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CENTRALIZED SUPERVISORY-CONTROL FOR ELECTRIC POWER EQUIPMENT IN STEEL WORKS

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I. INTRODUCTION

Fuji Electric has already delivered a number of centralized supervisory-control systems for electric power equipment in steel works. The primary objective of the centralized supervisory-control system is the centralized monitoring (and control, if required) of electrical power, gas, and water supply data. The control center is generally referred to as the "Energy Center." The major components of the system are:

(1) Transducers to convert the variables into signals to be transmitted to the energy center.
(2) Telemetry to transmit the converted signals to the energy center.
(3) Meters at the energy center.
(4) Remote supervisory-control system to display and control the operating states of the various units.
(5) Communication or control cables for transmission lines.
(6) Monitoring and control panels in the energy center.
(7) Control computer.

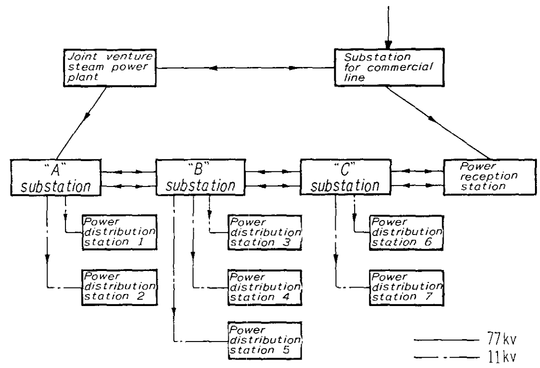
The objective of the centralized control system includes:

(1) Monitoring of electricity, gas, water, etc.
(2) Economical distribution of energy.
(3) Centralization and rationalization of operation monitoring.
(4) Labor economization through the reduction of supervision and maintenance personnel.

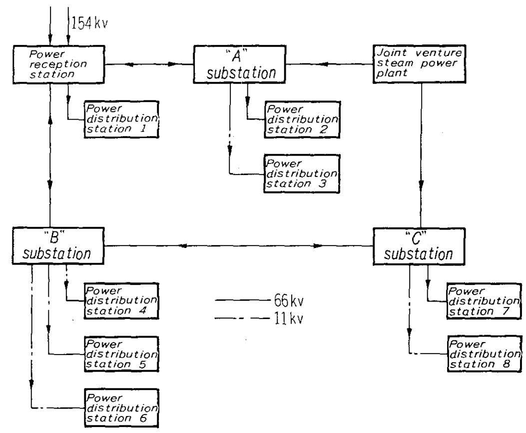
This articles primarily deals with the centralized supervisory control of electrical installations (substations and power distribution stations).

II. ELECTRIC POWER EQUIPMENT IN STEEL WORKS

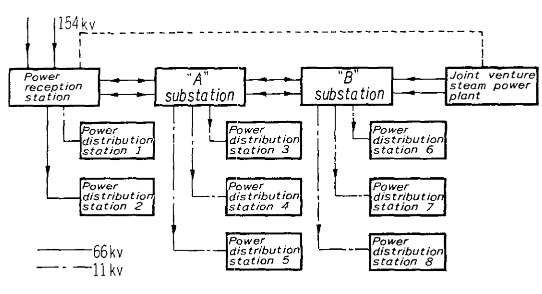
The total electric power consumed by a modern steel mill amounts to 300 to 500 Mw. For this reason, the electrical power system requires a powerful electric source. Electricity is generally supplied from a commercial line and the mill's own steam power plant (or joint venture power plant). The electricity purchased commercially is an ultra-high voltage. The main power line voltage of the electrical system of the mill's own power plant is 110 kv, 77 kv, or 66 kv. The electricity generated by the mill's own power plant is distributed to the various loads through substation and distribution stations.



(a) System construction (Example 1)



(b) System construction (Example 2)



(c) System construction (Example 3)

Fig. 1 Electric power systems in steel works

Although various systems can be used, they are all basically the same as those shown in *Fig. 1*. The system shown in (a) consists of a loop having both a commercial line source and a joint venture steam power plant source. That shown in (b) consists of only a own power plant (joint venture power plant) and its substations. That shown in (c) has power sources at both sides and a provision for future expansion of the own power plant (joint venture power plant) as shown by the dotted lines. Each substation converts the voltage to 11 kv or 3 kv and supplies it to the power distribution stations. Referring to the systems shown in (b) and (c), the power distribution stations which supply power to the blast furnace and its associated equipment are connected to the substation located closest to the own power plant (joint venture steam power plant), so that if the commercial power fails, power can be supplied to the major load from the own power plant alone. In either case, the electricity system tends to become a more complicated as the steel works become more complicated.

III. CONSTRUCTION OF THE CENTRALIZED SUPERVISORY-CONTROL SYSTEM

The primary objective of the centralized supervisory control system for electric power equipment in steel works is the monitoring and control of the operating states of the electrical equipment of the electrical power systems, the measurement and recording of electrical quantities, and the centralized computation of this data at the energy center. This objective is realized by using remote supervisory-control equipment, telemetering equipment, and a control computer system.

