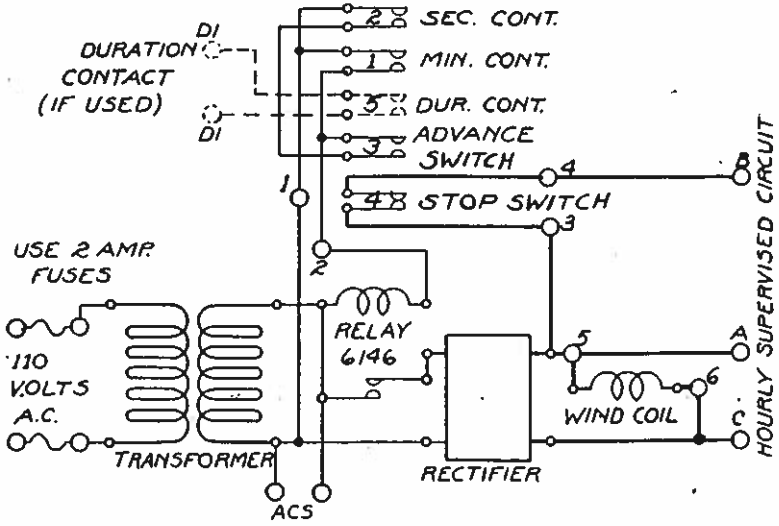


Fig. 7

The advance switch is connected in series with the two seconds contact and thus controls the operation of the latter. The advance switch is operated from a cam placed on the center or minute hand shaft. This cam makes one revolution each hour and is cut so as to operate the advance switch once an hour viz: closes same at 59' 10" past the hour and opens it at 59' 50" past the hour. The switch only remains made for 40 seconds each hour, therefore, allows several of the two seconds or rapid impulses to be sent out to the system. The upper strap should be raised 1/64" above its normal position when made, and it also should have a quick break. This switch is properly timed and adjusted at the factory and should not be changed.



ARRANGEMENT OF UNITS

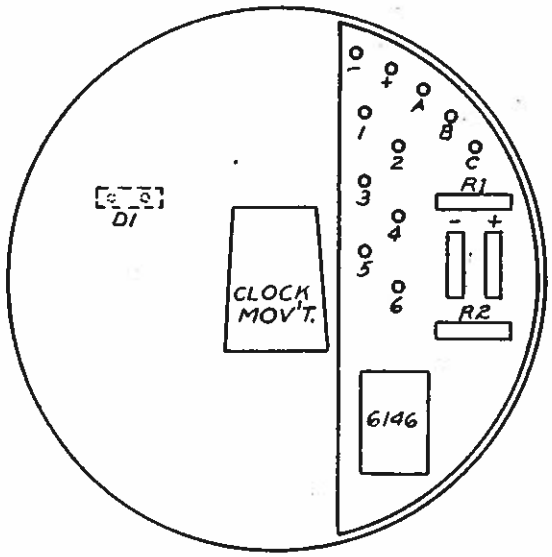


WIRING DIAGRAM

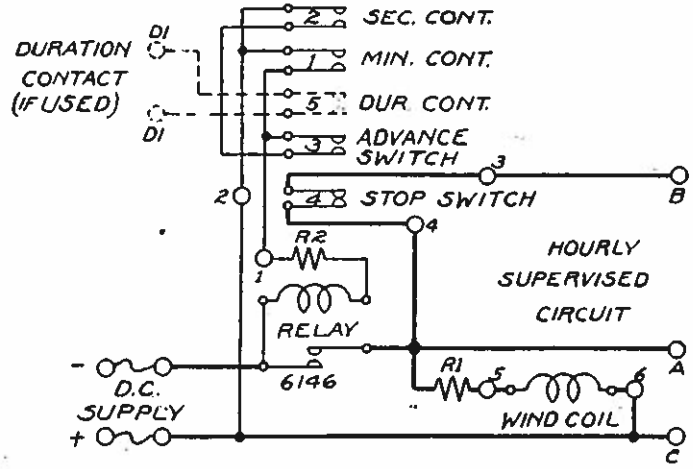
CONTACT #1 MAKES EVERY MINUTE (IMPULSE)
CONTACT #2 MAKES EVERY SECOND
SWITCH #3 MAKES 59'10" BREAKS 59'45" (35 SEC'S)
SWITCH #4 MAKES 59'45" BREAKS 49'45" (50 MIN.)
CONTACT #5 MAKES EVERY MINUTE (DURATION)

#11 MASTER CLOCK

FIG. 8



ARRANGEMENT OF UNITS



WIRING DIAGRAM

CONTACT #1 MAKES EVERY MINUTE (IMPULSE)
CONTACT #2 MAKES EVERY SECOND
SWITCH #3 MAKES 59'10" BREAKS 59'45" (35 SEC'S)
SWITCH #4 MAKES 59'45" BREAKS 49'45" (50 MIN.)
CONTACT #5 MAKES EVERY MINUTE (DURATION)
R1 REQUIRED FOR 125 VOLTS OR OVER
R2 REQUIRED FOR VOLTAGES ABOVE 24

#12 MASTER CLOCK

FIG. 9

The stop switch is used to open the circuit to prevent the impulses from ›ing out over the "B" wire to the secondary units between 49′ 10″ and 59′ 50″ ıst each hour. It is much heavier than the other switches, as it carries the current, ıt does not break the circuit to the master circuit which controls the distribution lays or a single circuit of secondary units. This switch also operates from a cam aced on the center or minute hand shaft, and is timed to break at 49′ 10″ past ch hour and make at 59′ 50″ past each hour. It is very important that the ljustments are such that a good contact is made; that is, there should be tension ı the upper strap when made and also a good air gap when open.

If the Master Clock is equipped with a duration contact, it is operated from ms placed on the auxiliary cam shaft and normally makes a second or two after e minute impulse contact breaks. The cams for a duration contact are placed tween the clock plates, whereas the cam for the minute impulse contact is aced on the outside of the front plate. Two cams are used for each duration ntact to permit changing the length of duration of the signals. Turning the ms on the shaft so that the faces or points are farther apart increases the dura-›n, and vice versa. The adjustments of the duration contact are exactly the ne as for the minute impulse contact.

Sometimes a seconds beat contact is used for special purposes. When this the case, the contact is a double rapid impulse contact, that is, one contact ring operates between two contact points. When the pendulum is at rest, both ntacts should be open.

OILING

The oiling of the Master Clock is very important. It does not need frequent ing, but, when it does need oiling, it should be done properly. The pallets and bearings shoud be oiled, the gear teeth never. Too much oil is more harmful n not enough. Only a good grade of clock oil should be used, such as can be tained from any clock and watch makers, jobbers. Enough oil for each bearing ı be applied by means of a wire the size of a common pin, dipped into a reservoir the depth of about a quarter of an inch.

MASTER RELAY EQUIPMENT

ALTERNATING CURRENT

No. 300

Jan. 1, 1932

INTERNATIONAL TIME RECORDING [redacted] DIVISION

Division of

INTERNATIONAL BUSINESS MACHINE CORPORATION

270 Broadway New York, N. Y.

MASTER RELAY EQUIPMENT

ALTERNATING CURRENT

The master relay equipment is the same regardless of whether it is mount in a single cabinet by itself, in a cabinet with distribution equipment, or in the Master Clock case. It consists of a transformer to step down the commercial A. C. to the desired voltage, a dry plate rectifier to change the A. C. to an unidirectional or pulsating D. C., a relay for completing the circuit to the secondary of the transformer, a "run" and "advance" switch, and the necessary fuses and terminals.

The transformer and rectifier, in conjunction with International hourly Supervised system, enables the power to be taken directly from the electric power lines, thus eliminating batteries of any kind.

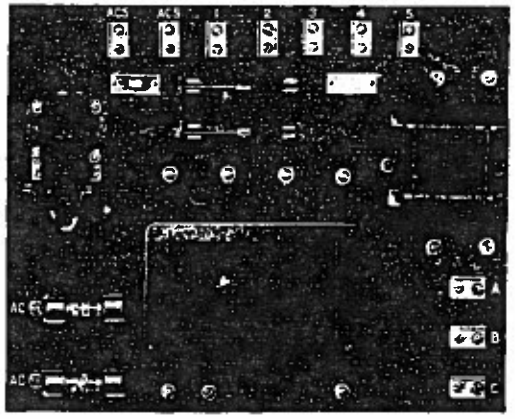
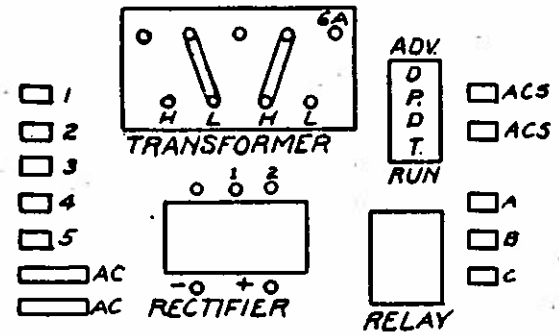


FIG. 1

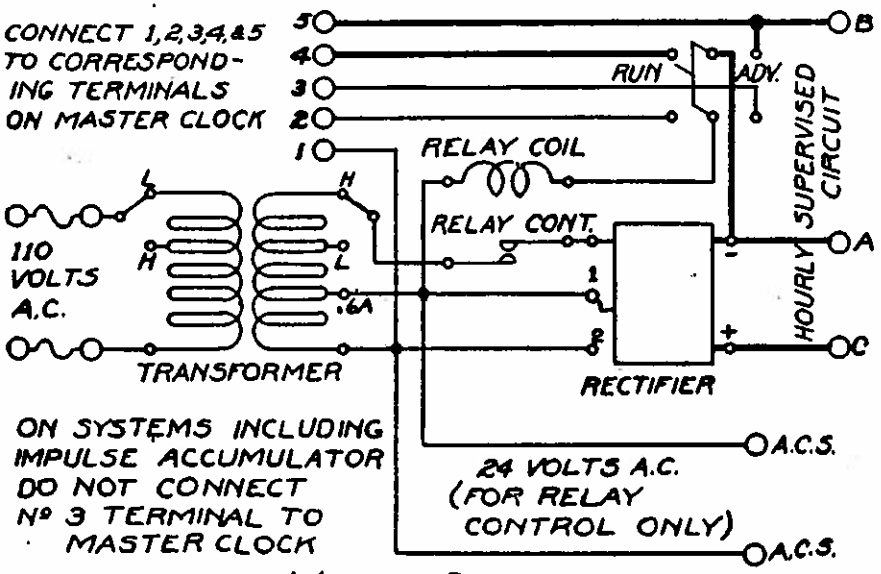
The relay is necessary in order to keep the load on the Master Clock contacts as light as possible. The Master Clock contacts close the circuit to the coils of the relay, and the contacts of the relay in turn close the circuit to the secondary of the transformer. The relay makes possible lighter construction of the master clock contacts than would otherwise be possible and consequently the Master Clock will keep more uniform time.

