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S-SERIES ELECTROMAGNETIC SWITCHES

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I. FOREWORD

Over ten years have elapsed since Fuji Electric imported the techniques of Siemens Company and introduced to this country an epochal new type of electromagnetic switches, shattering long established concepts. Through its outstanding features, applications of the electromagnetic switches unimaginable in the past have opened up in the field of various types of industrial controls, starting with the control of the motors, thereby aiding the development of modern industry. Improvements of the internal parts have been continuing as usual during this interval. However due to the necessity of compatibility with the worn parts of already delivered products, the method of installation has not been changed and the original form has been maintained. This may appear to be retrogressive in the age of technical renovation at a fast tempo, but this is because this campany, whose electromagnetic switches are being used in great quantities, exerts a maximum effort to avoid any inconvenience to the users when replacing with spare parts or completely renewing. However, in the technical advancement of electromagnetic switches, the demand is for a product which can endure much more severe service, while from the viewpoint of application, it is important to satisfy the demands for improvement.

At this time, a series of improvements accompanied by some external modifications were applied to the RC 3931 series favored in the past. With the increased employment of new types, a type change is being conducted of the S-series (the Super Long Life series). This utilizes the rich experience of the past, greatly improving the features, as well as incorporating new conveniences for the various applications of users. An introductory outline of this device is given here for use as a reference.

II. PRINCIPLE MODIFICATIONS OF S-SERIES

1. Outline

The S-series electromagnetic switches have been made to succeed the original RC 3931 series, with new improvements applied to various parts and designated as SRC 3931 series. Classifying according to difference of rated capacity, the 14 varieties shown in *Fig. 1* are available, making it possible to select an electromagnetic switch to correspond to the rating of practically any motor.

The area surrounding the contact section has been improved materially for this type change. The plan also included improving the characteristics. At the same time, the construction was improved to offer accommodations in practical applications. The main resulting points are as follows:

(1) The material for the arcing chamber has been made arc-tight throughout and anti-inching characteristic have been improved considerably.
(2) Silver alloy has been used for contacts of 0 type and above. Together with improving the electrical life of the unit to nearly four times that of the maximum life according to JIS C 8325 standards, the anti-inching life has been extended greatly.
(3) The characteristics of the thermal relays in the 4T subsequent types have been changed to faster reaction types than the original ones, thereby improving the protective features. Also, it has been made possible for 3-pole heat elements to be attached easily.
(4) All types below 10 have been made with their installation dimensions compatible with the electromagnetic contactors made by Siemens.
(5) It has been announced that the double standard rating of those without case is somewhat higher than those with the case cover attached.
(6) The case has been modified to some degree, types below 4 having been made deep drawn. Also, the case installation holes of the larger types were improved for easy mounting. Furthermore, the base used in common for coupling of thermal relay and the electromagnetic contactor used in types above 4T has been eliminated and the form for using without covering has been made more neat-looking.