In the centralized monitoring system, data must be collected at an operational center, such as an energy center. The center may be installed either in one of the substations or power distribution stations or at a point away from the substations and power distribution stations.

The connection for signal transmission between the supervisory center and supervised equipment are made radially from the supervisory center to the supervised equipment (joint venture steam power plants are often excluded) by data lines which are independent from the power lines.

The data line generally employs communication cables. The communication cables are often shielded cables having a conductor diameter of 0.9 mm or 0.65 mm. The number of conductors is determined in accordance with the requirements of the respective channels. The control and indicating signals for the remote supervisory-control equipment and the measured data signal for the telemetering system are transmitted through these cables.

The remote supervisory-control system, to be explained later in detail, consists of a control station

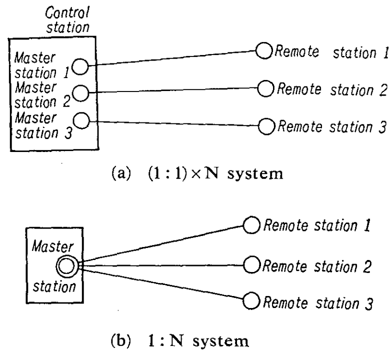


Fig. 2 Concentrated method of remote supervisory-control equipment

(master station) located at the control center and a controlled station (remote station) located at each substation. There are two centralized systems: One is the "(1 : 1)×N" system in which N number of master stations are installed in the control station and one remote station is controlled by each corresponding master station (this system is shown in *Fig. 2* (a)), and the other is the "1 : N" system in which one master station controls the N number of remote stations (this system is shown in *Fig. 2* (b)). The "(1 : 1)×N" system is more advantageous from the following viewpoints:

(1) At each substation, there are monitored or controlled items in numbers and are of higher importance.
(2) The system is readily expandable.
(3) Simultaneous operations between substations can be made at the center, minimizing effects of a failure.
(4) High interchangeability in equipment is maintained.

Connections from the center to substations may be either of the two methods: One is as shown in *Fig. 3* (a) in which the connections for the center, substation, and power distribution stations are made in a system of "mother—children—grandsons" and the other is as shown in *Fig. 3* (b) in which connections for the center, substations, and power distribution stations are made in a system of "mother—children."

When the former system is employed, remote supervisory-control system for the substation and power distribution station are installed in the center and substations. The data signal for the power distribution stations are relayed at substations. The relaying operation may be made either by directly connecting the corresponding cables or by employing simplified remote supervisory-control devices. In some cases, control panels for power distribution stations may be installed at the substation, in order that they can be monitors either from the center or the substation. When the latter system is employed, no relaying devices are required since the center is directly connected to the supervised objects.

To determine the system, the problems of cable

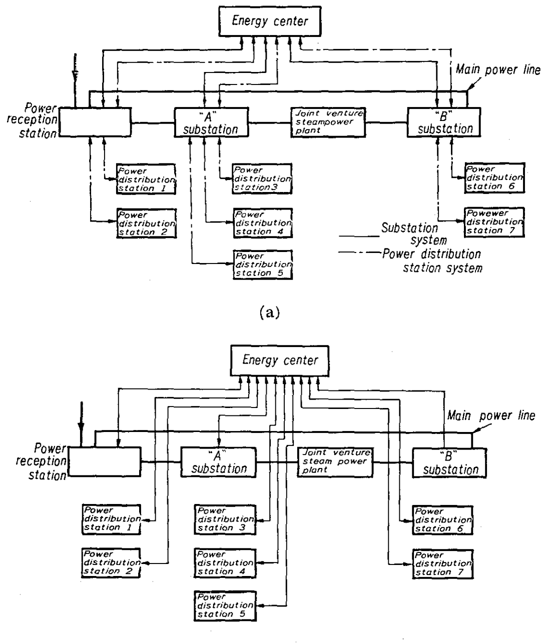


Fig. 3 Skeleton diagram of centralized supervisory-control

laying, supervisory method and maintenance method must be taken into consideration. The data transmission system of the telemetering system will be identical with that of the supervisory-control system.

IV. REMOTE SUPERVISORY-CONTROL EQUIPMENT

As was mentioned in the preceding section, the "(1 : 1)×N" system is employed. The equipment is transistorized for economization in installation space and for improvement in reliability.

1. General Description of the Equipment

In cooperation with Fujitsu Limited, Fuji Electric has developed, leading in the industry, a transistorized remote supervisory-control system in which are incorporated with various advantageous features, and supplied a number of units. The standardized system (Type TC–100URS) is directly applicable also to centralized supervisory-control for electric power equipment in steel works. In the remote supervisory-control system, the term "position" is often used. 1 position corresponds to on/off (make/break) control action and its resultant indication. Therefore, the capacity of the equipment is determined by the number of positions accomodatable. Of the Fuji's equipment, up to 100 positions can be fabricated. In this equipment, a pulse code system is employed in order to minimize the number of wires (4 wires or 2 wires) to connect the master station to the remote station and to distinguish the positions, control signals, and display signals. On the other hand, since the pulse signal available from the transistorized circuit is of a small voltage and width, the signal cannot be fed directly into the transmission line.