Figure 2 is a wiring diagram of a master relay panel showing the wiring as well as the arrangement of the units. The principle of operation is as follows:

When the master clock contacts make, a circuit is completed from a tap on the secondary side of the transformer to the coils of the relay which energizes same and attracts the armature. When the armature is attracted, another circuit completed and this applies the A. C. voltage from the secondary of the transform to the A. C. side of the rectifier. Thus the A. C. is changed to a pulsating D. C and applied to the secondary units which are connected permanently to the D. C side of the rectifier.



ARRANGEMENT OF UNITS



WIRING DIAGRAM

NOTE:- BE SURE TRANSFORMER TAPS ARE ADJUSTED 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

FIG. 2

The master relay equipment includes a double pole, double throw switch marked on one side "run" and on the other side "advance." When the switch in the "run" position, the relay will be operated normally, but when the switch is in the "advance" position, the relay will be operated at two second interval This switch will be found very useful in setting the system after a long power lapse, where an impulse accumulator is not used to automatically set the secondary clocks.

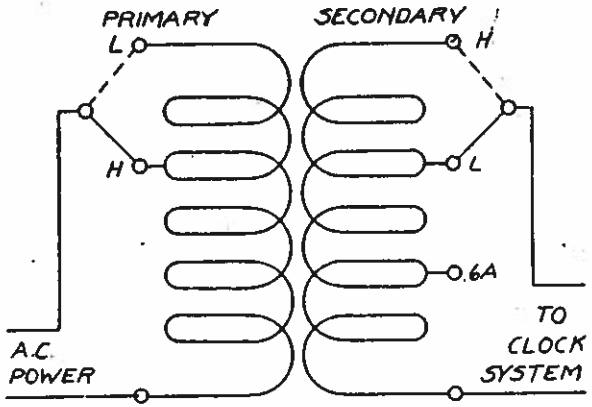


FIG. 3

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 primary or secondary that are in use, thus changing their relation to each other As the primary voltage is practically constant the secondary voltage will be either higher or lower according to the revised ratio of turns.

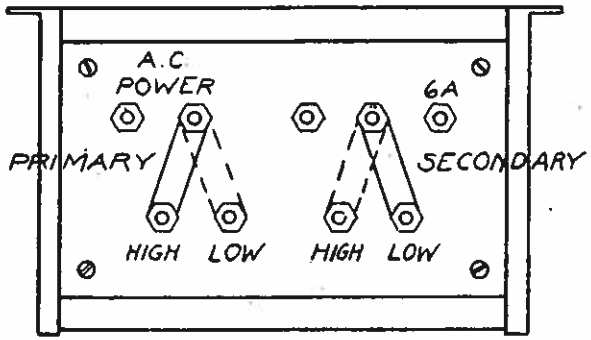


FIG. 4

Figure 4 is a drawing of the transformer terminal block showing how the terminal strips may be connected to obtain high and low voltage at the secondary of the transformer. Four different combinations are available and a little thought

INTERNATIONAL UNIT TYPE RELAY

DIVISION

INTERNATIONAL TIME RECORDING [redacted]

Division of

INTERNATIONAL BUSINESS MACHINE CORPORATION

270 Broadway New York, N. Y.

INTERNATIONAL UNIT TYPE RELAY

As all contacts on Master Clocks and Program Devices must necessarily e of light construction, it is not advisable to pass much current through them, herefore, a relay is used. The above mentioned contacts are used to complete he circuit and carry the current to the coils of a relay, and the contact points of he relay, which are much heavier, are then used to complete the circuit and carry he current for the secondary units, bells, etc. A very small current is sufficient o energize the coils of a relay, in fact, the amount of power which the relay ontacts will handle is many times that required to energize the coils and attract he armature, therefore, the current that passes through the Master Clock and rogram contacts is very small and the contacts will not be pitted even after ng periods of service.

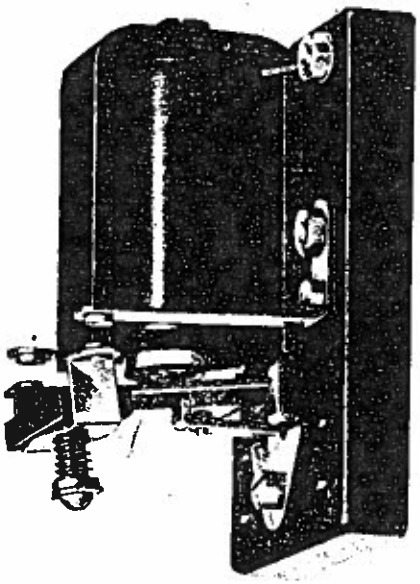


FIG. 1

The International unit type relay is very compact in design and efficient operation. It is made in two styles for operation from alternating or direct rrent and in either the circuit closing, circuit opening or transfer type. It provided with two sets of contacts designed to quickly break the circuit at two oints which greatly diminishes the arc that always tends to occur when an electrical circuit is established or broken. The contact points are of pure silver and xidation will not effect their conductivity as oxide of silver is practically as od a conductor as silver itself. The relay is designed so that it is easily removle from the front of the panel without disconnecting any wires. The coils l contacts are connected to the studs in the relay through which the mounting ews attach the relay to the panel. The relay studs make contact with the uds in the panel to which the wires are permanently connected.

The contact arrangement is very simple, as the contact arms on either si are connected to the lower mounting studs and, when the armature is attracte a short bar which is attached to the armature, but insulated from it, and with contact point in each end makes or breaks the circuit depending upon the pa ticular style of relay.

ADJUSTMENTS

Adjust the contact arms (upper) until there is an air gap of 3/64 between the armature and core, when the armature is raised by hand until bot contacts just make. This insures good contact when the armature is attracte by power, and sufficient spring tension to make a quick break when the armatu is released.

There should be 1/8" air gap between the contact points when the arm ture is released. All adjustments are properly made at the factory and should n be changed unless the contact points are sanded to remove pits.

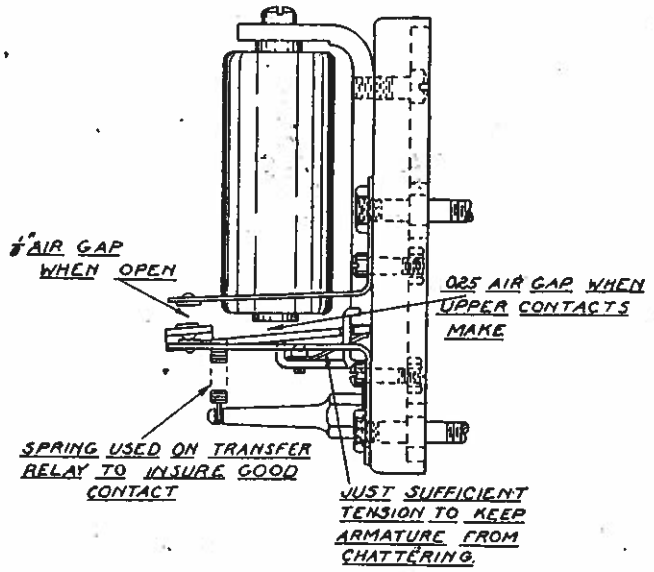


FIG. 2

CARE

This relay requires no attention whatever, except occasional inspection tc ascertain if the contact points are pitted. If they are pitted a piece of very fine sand paper may be used to smooth the contact surfaces. Do not remove more of the silver than is necessary and check the relay afterwards to insure that the point make good contact.

It is advisable to turn off the power while removing pits from the contact or making any adjustments on the relay. It is understood that the power should be turned off only when it does not interfere with the operation of the system. thus causing confusion and inconvenience. *Do not use oil on this relay.*

l determine the connection best suited for the particular condition. Other ngs being equal, the greater the load or the longer the lines to the secondary ›aratus, the higher the transformer secondary voltage should be. If only one two secondary units are in use, the connection that will give the lowest sec-lary voltage should be used.

The number of secondary units that may be connected to the master relay imited only by the capacity of the transformer, rectifier and relay. However, here are several circuits of secondary units, the master relay should be used v for operating the distribution relays and possibly the program machine.

From studying the position of the contacts in the Master Clock in con-ction with wiring diagram (Figure 2), it will be seen that the master relay rates approximately 80 times an hour, or once for each minute, and approxi-tely 20 extra times between the 59th and 60th minutes. Also power is avail-e to the secondary units over the "A" and "C" wires for every one of these 80 ›ulses, but over the "B" and "C" wires for only 50 impulses, or between the h and the 49th minutes inclusive.

The master relay cabinet should be installed in a clean, dry place. It is ınged to be attached to the wall with 4 screws. The panel may be easily re-ved from the cabinet. All wires leading to and from the cabinet should be ıer in conduit or sheathed cable, preferably conduit. It is advisable to keep the inet locked as this helps to keep it clean.

It is extremely important that the source of power is from some point that not be turned off, otherwise the clock system may be carelessly stopped. All ninals of the master relay panel should be connected to other correspondingly ·ked terminals in the system or according to system wiring diagram which ays accompanies the equipment.

If the system fails to operate, always check the fuses first. A. C. power uld be available continuously at both ends of the fuses. Also the stop switch he Master Clock may be tested by checking the power during the impulses at "B" and "C" terminals that lead to the secondary units. D. C. power should vailable for two seconds each minute for 50 minutes of each hour or from the h minute to the 49th minute inclusive. As stated before, D. C. power is ilable for two seconds each minute at the "A" and "C" terminals and also ·ral extra times between the 59th and 60th minutes.

INTERNATIONAL PROGRAM DEVICE

METAL DISC MODEL

500

May 1, 1934

INTERNATIONAL BUSINESS MACHINES CORPORATION
INTERNATIONAL TIME RECORDING DIVISION
270 Broadway New York, N. Y.