When transistorized electronics are employed, the pulse code is converted into a frequency signal through FS modulation and the frequency signal is sent through an isolating transformer to the transmission line. The standard signal transmission speed is 200 Bauds.

1) Control code

The code construction of the TC–100URS is shown in *Fig. 4*. The 100 positions are distingushed as follows: The 100 positions are grouped into 10 groups—each group consisting of 10 positions. Each of the 10 groups is identified by $_5C_2$ code which has two long pulses among 5 pulses. Each of the 10 positions are identified with the $_5C_2$ code. Thus, identification can be made for 10 (groups)×10 (positions)=100 (positions).

The control items are identified with $_3C_1$ code for the ON, OFF, and spare. The spare can be used for telemetering command as required. The code is transmitted consecutively twice and is checked at the receiving station in order to guard against errors. As for the code, a PDM (pulse duration modulation) system is employed. The point changing from a mark to a space or from a space to a mark represents the head of each pulse. The bit is determined whether the period to the next changing point is longer than a specified value (long pulse or 1) or is shorter (short pulse or 0). The period of the long pulse is twice that of the short pulse. Of the two

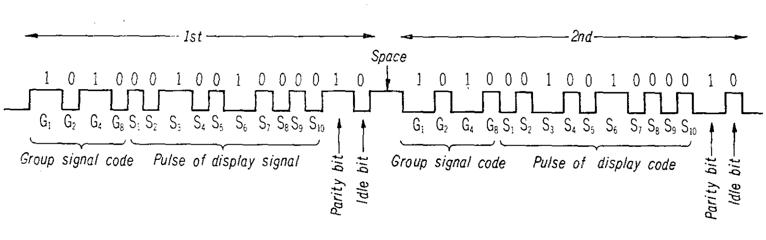


Fig. 4 Construction of control signal code

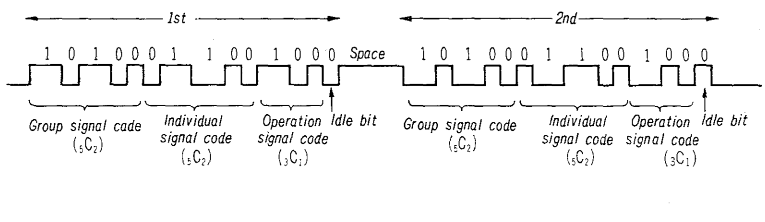


Fig. 5 Construction of display signal code

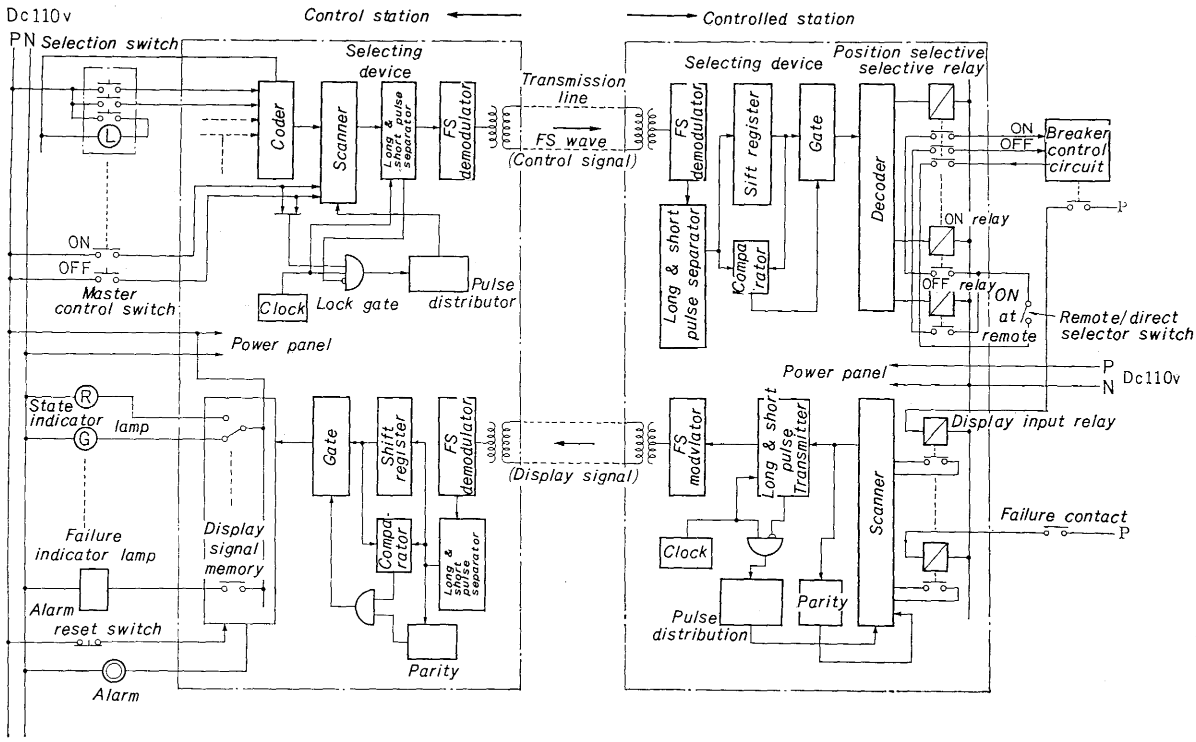


Fig. 6 Block diagram of URS type remote supervisory-control equipment

consecutive transmissions of the code, the marks and spaces are inverted for the 1st and 2nd transmission, in order that errors caused by increase in code distortion can be easily detected.

2) Display signal code

The construction of the display signal code is shown in *Fig. 5*. The display signal is transmitted in a cyclic system and, therefore, the signals for all displayed items are constantly and sequentially transmitted to the master station. That is, all displayed positions are grouped into 10 groups, a display code as shown in *Fig. 5* is provided for each group, and the positions are transmitted cyclically with a PDM code. The initial four bits (G1, G2, G4, and G8) are group codes which identify 10 groups with a binary code. The subsequent 10 bits (S1, S2,...... ......S10) are display bits, each of which represents the state of the monitored devices. The bit which is representing a device in the ON state is made a long pulse (1) and that representing a device in the OFF state is made a short pulse (0). For example, the S5 pulse indicates that the device of position 55 is in the OFF state, since the group code is $1010 \rightarrow 1\times2^0+0\times2^1+1\times2^2+0\times2^3=5$ or is designating group 5. The signals are transmitted constantly and sequentially starting by group 1 signals. The time period for 1 cycle is 2~3 seconds at a transmission speed of 200 Bauds.

3) Construction of the equipment

The construction of the equipment is shown by the block diagram in *Fig. 6*. The individual circuits which send or receive the command signals and instruction signals from external power line circuits consist of electromagnetic relays (primarily wire spring relays) for isolation from the external circuits. Other common circuits are of transistors and other solid state electronics.

2. Monitored and Controlled Items

The items to be monitored and controlled by the center through the remote supervisory-control equipment are conditions of equipment at the substations and power distribution stations. The items would be classified as follows:

1) Monitor and control
   (1) ON or OFF states of all circuit breakers of substations (power distribution stations).
   (2) ON or OFF states of disconnectors of substations (power distribution stations).
   (3) LRT tap switching control (auto/man switching, increase/decrease switching).
   (4) Start or stop states of transformer cooling fans.
   (5) Others (operation/lock switching of relays, etc.).
2) Monitor only
   (1) LRT tap positions
   (2) Failure indications

Quite a large number of indications are required if an indication is provided for each failure. Failures should be classified according to nature in order to reduce the number of indications (positions). As a general rule, they are classified as follows:

(1) Banking display.
(2) Short circuiting (may be classified together with banking indication).

(3) Short-circuiting to the ground (may be classified together with banking indication).
(4) Serious failures of transformer (may be classified together with banking indication).
(5) Light failure of transformer (may be classified together with banking indication).
(6) Overvoltages (for respective voltage levels)
(7) Undervoltages (for respective voltage levels)
(8) Bus bar grounding (for respective voltage levels)
(9) Pilot wire relay failures (if used)
(10) Abnormal states of OF cables
(11) Ac source failures
(12) Dc source failures
(13) Abnormal states of control air pressure
(14) Fire
(15) Open states of doors
(16) Remote/direct switching
(17) Others

V. TELEMETERING EQUIPMENT

Various types of telemetering systems are possible. A dc direct transmission is employed from the following viewpoints:

(1) Since the signal transmission is within the same site, the distances from the measured points (substations and power distribution stations) to the monitoring point (center) are small.
(2) The number of required transmission cables can be estimated and laid.
(3) System expansion can be conveniently accomplished.

1. General Description of the Equipment

The measured items primarily are electrical quantities. It is desirable that the output currents for all measured quantities are of an electrical current signal of a certain range. For examples, ratings of Fuji F-series direct telemetering converters are shown in *Table 1*. The outputs of these converters are standardized at 0.15~3 ma dc. Measuring principles of the converters are as follows:

(1) 3-phase wattage: Time division multiplier
(2) 3-phase reactive power: Time division multiplier
(3) Ac rms voltage: Square mean circuit and root
(4) Frequency: Transistorized switching circuit and saturation transformer
(5) Ac voltage: Rectifier
(6) Ac current: Rectifier

All transducers are of the solid state type. The transducer output (0.15~0.3 ma dc) are transmitted through the transmission cables to the center. Transmission distances of several killometers can be well covered, taking the internal impedance of the receiver also into consideration, since the gauge of the transmsission cable conductor is 0.9 mm or 0.65 mm of diameter which corresponds to 55 Ω/km or 105 Ω/km and since the permissible load resistance is 0~20 kΩ. In the output circuit of the transducer, a voltage which is proportional to the output current is applied through a negative feedback circuit to the dc amplifier.