INTERNATIONAL PROGRAM DEVICE

A device for controlling the operation of signals, such as bells, horns, and whistles, eliminating time on Job Time Recorders, or performing any other function according to any predetermined schedules is known as a Program Device

DRUM TYPE PROGRAM

The drum type or universal program is much more flexible and positive in operation than any other program device on the market. It is designed to meet the most exacting requirements as it will handle very complicated schedules. It consists of a number (8 or 12) of slotted discs forming a drum-like stack. Each disc has 360 slots, or one for each minute during a six-hour period. These are supported on an iron base which also carries the driving magnet, the calendar attachment, the contacts, etc. The calendar drum is made up of discs in the same manner as the big drum but instead of being divided into minutes, it is divided into six-hour periods covering one week, one slot for each six-hour period, making 28 slots in all. The program schedules are set by inserting metal pins into these slots wherever a signal is desired. These pins projecting from both discs operate on the same set of contacts to ring the bells or perform other operations. The conditions under which both pins will press together on the same set of contacts is determined as follows: The larger drum which is advanced every minute makes one revolution in six hours. This means that one disc takes care of a six-hour period only. The calendar drum makes one revolution a week, being advanced one space every revolution of the large drum by a cam wiper dropping from a cam attached to the large drum. It is apparent, therefore that a pin, when inserted in a slot on the calendar drum, will determine the particular six-hour period of each day in which the signals, sets up on the large disc directly in line with it, will operate. (See Fig. 1).

It is easy to see that if another set of signals is to occur during the following six-hour period of the same day, a pin must be inserted in the next suceeding slot of the next small calendar disc, the signals, of course, being set up with pins on the large disc in line with the second calendar disc.

It is obvious that a schedule set up on the large disc will be repeated automatically every six hours, if the clips or pins are placed in the calendar disc for the six-hour period.

In order to fully understand the operation and flexibility of the Program Device, the difference between a program schedule and a program circuit must be thoroughly understood.

A program circuit may be defined as one where all bells and signals ring together and can be controlled from one push button or one automatic control. The only thing that limits the number of bells or signals on one circuit is the carrying capacity of the relay used.

One program circuit may ring the bells on several program schedules; at is, the same circuit could be used for Monday, Tuesday and Wednesday on e schedule and also operate signals on an entirely different schedule for the mainder of the week.

A separate circuit must be provided for signals that are to be operated ıen the other signals are silent. This holds true even though but one bell is quired to be silent on a single day although it rings during the other days on e same schedule as all other bells.

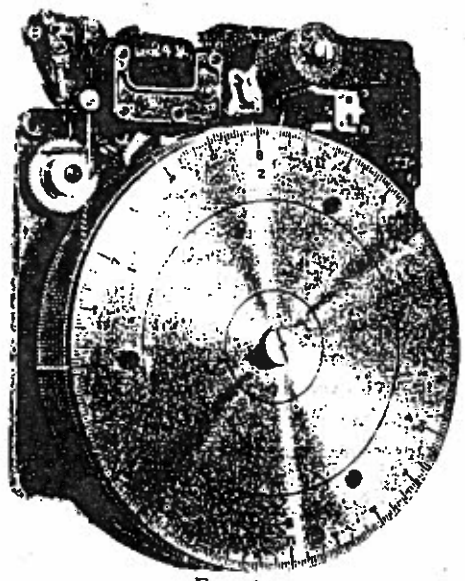


FIG. 1

Only such bells can be included on one circuit as ring in unison on all edules, in other words, the schedule that applies to one bell on a circuit must ly to every bell on that circuit without variation or exception.

For example, supposing in a school program, the yard gong must ring at . M. every day except Saturday and Sunday, and in the school rooms the bells st ring every half hour from 9 A. M. to 4 P. M. every day except Saturday l Sunday.

It is plainly seen that, if made into one circuit, all bells, including the d gong, would operate each half hour.

To handle a twelve-hour schedule, for instance, any combination of signals ween 6 A. M. and 6 P. M. for one day, two discs are required. Likewise, an iteen-hour schedule requires three discs and a twenty-four-hour schedule four s, all because of the fact that one revolution of the big drum controls only a hour period.

If the schedule of signals varies on certain days of the week, addition discs must be used for the changed schedule on the basis of one disc for ever six-hour schedule. If on a twelve-hour schedule the signals must operate on different schedule on any one day, two additional discs are required, and if th are to operate on an entirely different schedule Saturday morning, an addition disc must be used, making five in all. It is understood that these signals wil be silenced at night, Saturday afternoon and Sunday by leaving pins out of the proper section of the calendar drum.

Another important thing to bear in mind is that a schedule that is operate on a given circuit for one day cannot be transferred to operate on another circui on some other day, from the same disc. Each individual circuit must be con nected permanently to enough discs to handle all the schedules of signals require by that circuit. There is no way by which a calendar drum can shift a schedul from one circuit to another.

To better understand the procedure of laying out a schedule properly study the following example.

Assume that bells are to be rung as follows:

High school bells at 9:00 A. M., 9:30 A. M., 11:00 A. M., 12 M., 1:15 P. M., 3:00 P. M. and 5:20 P. M., on Monday, Tuesday and Wednesday, and at 9:15 A. M., 9:45 A. M., 11:15 A. M., 12:15 P. M., 1:30 P. M., 3:15 P. M., and 5:30 P. M. on Thursday and Friday.

Grammar school bells at 9:30 A. M., 10:15 A. M., 11:00 A. M., 11:45 A. M., 1:15 P. M., 2:00 P. M. and 2:45 P. M., on Monday, Tuesday, Wednesday and Thursday, and at 9:30 A. M., 10:15 A. M., 11:00 A. M., 11:45 A. M., 1:15 P. M., 1:55 P. M. and 2:35 P. M., on Friday.

Outside gongs at 8:45 A. M., 8:55 A. M., 12:00 M., 1:00 P. M., 1:10 P. M., and 5:20 P. M., on Monday, Tuesday and Wednesday, and at 9:00 A. M., 9:15 A. M., 12:15 P. M., 1:15 P. M., 1:25 P. M. and 5:30 P. M. on Thursday and Friday.

All bells are to be silent on Saturday and Sunday.

After studying the above program, it will be noted that no two of the schedules are the same. If we attempt to put any part of the two schedules on the same circuit, the bells would be ringing at the wrong time and place, causing confusion.

As each disc will take care of only a six-hour period and each schedule covers a twelve-hour period, it will be apparent that an eight-disc program device would not be sufficient and that a twelve-disc program device would be required to handle the above program.

Assuming the calendar change to be regular (approximately three minutes past 6 and 12) the twelve-disc program device would be wired in three circuits of four discs each; the first four discs for the High School circuit, the next four for the Grammar School circuit and the last four for the outside circuit.

We will set the schedules for the various circuits, starting with the High chool.

Insert pins at the following places:

On the large drum: 9:00, 9:30, 11:00 and 12:00 in the first disc; 1:15, :00 and 5:20 in the second disc; 9:15, 9:45 and 11:15 in the third disc; 12:15, :30, 3:15 and 5:30 in the fourth disc.

On the calendar drum; the second A. M. section of the first disc for londay, Tuesday and Wednesday; the first P. M. section of the second disc for londay, Tuesday and Wednesday; the second A. M. section of the third disc or Thursday and Friday; the first P. M. section of the fourth disc for Thursday nd Friday.

The schedule for the Grammar School is set up as follows:

On the large drum: 9:30, 10:15, 11:00 and 11:45 in the fifth disc; 1:15, :00 and 2:45 in the sixth disc; 1:15, 1:55 and 2:35 in the seventh disc.

On the calendar drum: the second A. M. section of the fifth disc for londay, Tuesday, Wednesday, Thursday and Friday; the first P. M. section of ie sixth disc for Monday, Tuesday, Wednesday and Thursday; the first P. M. ction of the seventh disc for Friday.

It will be noted that the Grammar School schedule for the program period om 6:03 to 12:03 is the same for all days of the week. Therefore, there will : no pins in the eighth disc of either the large or small drum as the schedule r Friday morning is taken care of by inserting a pin in the second A. M. section the fifth disc on the calendar drum for that period. Just the schedule for ie six hour period that deviates from the regular schedule is all that needs to : set on a separate disc.

The schedule for the outside gongs is set as follows:

On the large drum: 8:45, 8:55 and 12:00 in the ninth disc; 1:00, 1:10 d 5:20 in the tenth disc; 9:00 and 9:15 in the eleventh disc and 12:15, 1:15, 25 and 5:30 in the twelfth disc.

The pins in the calendar discs are placed at the following positions:

Second A. M. section of the ninth disc for Monday, Tuesday and Wedsday; first P. M. Section of the tenth disc for Monday, Tuesday and Wednesday. cond A. M. section of the eleventh disc for Thursday and Friday and the first M. section of the twelfth disc for Thursday and Friday.

No pins are placed in the calendar device at the positions for Saturday and nday. Thus the signals are silent during these days.

This very clearly shows that as the big drum revolves, the calendar drum es likewise and as a pin on the big drum reaches the specified time, it closes e contact and at the same time the other contact is closed by the pin on the lendar drum, completing the circuit for a signal.

CHANGING A SCHEDULE

The usual practice is to call the circuit controlled by the outside grou of discs No. 1, the second group of discs from the front No. 2, etc. The disc of the program device that control any one circuit are generally grouped togethe The number of discs on any circuit may be ascertained by checking the connections to the contact fingers. (See Fig. 2). One side of the contacts i common and all are connected together. The other side of the contacts ar connected together according to circuits. As each contact represents a disc, th

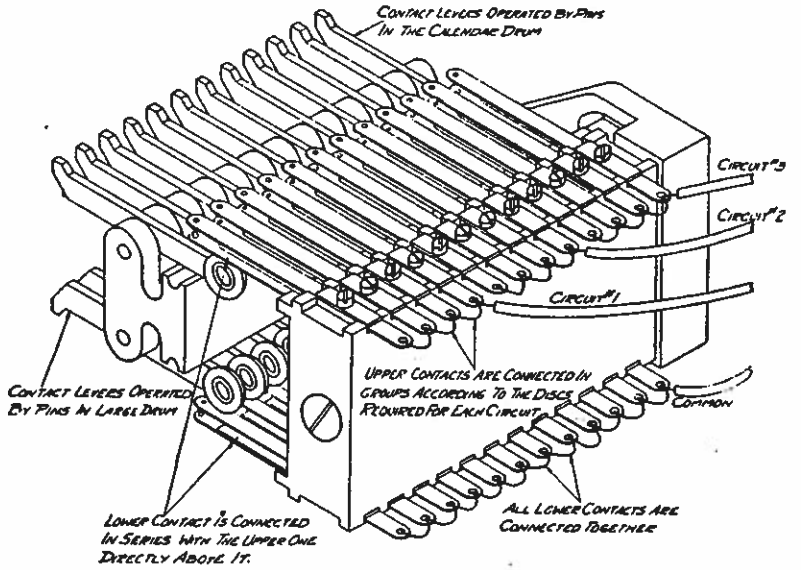


FIG. 2

number of contacts connected together represents the number of discs on that particular circuit. To change the number of discs in a circuit all that is neces sary is to change the contact connections.