The measured signal which has been transmitted through the transmission line to the center is indicated by an indicator and at the same time recorded by a recorder. The received current signal may be converted into a millivolt signal by a precision recorder, a potentiometric self-balancing recorder (1-pen or 2-pen type) is used in general. The signal also may be applied to a control computer to provide data for wattage computation. Minimum two wires are required for transmission of one signal. The number of wires can be reduced by employing

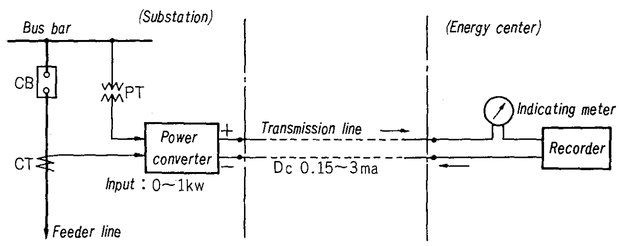


Fig. 7 An example of direct telemetering circuit

Table 1 **Ratings of Direct Telemetering Converter**

Item	Input: Voltage rating (v)	Input: Current rating (amp)	Input: Measuring range	Output	Remarks
Three-Phase Power	110	5	0~1 kw −1~0~1 kw	Dc 0.15~3 ma (Load resistance 0~2 kΩ)	Power source: Eiher one of the below Dc 24 v Ac 110 v, 100 v Ac 200 v Allowance: ±0.5% * mark denotes ±1.0% For ac voltage and current measurement, the following are also available: Output: Dc 0~10 ma Dc 0~ 1 ma
Three-Phase Reactive Power	110	5	0~1 kvar −1~0~1 kvar		
Ac Voltage (rms)	110	—	70~140 v 90~120 v		
Ac Voltage *	110	—	0~150 v 70~140 v 90~120 v		
Ac Current *	—	5	0~5 amp		
Frequency	110	—	45~55 Hz 55~65 Hz		
Dc Voltage	—	—	0~5 v 10~50 ma		

a common return lines.

In addition to the above measurements, watt hour (whr) and var hour (varhr) also are measured. For this measurement, pulse transmitters are incorporated with the whr and varhr meter of the substation or power distribution station, and the transduced signals are transmitted through a pair of transmission lines to the center. At the center, these signals are counted and indicated by a counter. For the overall wattage, the pulse signals which are received from the required power input and output points are totaled by a pulse adder and then displayed by the counter.

2. Measured Items

In order to minimize the number of indicating and recording instruments, items which are not required to be constantly monitored are displayed or recorded through selectors. The selection command signals are transmitted from a combination of the corresponding circuit breaker selector switch and instrument switch through the remote supervisory-control equipment to the remote station. The remote station connects the transducer output to the transmission line in obedience to the received command signal. Typical measured items are shown below. Some of them may be omitted and some other items may be added in accordance with special features of individual steel works.

1) Constantly indicated items

(1) Line flows of power reception lines and main power lines (w and var)

(2) Generated wattage of power plant (own power plant or joint venture steam power plant)

(3) Total electricity of steel works (w)

(4) Frequency (f) at power receiving substation

(5) Each feeder wattage (w) (may be selectively measured)

(6) Each bus bar voltage (v) (may be selectively measured)

(7) Each substation bank secondary voltage and current (v and amp) (often measured selectively or by switching)

(8) Total electricity consumed by the steel works (whr)

(9) Reception line wattage and reactive wattage (whr, varhr)

(10) Total wattage of each substation (whr)

(11) Maximum wattage of power reception and overall premises consumption (15-minute demand)

2) Constantly recorded items

(1) Line flows of connection lines and main power lines (w and var)

(2) Reception point bus voltage (v)

(3) Frequency (f) at the reception point

(4) Substation bank secondary wattage (w) (may be omitted)

3) Selectively measured items

(1) Each feeder current (amp)

(2) Each bus voltage (v)

In addition to the above, synchronous tuning of the system may be controlled from the energy center. For synchronization inspection, the voltages, frequencies and phase difference of both systems must be measured. The voltages and frequencies can be readily measured with the remote measuring system. However, the phase difference cannot be easily made with the remote measuring system. For phase difference measurement, the outputs of the PT secondary circuits are directly transmitted to the energy center and are applied to the synchronization detector.

VI. ENERGY CENTER INSTRUMENTS

The energy center has an overall supervisory panel (on which indicating lamp, display the states of the instruments and failures to which signals are being transmitted through the remote supervisory-control equipment, indicating meters which displays remotely measured values, recorders, and integrators are installed at most effective locations), and control desk on which apparatus control switches which are operated through the remote supervisory-control equipment, and telemetering switches are installed.

1. Overall Supervisory Panel

The objective of the overall supervisory panel is to monitor the overall electric power system of the steel works. Various types of supervisory systems are used according to maintenance systems of steel works. Typical ones are illuminated-type switchboards, graphic boards and mosaic boards. They are classified according to the display systems of the electric power systems on panels.

1) Illuminated-type switchboard

The overall electric power system within the premises is displayed with illuminated and simulated bus bars. An example is shown in *Fig. 8*. Illumi-

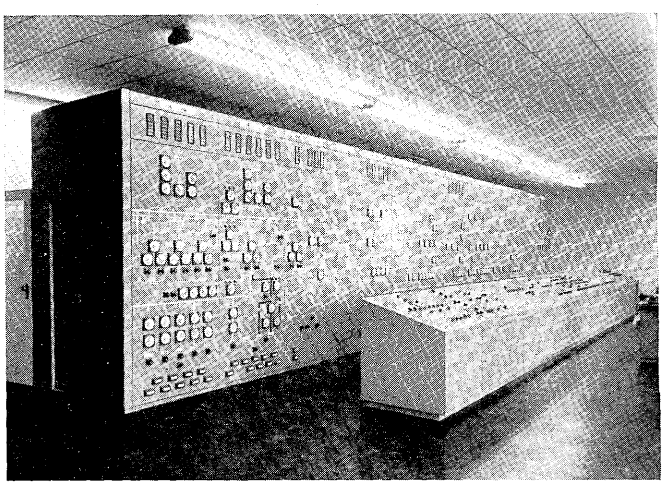


Fig. 8 Illuminated type switchboard and control desk

nated and simulated bus bars, illuminating indicator lamps, illuminating symbol lamps, and indicating meters are mounted on this board. The illuminated and simulated bus bars are color coded in accordance with voltage levels so that the system can be easily monitored even when lamps go off. Apparatus symbols (CB, DS) are installed at the corresponding positions on the system. The breakers are indicated by square symbols and disconnectors with circle symbols, and the corresponding apparatus numbers are written being enclosed with respective symbols. The illumination system is of a voltage application system, and the voltage conditions of the required systems are transmitted through the remote supervisory-control equipment. Each symbol is lighted with an output of the remote supervisory and control equipment. The indicating meters are installed near the respective apparatus to be indicated. The wattage indicators are mounted on bus bars in order that line flows can be easily monitored. Illuminated failure indicators are monuted on the top panel and are lighted with output of the remote supervisory-control equipment. Recorders, integrators, illumination circuit auxiliary relays are mounted on the rear panel. The remote supervisory-control equipment also is installed in parallel. As shown in *Fig. 8,* the control desk is installed in the front of the switch board. Switches and bus bar corresponding to those on the illuminated type switch board are mounted on the control desk. The apparatus control switch is of a one-lamp-type switch, and the operating state of the apparatus can be checked by the switch position. The operation command signal is delivered from this switch to the remote supervisory-control system.

2) Graphic board

The graphic panel displays the overall electric system graphically in the most compact fashion. An example of a graphic board is shown in *Fig. 9*. A panel is provided for each of the substation groups shown in *Fig. 1*. The upper part of the panel indicates the substation and the lower part indicates the system in which the distribution stations are connected with the substation. The system is indicated by the pasted bus bars which are not illuminated. Operating states of apparatus are indicated with illuminated symbol lamps. As is the case for the illuminated type switch board, the breakers are denoted by square symbols and the disconnectors by circular symbols, with apparatus numbers enclosed in them. The indicating meters are of horizontal-scale type and are mounted at the top of the board. The meters for monitoring the line flows are mounted on the system simulating bus bars. The recorders are mounted on a lower section of the front panel.

The rear panel consists of an auxiliary relay panel and a remote supervisory-control rack. The apparatus control switches and failure indicators are mounted on the control desk which will be described later.

The board shown in *Fig. 10* is different from that shown in *Fig. 9*. In this case, the substations and power distribution stations shown in *Fig. 3* (b) are connected in the relationship of corresponding master station and remote stations. One panel is provided for each combination of a substation and a power distribution station, and such panels are laid out in parallel, resulting a graphic board in appearance. Each panel indicates the substation and power distribution station with pasted bus bars and indicates the breakers and disconnectors with illuminated symbols. The breaker symbol is used also as a name plate, and a line name may be inscribed on this plate. Compact lock-type control switches also may be mounted in parallel with symbols on this boord. Command signals to the remote supervisory-control equipment are generated by operating a combination of the selector switch and