The actual change in schedule is accomplished by pulling out a clip (usin small pliers) and replacing it in the proper slot of the proper disc. Always pinc the prongs of the clip slightly to insure its fitting snugly into the disc and then tap the clip gently into position. Make certain that it is properly seated in its slot. (See Fig. 3).

The disc on the front of the drum is marked with the hours and minute to assist in locating the pins in the proper slots. The calendar device is al marked with arrows pointing to the sections covering six-hour periods. (See Fi 4). The pins in the calendar drum determine which discs in the large drum ar operative. Before changing any pins in the large drum first determine which dis controls the schedule for the time the change is required. This may be determine by checking the location of the pins in the calendar drum.

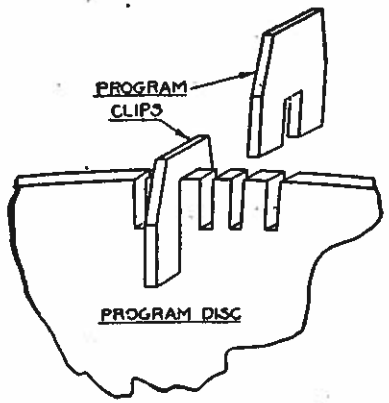


FIG. 3

To determine the proper slot in which to insert the pin, ascertain first hether the set of bells (circuit) is to be operated through a duration contact in e Master Clock or through a timing relay.

If operated from a duration contact which is usually the case, the pin ould be inserted in the slot in line with the minute on which the ringing of the lls is to occur. This holds true if a timing relay is used in conjunction with the ıration contact to give an extra long ring on one or more circuits, such as yard ngs, etc., also if the timing relay operates every minute.

If a timing relay is used instead of a duration contact the pin should be serted in the slot one minute prior to the time the ringing is to occur.

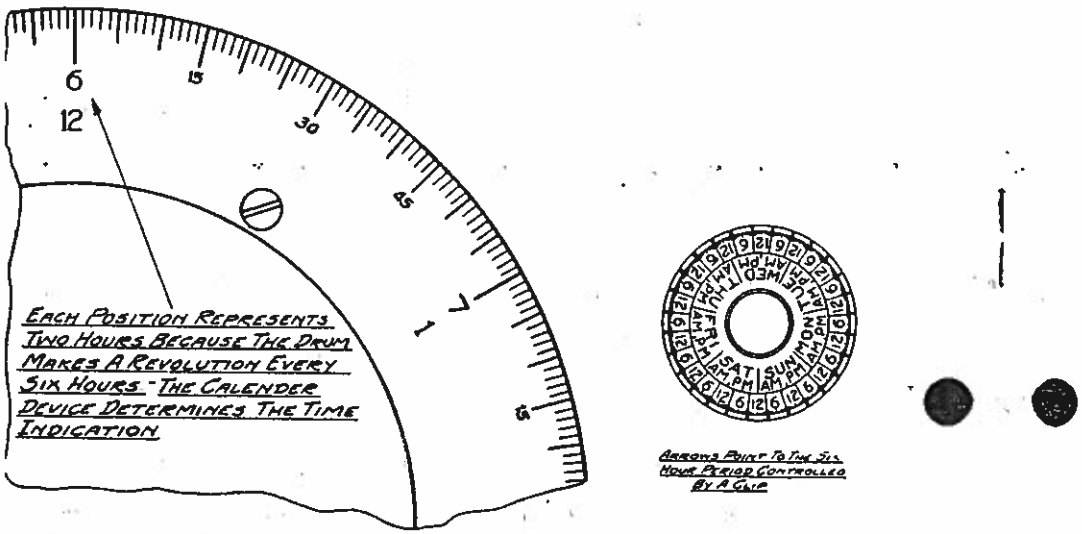


FIG. 4

In changing the schedule which is set up shortly before or after six twelve o'clock, care must be taken not to confuse the ringing periods. The regul change of the calendar wheel occurs at 6:03 and 12:03. It will be observe. therefore, that if bells which operate at 5:55 are to be changed to ring at 6: another disc must be used, as at 6:03 the calendar device will introduce a schedul set up on a different disc. The same theory will apply when a schedule change occurs between 11:55 and 12:10 or if the calendar change occurs at some tim other than regular.

The schedules may be easily changed without removing the drum; in fac the drum should be removed only when necessary and then it must be replaced i the same position in relation to the supervising switch, otherwise the progr device will be thrown out of step with the Master Clock by the automatic super vising feature. The supervising switch must shift from one wire to the other the drum advances to the 4th and to the 59th minutes. Also check to see th the cam wiper for the calendar device is riding properly on its cam.

ADJUSTING DURATION OF RING

If a timing relay is used, raise the weight (by loosening the thumb screw on the pendulum of the timing relay to shorten the duration of ring, and lower the weight to lengthen the duration of ring. Tighten the thumb screw in th weight after the setting has been determined. Be sure that the head of the thum screw is toward the front of the relay.

If a duration contact in the Master Clock is used to control the duratio of the signals it is necessary to remove the clock hands and dial in order to gai access to the contact. This, being a rather delicate procedure, requires the service of a skilled mechanic. Therefore, it is recommended that a representative of th company be called to make the necessary adjustment.

ADVANCING THE MINUTE DRUM

If it is necessary to advance the drum, press the armature to the electro magnet and turn the drum *counter clockwise*. Never attempt to turn the drum in a clockwise direction.

ADVANCING THE CALENDAR DRUM

If the large drum has not advanced more than two hours since the cal endar drum automatically advanced, operate the small lever which projects belo the contact block assembly. By pressing toward the left as far as it will go and then releasing same, the calendar will be advanced one space (6 hours).

If the large drum has advanced more than two hours since the calend drum automatically advanced, press the calendar setting lever and turn the ca endar discs carefully in a *clockwise* direction to the desired six-hour period. Afte having set the calendar drum in this manner, make certain that the retaining paw has dropped in the proper tooth of the ratchet.

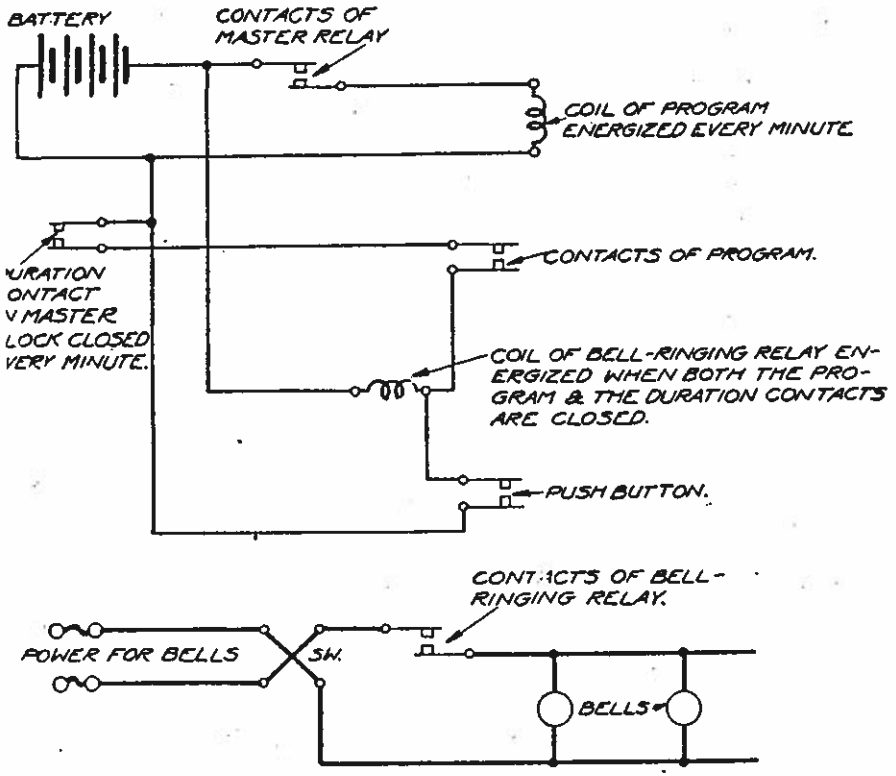


FIG. 5

The contact points of the program device and duration contact must ecessarily be of light construction, therefore, only enough current to energize ie coils of a relay is passed through them and the contact points of the relay irry the bell load. The coils of the relay are always connected in series with oth the program contacts and duration contact. The duration contact makes very minute, but the program contacts only make when pins are inserted in the rum, therefore, the circuit is completed to the coils of the relay only when both ontacts are made. The contacts of the relay connect the bells direct to the ower supply.

Fig. 6 is a schematic wiring diagram of a program device equipped to perate one circuit of signals (classroom buzzers) with a short ring, and one ircuit (outside gongs) with a long ring. The duration contact in the Master lock controls the duration of the first mentioned circuit while on the second

relay will be energized for the time the duration contact is close... The s... will be operated during this time as well as while the timing relay is running down.

The contacts of the timing relay are light in construction, therefore; only enough current to energize the coils of a circuit closing relay is allowed to pass through them and the points of the latter relay are used to carry the current.

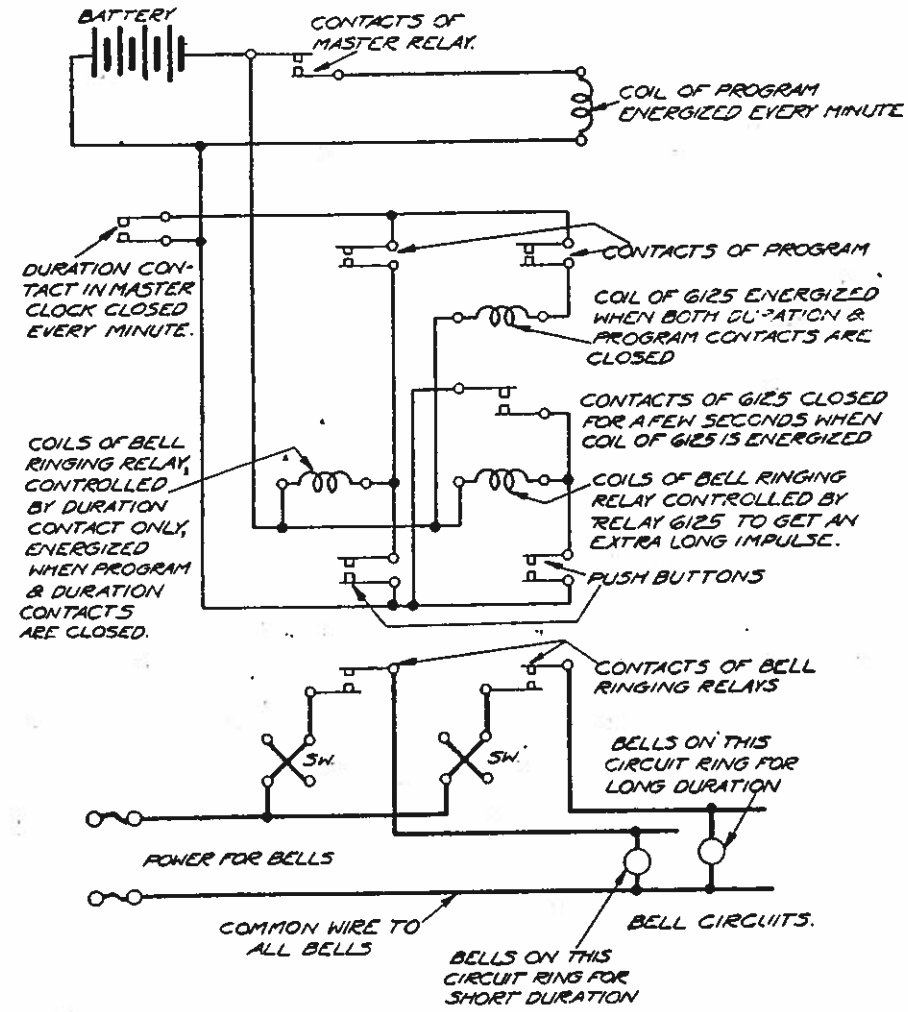


FIG. 6

ADJUSTMENTS

All adjustments of the metal disc program device are self-evident when gures 7 and 8 are studied. Use extreme care when making adjustments so that e mechanism will not be damaged.

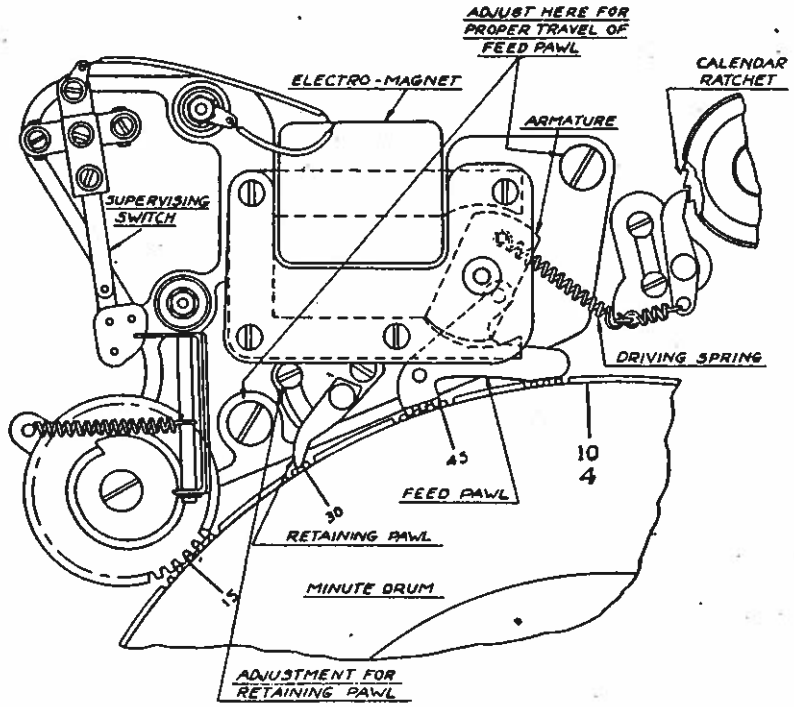


FIG. 7

SUPERVISING SWITCHES

All International secondary units may be hourly supervised so they are ays in agreement with the Master Clock. The supervising switches must be usted as follows:

The switch cam is properly timed at the factory and should not require nging, however, the timing of the switch may be adjusted by shifting the re switch block assembly. The secondary unit or recorder should transfer the "B" wire just before it reaches the 59th minute. A quick drop of the r from the cam is essential. If the lever rides down the face of the cam there anger of a poor contact.

Make certain that the center switch blade does not touch both the "A" "B" switch blades at the same time. The brass supports for the "A" and switch blades should be adjusted so that the center switch blade makes equal positive contact with each and so that the switch operating lever never rides oth cams at the same time. This assures that the full tension of the switch ating lever spring is applied to the switches. (See Fig. 9).

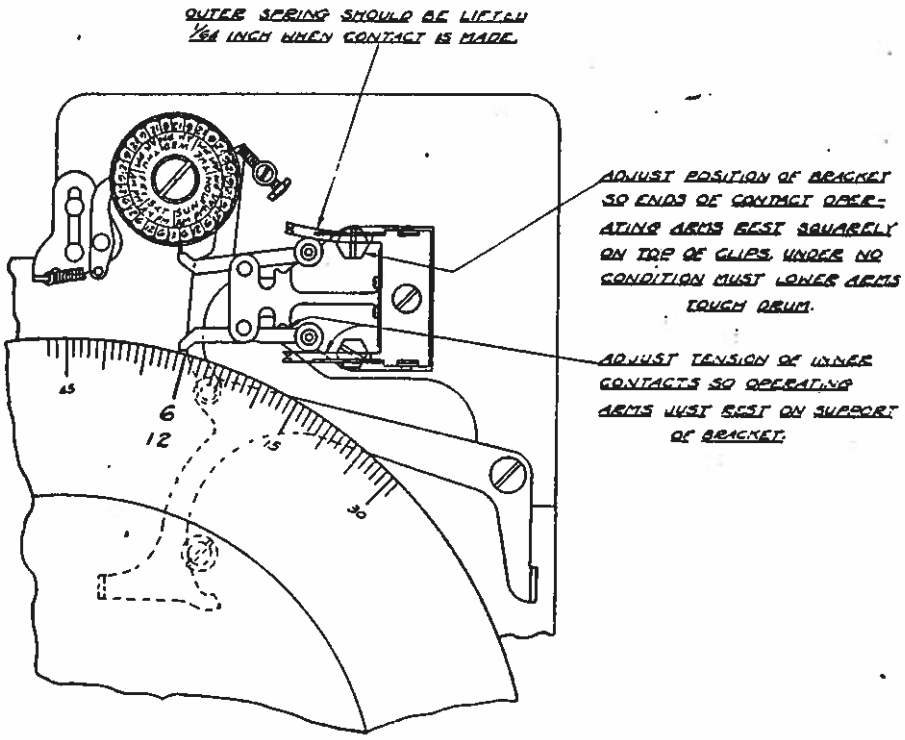


FIG. 8

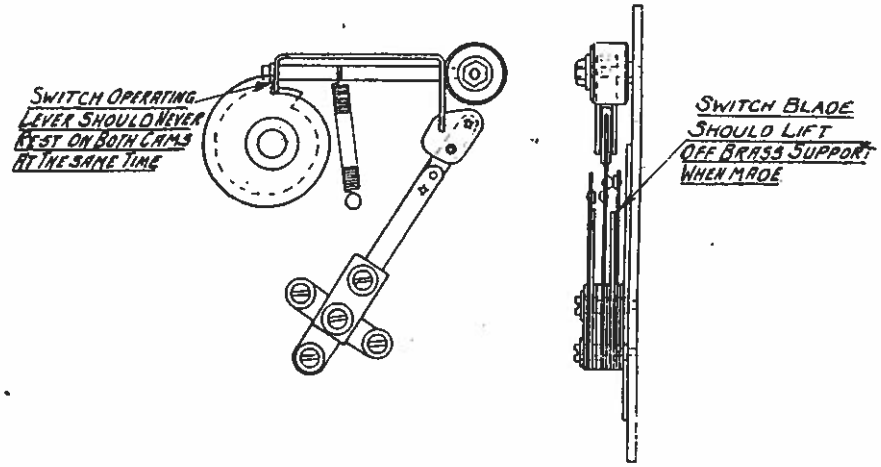


FIG. 9

SECONDARY CLOCKS

ROTOR TYPE

DIVISION
INTERNATIONAL TIME RECORDING [redacted]
Division of
INTERNATIONAL BUSINESS MACHINES CORPORATION
270 Broadway New York, N. Y

No. 200 Jan. 1, 1932

SECONDARY CLOCKS

ROTOR TYPE

By secondary clocks we mean those clocks that operate from a Mast Clock and are used for indicating the time. The style of the case and the siz of the dial may vary, but the underlying principle of operation is the same The mechanism operates on the ratchet and pawl principle; that is, an electro magnet energizes a spring which in turn operates a pawl which advances a ratche and moves the hands.

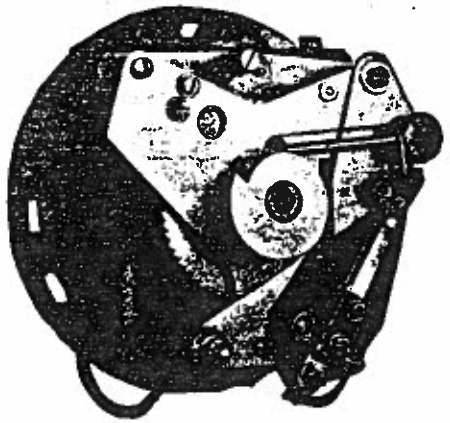


FIG. 1

The locations and installation of secondary clocks are very important. A person normally does not easily see things that are higher than an angle of 3(degrees above the horizontal. In a well designed room, pictures and the like ar kept fairly low down on the wall, well within the line of vision, and clocks ar no exception to this general rule. They should also be placed so that they are easily visible, usually on the wall opposite the windows so that the person reading them will not have to look toward the light. There is no reason why Internationa secondary clocks should be placed within reach as they never require individua setting, this being done automatically by the Master Clock, if required.