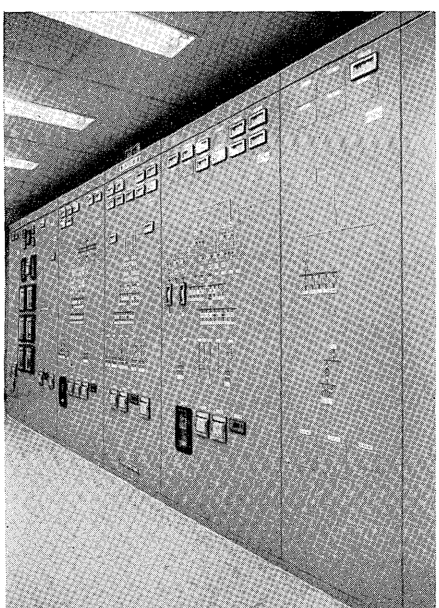


Fig. 9 Graphic board for power systems

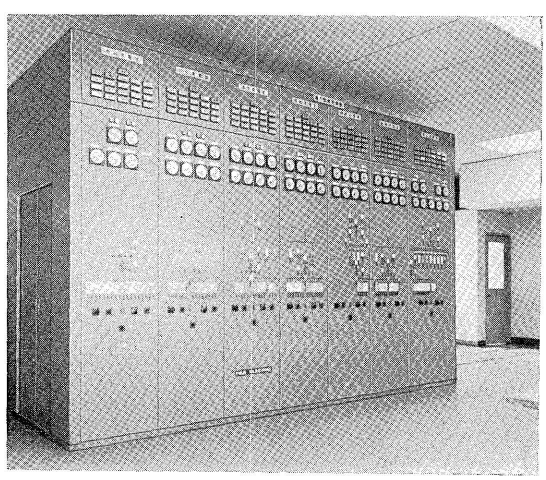


Fig. 10 Remote supervisory-control switchboard

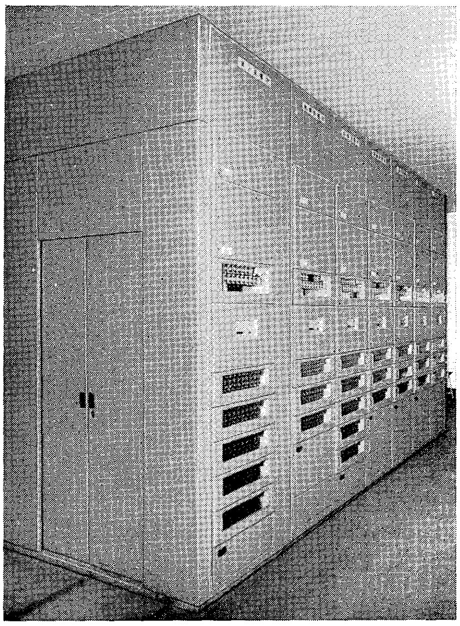


Fig. 11 Remote supervisory-control equipment (Energy center)

master control switch (two-control-action) of this board. Or, since no control desk is employed, the command signals are transmitted directly from this board. The indicating meters (both of constantly indicating meters and selectively indicating meters) are of wide-angle types and are mounted on this board. The illuminated failure indicators are mounted at an upper section of the board. *Fig. 11* are rear view of the panel shown in *Fig. 10*. The remote supervisory and control equipment panels are installed in parallel. Each of these panels corresponds to each of the front panels.

3) Mosaic board

The mosaic panel consists of base plates on which a number of holes of a standardized dimensions of 25×25 mm are perforated, and plastic-resin symbol blocks, blind blocks, switches, and illuminated indicators are inserted in these holes and are tentatively fixed. As for symbol blocks, lines, bus bars, transformers, generators, breakers, and disconnectors are available. Systems are made up using these blocks. An example is shown in *Fig. 12*. An advantage of the mosaic board is that it can be modified rapidly, simply by changing mosaic blocks, in accordance with actual modification of the supervised electrical power system. Therefore, this system is advantageous for supervision and control of electrical power systems of steel works where modifications are often required. *Fig. 12* shows a board which is used for line flows monitor of the main power lines. The main power line is displayed on this board.

All of the bus bars, lines, and apparatus symbols are illuminated in a fashion similar to that described in Item 1). Selector switches also are mounted on this board in order that the breakers of the system can be remotely controlled from this panel. The line flow of the system is indicated by the 80 mm wide angle indicating meter which is mounted on the simulated connection line. Illuminated failure indicators and feeder power indicators are mounted on the top panel. The total power meter, reactive power meter, and receiving frequency and voltage recorder are mounted on a lower section of the board.

4) Control desk

An example of control desk is shown in *Fig. 13*. This control desk is used in combination with the graphic board shown in *Fig. 9*. Remote-measurement selective-indicating wide-angle indicating meters and illuminated collective indicators are mounted on the slanted section of the desk. Selector switches and control switches corresponding to the remote supervisory and control equipment are mounted on the flat top of the desk. These meters and switches are laid out graphically. Internally-illuminated compact lock-type switches are used as selector switches. Remote control operation is made as follows: The selector switch is pulled so that the corresponding symbol on the graphic panel flickers. Then, either the ON or OFF pushbutton is depressed so that the signal is transmitted through the remote supervisory-control equipment to the corresponding apparatus of