The electromagnet is of the double coil type which insures positive oper- ation and high efficiency. The armature is of the rocking type and operates between two pole pieces which are extensions to the magnet cores. The rockin type armature insures quiet operation, as there is no contact of armature and po pieces to make a noise. The feeding pawl is attached to the armature and rocks with it. When the electromagnet receives an impulse, it is energized and draws back the feeding pawl until it engages the next tooth of the ratchet. When the impulse is completed, a spring attached to the feeding pawl returns the armatur and the feeding pawl to their normal positions and at the same time advances t ratchet one tooth. The ratchet has 60 teeth, and as the minute hand is attache to the same shaft, advancing the ratchet one tooth advances the secondary on minute. In the case of half minute impulse secondary clocks, the ratchet ha 120 teeth and advances ½ minute each impulse.

To prevent the possibility of the secondary clock advancing when the mature is attracted, a safety or interlocking feature is provided which consists f a pin resting on the retaining pawl, thus holding the ratchet in place during ie time the feeding pawl is out of its locked position. When the feeding pawl in its normal position, it is wedged or locked behind a fibre stop which positively cks the ratchet.

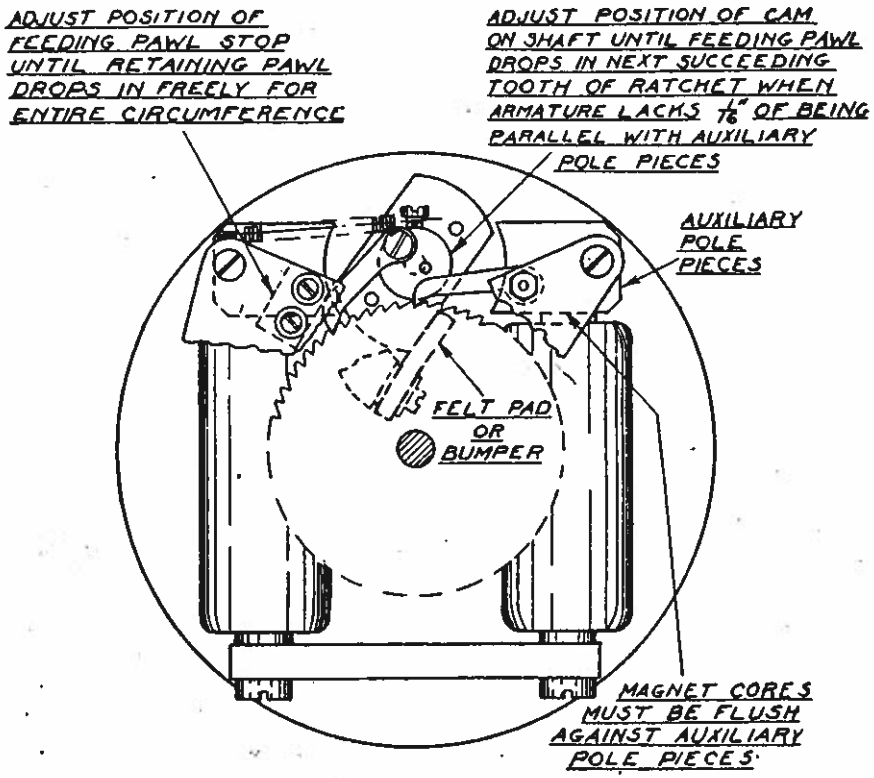


FIG. 2

The electromagnet which consists of two coils and a soft iron yoke is ounted rigidly to the main plate. The pole pieces of the electromagnet are sh against two auxiliary pole pieces between which the armature oscillates. ie auxiliary pole pieces are also mounted rigidly to the main plate. The inside d of the auxiliary pole pieces are cut circular so that the armature may oscil- e between them and have as small an air gap as possible. This construction ures the highest possible efficiency from the electromagnet.

The armature consists of many laminations of soft iron, riveted together so as to form a rectangular block, the ends of which are cut circular to fit the auxiliary pole pieces. The armature oscillates through an angle of approximately 70 degrees. When the electromagnet is deenergized and the armature is released the ends of the armature overlap the auxiliary pole pieces approximately 3/32". The armature is held in position by the tension of the armature return or driving spring.

The secondary clock is designed so that only one spring is used and that for the return of the armature to its de-energized position. Both the retaining pawl and the feeding pawl operate by gravity.

The movement is equipped with a felt pad which acts as a cushion for the armature, stopping its momentum and preventing it from over-throwing.

The hour hand is geared to the minute hand in the ratio of 12 to 1, therefore, when the minute hand has made 12 revolutions, the hour hand will have made one.

ADJUSTMENTS

The fibre stop for the feed pawl should be adjusted until the retaining pawl will just drop freely in the ratchet for its entire circumference.

The position of the cam cylinder should be adjusted on the armature shaft until the feeding pawl will just drop into the next succeeding tooth of the ratchet when the armature is moved until it lacks 1/16" of being parallel with the auxiliary pole pieces.

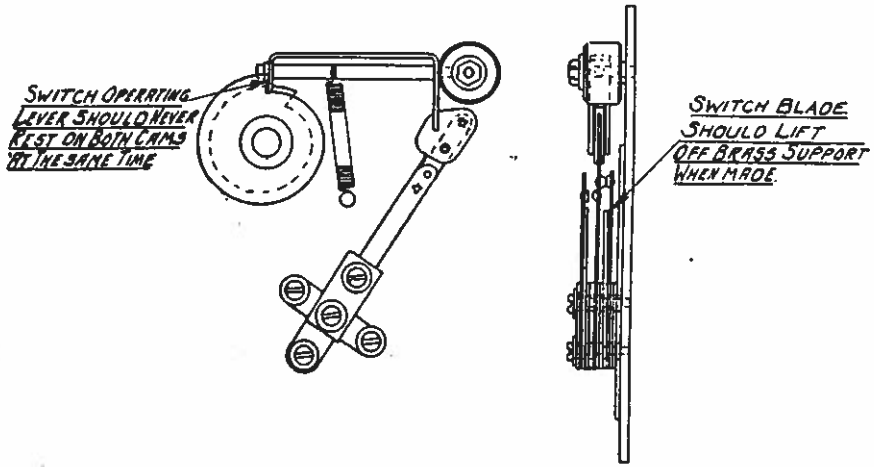


FIG. 3

The felt bumper or armature stop should be adjusted until the armature will travel 1/16" beyond the level of the auxiliary pole pieces. When the armature returns slowly, its stop should be the felt pad and not the feed-pawl striking its fibre stop.

The armature return spring should be adjusted so that the clock will operate satisfactorily on a 25% drop in voltage. This is properly adjusted at the factory and should not require changing.

The position of the entire movement may be adjusted, by loosening the three mounting screws, until the minute hand lines up with the minute marker.

ADJUSTMENT OF SUPERVISING SWITCHES

The cam for operating the switch is properly timed at the factory and should not require changing, however, the timing of the switch may be adjusted by shifting the entire switch block assembly. The secondary unit should transfer to the "B" wire just before it reaches the 59th minute and to the "A" wire just before the fourth minute. A quick drop of the lever from the cam is essential. If the lever rides down the face of the cam there is danger of a poor contact.

Make certain that the center switch blade does not touch both the "A" and "B" switch blades at the same time. The brass supports for the "A" and "B" switch blades should be adjusted so that the center switch blade makes equal and positive contact with each and so that the switch operating lever never rides on both cams at the same time. This assures that the full tension of the switch operating lever spring is applied to the switch.

SECONDARY CLOCKS

HEAVY DUTY TYPE

INTERNATIONAL BUSINESS MACHINES CORPORATION
INTERNATIONAL TIME RECORDING DIVISION
270 Broadway New York, N. Y.

May 1, 1934

To prevent the possibility of the secondary clock advancing when the armature is attracted, a safety or interlocking feature is provided which holds the retaining pawl in place, thus locking the ratchet when the armature is attracted.

Some secondary clock movements of this type are equipped with retard mechanism which let the hands move forward slowly. This mechanism consists of a fan escapement and the necessary gears.

ADJUSTMENTS

The armature must strike the pole pieces squarely. Adjust the entire magnet assembly to obtain this condition.

The retaining pawl should drop in freely for the entire circumference of the ratchet.

The feeding pawl should drop freely over the tooth it is to catch and propel forward, when the armature is attracted. The position of the electro-magnets and the adjustment of the retaining pawl govern the working travel of the feeding pawl.

The armature return spring should be adjusted so that the clock will operate satisfactorily on a 25% drop in voltage. This adjustment is properly made at the factory and should never require changing.

The position of the ratchet on its shaft determines the lining up of the minute hand with the minute markers. Two set screws are provided in the ratchet bushing for making this adjustment. Some of the larger hands are attached with set screws. When this is the case, they may be shifted to line up with the minute markers.

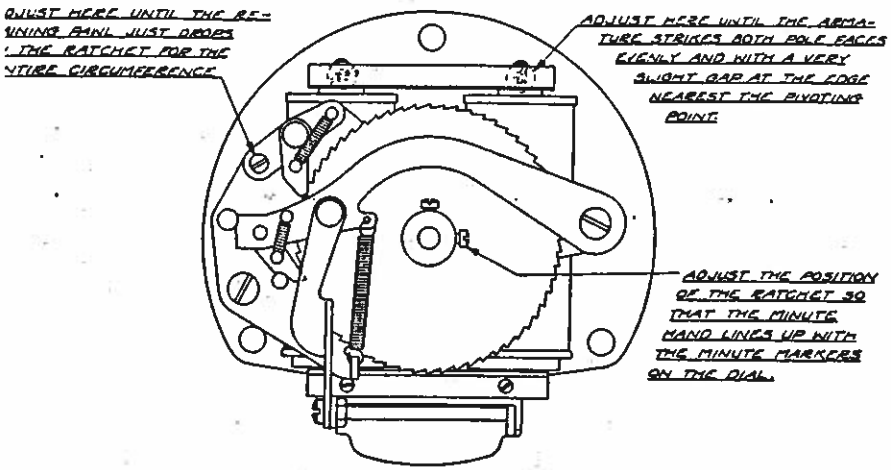


FIG. 2

ADJUSTMENT OF SUPERVISING SWITCHES

The cam for operating the switch is properly timed at the factory and should never require changing, however, the timing of the switch may be adjusted by shifting the position of the entire switch block assembly. The secondary unit should transfer to the "B" wire just before it reaches the 59th minute and to the "A" wire just before the fourth minute. A quick drop of the lever from the cam is essential. If the lever rides down the face of the cam there is danger of a poor contact.

Make certain that the center switch blade does not touch both the "A" and "B" switch blades at the same time. The brass supports for the "A" and "B" switch blades should be adjusted so that the center switch blade makes equal and positive contact with each, and so that the switch operating lever never rides on both cams at the same time. This assures that the full tension of the switch operating lever spring is applied to the switch.

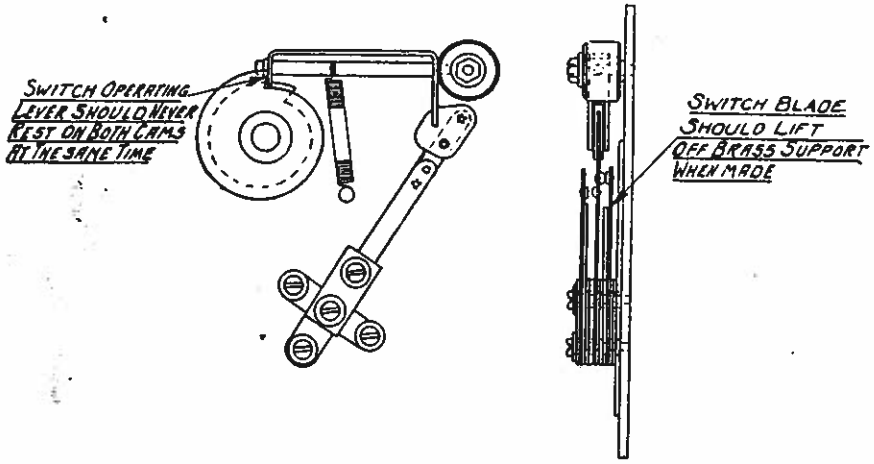


FIG. 3

SECONDARY CLOCKS

HEAVY DUTY TYPE

Those clocks that operate from impulses sent out by a Master Clock and are used for indicating time are called secondary clocks. They are not clocks in the true sense of the word, but merely a device for indicating the time of the Master Clock which is the only clock in the system. The style of the case and the size of the dial may vary, but the underlying principle of operation is the same. The mechanism operates on the ratchet and pawl principle; that is, an electromagnet energizes a spring which in turn operates a pawl which advances a ratchet and moves the hands.

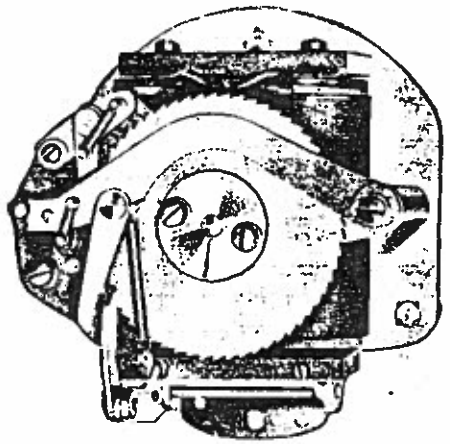
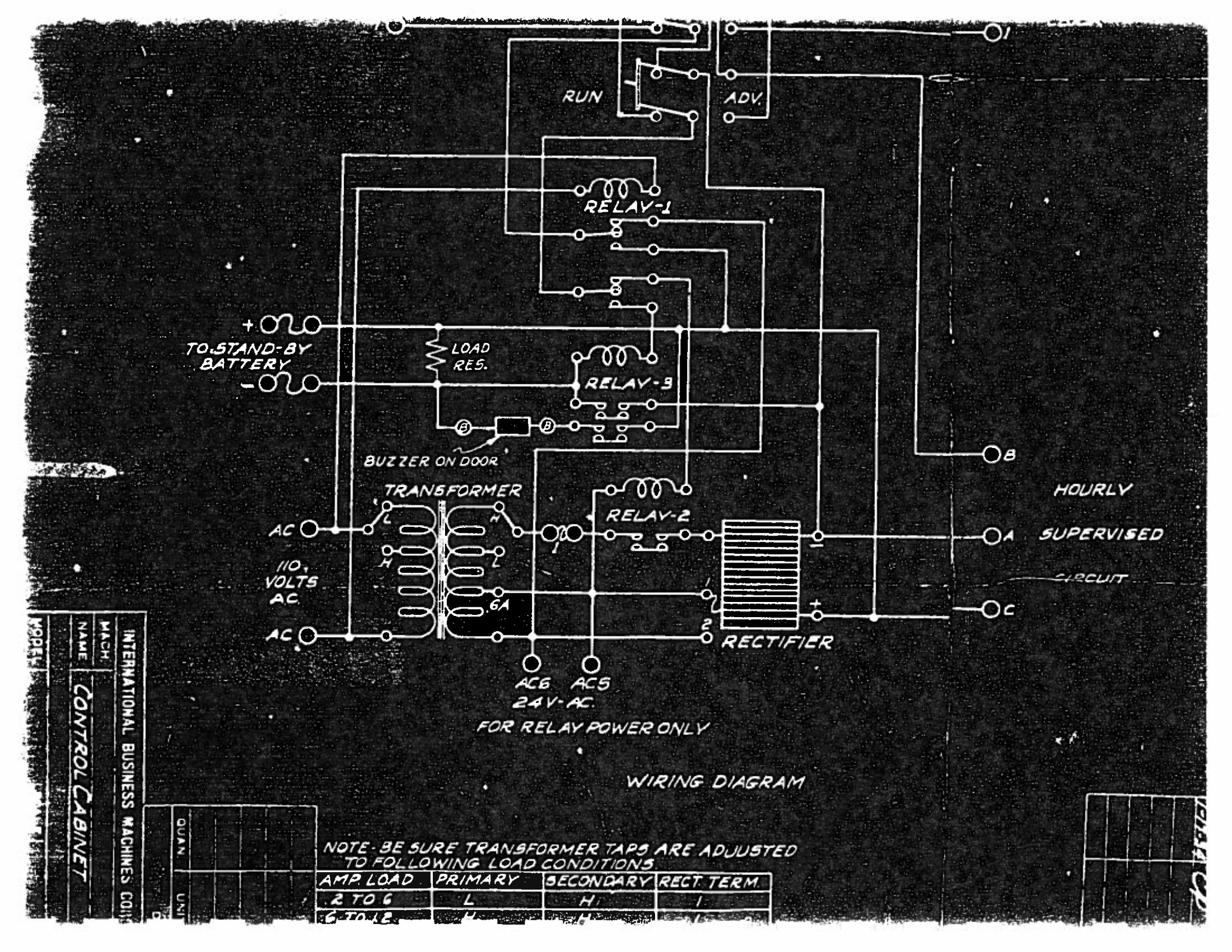
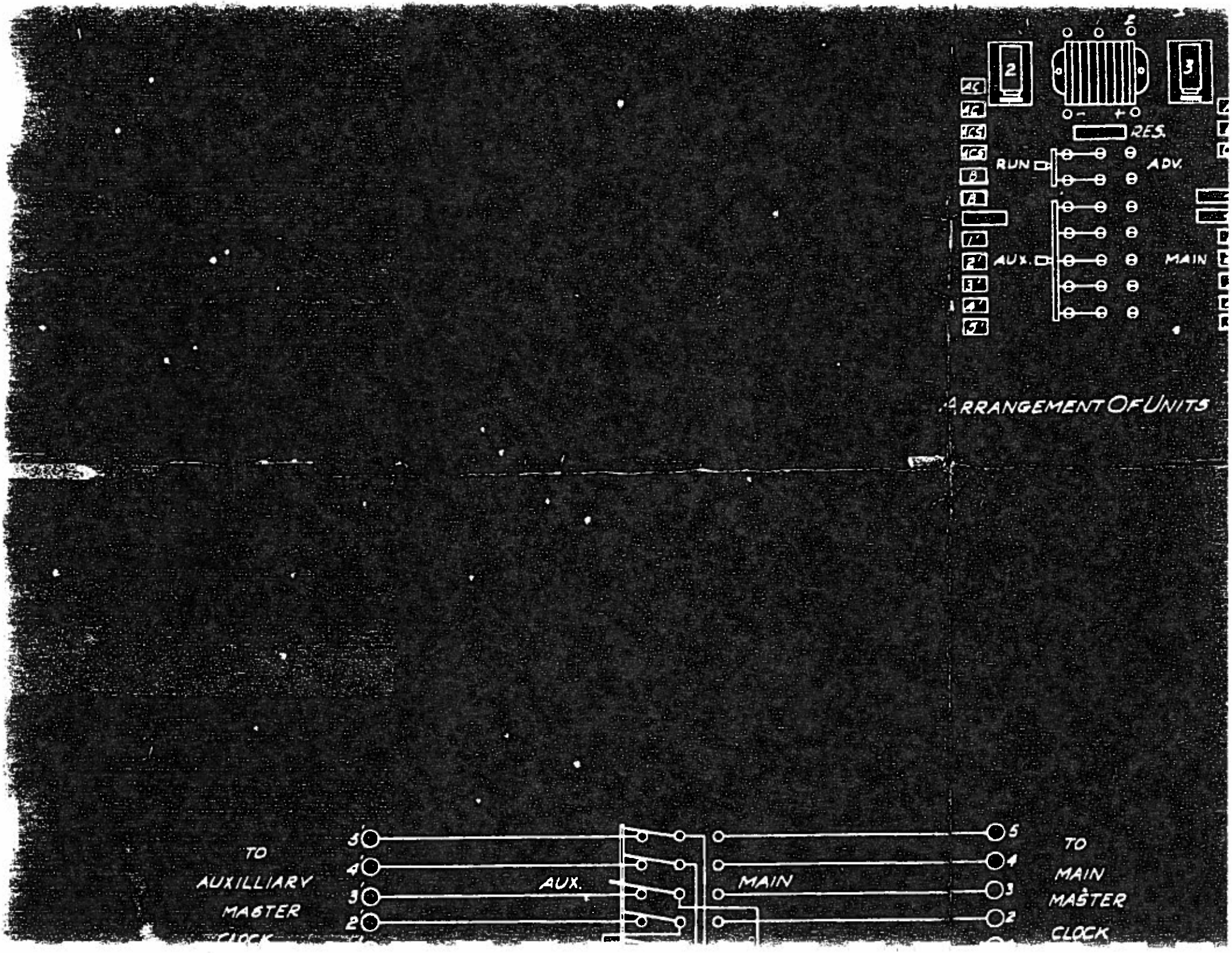


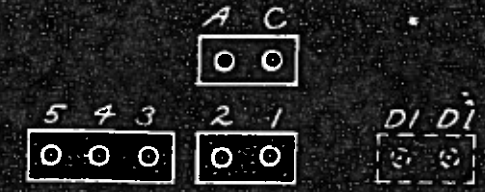
FIG. 1

The locations and installation of secondary clocks are very important. A person normally does not easily see things that are higher than an angle of 30 degrees above the horizontal. In a well designed room, pictures and the like are kept fairly low down on the wall, well within the line of vision, and clocks are no exception to this general rule. They should also be placed so that they are easily visible, usually on the wall opposite the windows so that the person reading them will not have to look toward the light. There is no reason why International secondary clocks should be placed within reach as they never require individual setting, this being done automatically by the Master Clock, if required.