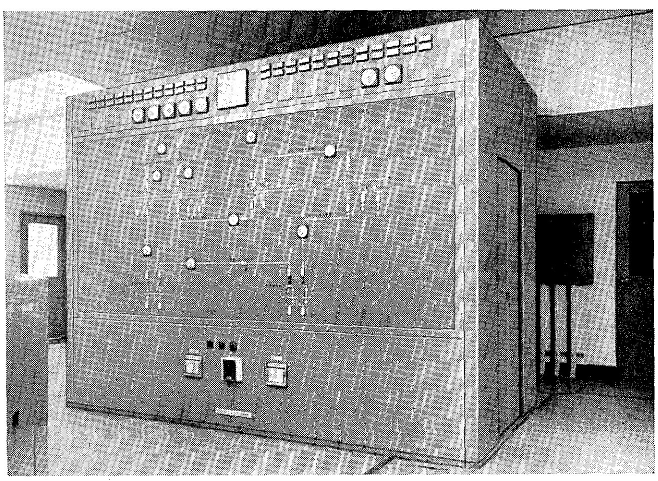


Fig. 12 Mosaic type supervisory mimic board for power systems

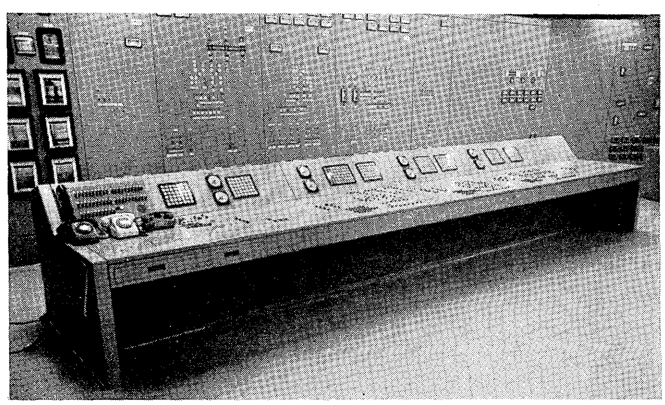


Fig. 13 Operation desk

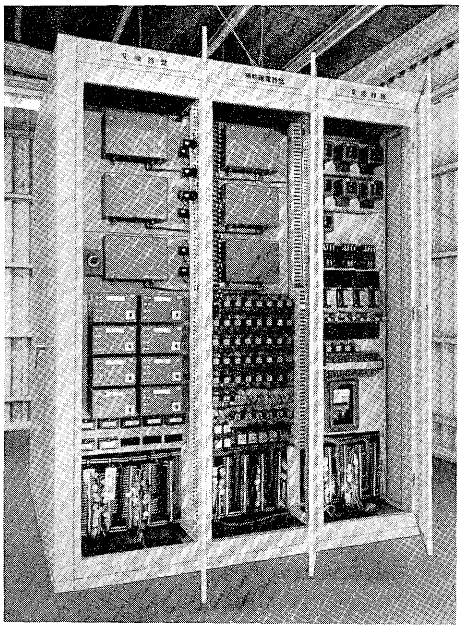


Fig. 14 Converter and auxiliay relay cubicle

the remote station. As the response signal returns from the remote apparatus to the center, the apparatus symbol stops flickering and lights continuously if the apparatus is in the ON state or goes off if the apparatus is in the OFF states. Upon insuring this, the selector switch will be reset. By this manipulation, the operation is complete. An interlock circuit is incorporated in order to prevent selection of a plural number of selector switches selected simultaneously.

Selective measurements are made on voltages and currents. As for indicating meters, a voltmeter and an ammeter are installed for each substation group. These meters are of percentage scale.

Actual value can be obtained by multiplying the indicated value by the multiplication factor which is indicated by the multiplication factor lamp located beneath each meter. For selecting operation, after the breaker selecting switch for the point to be measured is operated, depress the measuring push-button so that the command signal is transmitted to the remote supervisory-control equipment.

When this is done, the primary voltage and current of the PT or CT corresponding to the selected point are indicated by the lighting of the multiplication factor indicator lamp. The meter continues indicating the value so far as the measuring switch is kept depressed.

The failure indicator lamps flicker or continuously light in accordance with the nature of failures. An alarm reset button, a flicker reset button, and an indication reset button are provided for each substation group. All of the failure lamp lighting circuits are fabricated in the remote supervisory-control equipment.

VII. CONTROLLED BOARDS

A cubicle-type or open-type self-supporting rack, on which JEM-standard telemetering transducers are mounted, is installed at each substation or power distribution station. A remote station equipment for the remote supervisory-control equipment also is installed. *Fig. 14* shows an example of a converter and auxiliary relay cubicle.

VIII. CONTROL COMPUTER SYSTEM

A control computer system is installed at the energy center. This system collects and processes various data, including electricity, powers, gas, and water. The function of the electric section of the system are as follows:

(1) Electricity control diary (Total wattage for each hour, and sum for overall operation hour for the day)
(2) Computation of economical distribution of electricity
(3) Electricity demand computation and prediction (Prediction of demand values and future load distribution)
(4) Selective shut down of systems (When systems are separated, important loads which are corresponding to the generator output alone left connected and the other systems are disconnected.)

The control diary, together with other energy data, are typed out periodically. As for the computer, as FACOM 270–20 is employed. The input data to the computer is applied from the telemetering equipment after being conditioned to the compatible form by the converters located in the energy center.

IX. CONCLUSION

This article introduces an outline of a centralized supervisory-control system for electric power equipment in steel works. Special supervisory-control situations are omitted to be discussed. We intend to develop futher the centralized control engineering basing on our experience. We acknowlege with thanks the kind cooperation rendered by the concerned parties of steel works.