The electromagnet is of the double coil type which insures positive operation and high efficiency. The feeding pawl is attached to the armature and when the electromagnet receives an impulse, the armature is attracted, thus moving the feeding pawl to the next succeeding tooth of the ratchet. When the impulse is completed the driving spring returns the armature and the feeding pawl to their original positions, at which time the ratchet is advanced one tooth. As the minute hand is attached to the ratchet shaft it is advanced one minute.

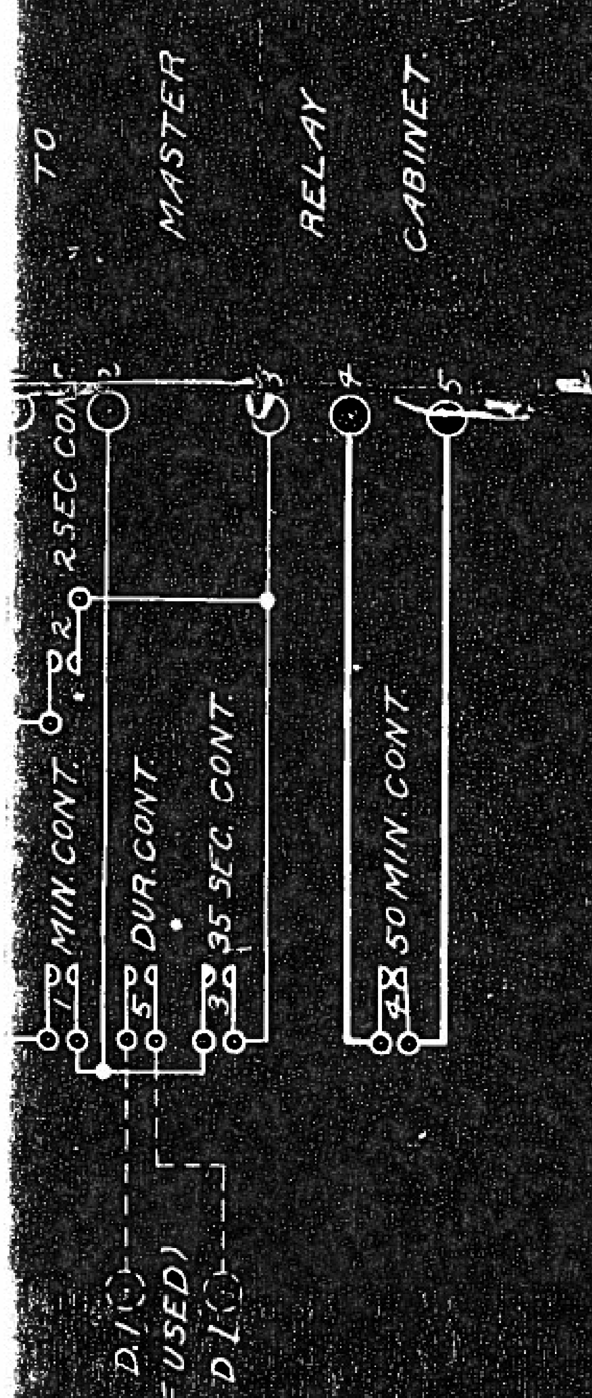

RUN
ADV.
1
RELAY-1
+
TO STAND-BY BATTERY
-
LOAD RES.
RELAY-3
BUZZER ON DOOR
B
TRANSFORMER
RELAY-2
AC
110 VOLTS AC
AC
L
H
H
L
1
2
6A
HOURLY
SUPERVISED
CIRCUIT
A
C
RECTIFIER
AC6 AC5
24 V-AC.
FOR RELAY POWER ONLY
WIRING DIAGRAM
INTERNATIONAL BUSINESS MACHINES CO.
MACH.
NAME
CONTROL CABINET
MODEL
QUAN
UNIT
NOTE - BE SURE TRANSFORMER TAPS ARE ADJUSTED TO FOLLOWING LOAD CONDITIONS.
AMP LOAD
PRIMARY
SECONDARY
RECT TERM.
.2 TO 6
L
H
1
6 TO 12


2
3
RES.
RUN
ADV.
AUX.
MAIN
ARRANGEMENT OF UNITS
TO AUXILLIARY MASTER CLOCK
AUX.
MAIN
TO MAIN MASTER CLOCK



ARRANGEMENT OF UNITS

ALTERATION	DATE	ENG. CH. No.



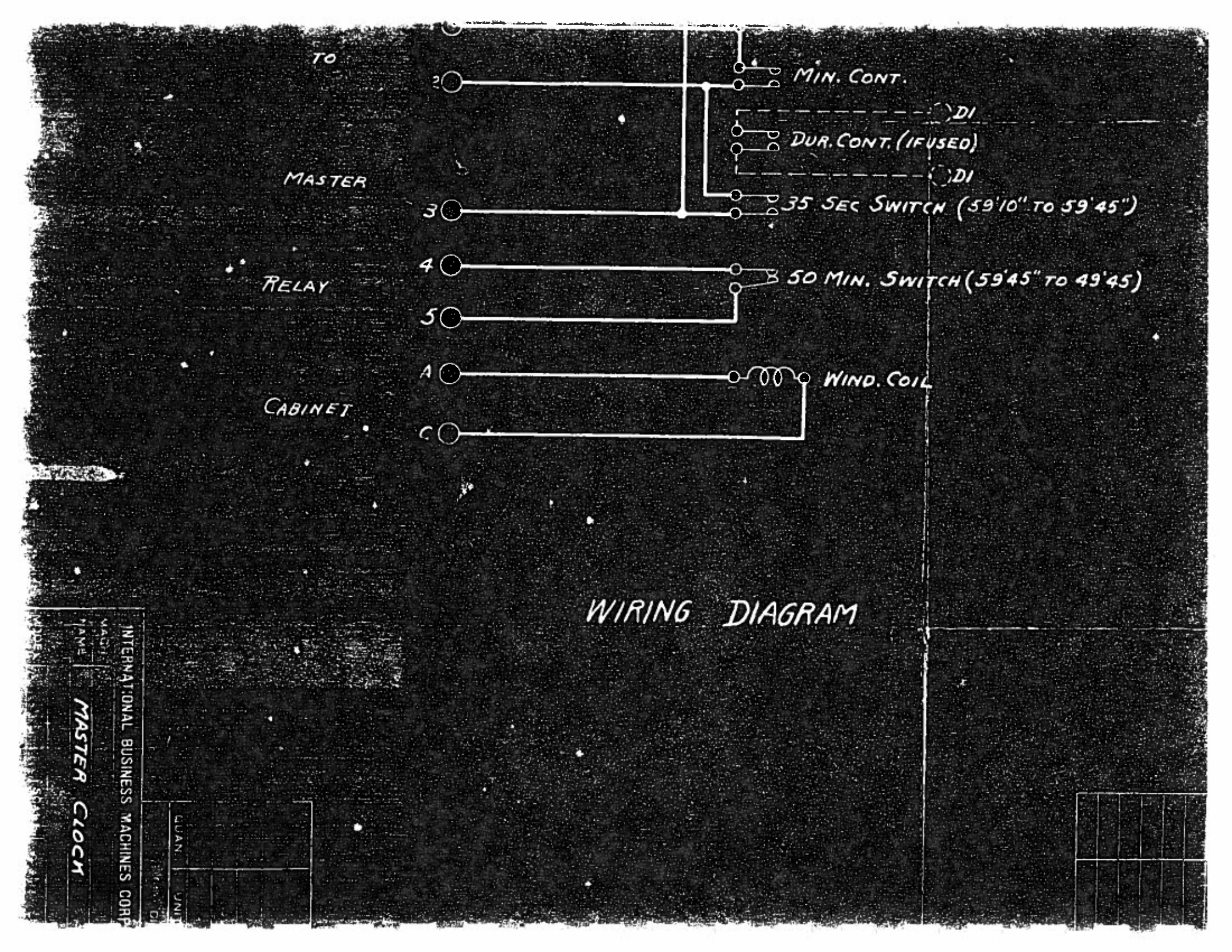
CONTACT NO. 1 CLOSES EVERY MINUTE (IMPULSE)
CONTACT NO. 2 CLOSES EVERY 2 SECONDS
CONTACT NO. 3 CLOSES 59' 10" OPENS 59' 45" (35 SECONDS)
CONTACT NO. 4 CLOSES 59' 45" OPENS 49' 45" (50 MINUTES)
CONTACT NO. 5 CLOSES EVERY MINUTE (DURATION)

WIRING DIAGRAM

...IONS		USED ON	No. REQ.	PART NAME: MASTER CLOCK		
DATE	BY					
				DR. R. J. E.	MATERIAL:	DIAM.:
				TR. R. J. E.	TEMPER:	WIDTH:
				CH. C. L. W.	STOCK PER 100:	THICK.:
				AP.:	FINISH:	SCALE:
				DATE: 6-20-30	INTERNATIONAL BUSINESS MACHINES CORP.	85965

ARRANGEMENT OF UNITS

2 SEC CONT.


TO
MASTER
RELAY
CABINET
2
3
4
5
A
C
MIN. CONT.
DI
DUR. CONT. (IF USED)
DI
35 SEC SWITCH (59'10" TO 59'45")
50 MIN. SWITCH (59'45" TO 49'45)
WIND. COIL
WIRING DIAGRAM
INTERNATIONAL BUSINESS MACHINES CORP.
MASTER CLOCK
QUAN.