2. Items Related to Contacts

1) Details of modification

The harmony of the materials, dimensions and

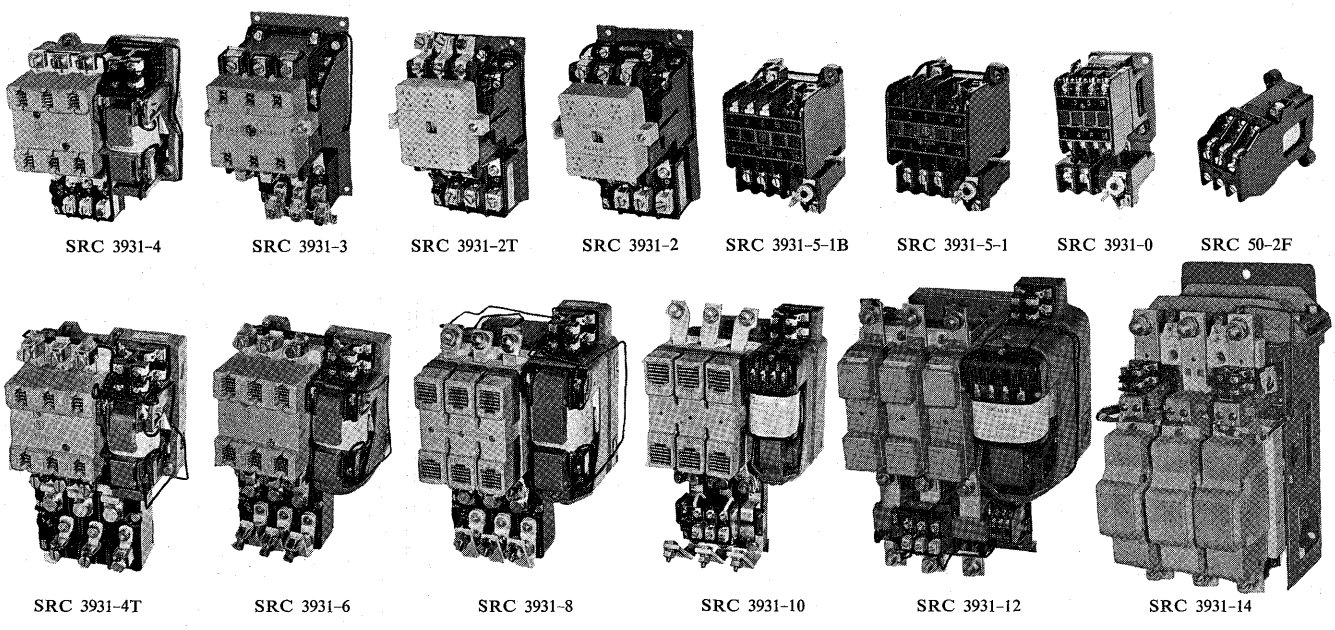


Fig. 1 S-series electromagnetic switches

construction of the making and breaking contacts of electromagnetic switches must be preserved. For instance, even if some strong material is used for the contacts, it is meaningless if the arcing chamber becomes rapidly damaged from arcing during inching. Also, it is not suitable for compensating for arcing continuing at the contact when current is broken or for excessive wear from starting surge current due to extra chattering construction with alloy contacts.

Customarily, 99.9% pure silver contacts have been used in Fuji electromagnetic switches. The electrical resistivity of pure silver is very low, so that the contact resistance is low. Furthermore, since it is very stable chemically, it will not markedly hinder the contact ability even with chemical changes such as oxidation and sulfidization, thus making them very outstanding contacts for low and medium capacity electrical applications. Moreover, the RC 3931 series incorporates rational design which includes new concepts of application and also many patents from the aspect of construction such as prevention of quick contact during the time of path closing, prevention of residual arc during path opening or for the purpose of curtailment of arcing time, and therfore, even without the employment of alloy contacts, high characteristics surpassing the features mentioned in A–1–1 can be insured. Also, with respect to inching, it is constructed so that the same number of rotations and current may be used.

However, for the requirements, it has been accepted that it must be able to withstand the most stringent demands on it and as an electromagnetic switch, it must also cope with these demands. Moreover, serious problems such as the following existed from the past. The first problem is damage of the arcing chamber from high arcing temperature during inching if the chamber is left as is, even with the contact made stronger. The second problem is the danger of decortication and falling off of contacts when severe inching is repeated. In other words, when large currents are repeatedly cut off from the contact, the contact surface undergoes considerable mechanical distortion, producing power strong enough to bend the base metal, as shown in *Fig. 2*. Also, additional mechanical impact force is applied to the soldered surface of the contact and it is necessary for the soldered joint to be strong enough to withstand this force. However, it is rather difficult to solder an alloy contact to base metal and if not done properly it is liable to result in decortication damage and abnormal wear. Accordingly, it becomes meaningless from a physical standpoint to use material with minimum anti-arcing wear properties.

Repeated investigations have been conducted for the past several years to surmount these two large obstacles. However, the problem of the wearing of the arcing chamber has been solved by the complete usage of the Fuji arc-tight arcing chamber, which has been developed and accepted. Also, the second problem has been solved by devoting a great deal of consideration to the alloy construction.

The SRC series were thus completed with assurance of withstanding severe service.

Of course the construction of the contact portion remains the same as those of the past and such features as increasing the electrical life with the

Fig. 2 Deformation of contact support by heavy inching

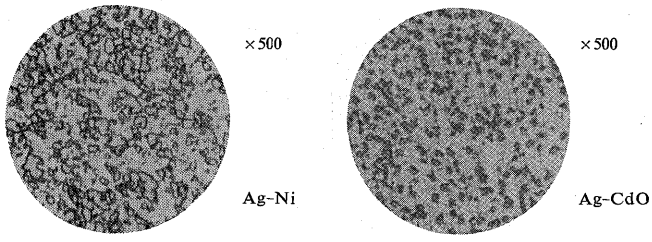


Fig. 3 Microscopic photograph of contact material

prolongation of life of the arcing chamber, quick contact prevention and prevention of residual current, have been carried over to the contact construction. Through this harmony of construction and material, it was possible to greatly heighten the performance.

2) Alloy contact

The alloy contacts for this S-series used special alloy of silver-nickel (Ag–Ni) for 0 to 2T types. As shown in *Fig. 3*, the anti-arcing wear amount of the sintered alloy of miniature construction is ½ to ⅓ that of the silver and sufficient malleability is provided even for rivet construction. Those which are much more thinner have equally satisfactory soldering properties and should be suitable be contact material for miniature contactor use. For types above 3, contact materials of the silver-cadmium oxide (Ag–CdO) system are used. With special construction of the soldering surface, the adhesive strength to the base metal has been increased.

3) Arc-tight arcing chamber

As already announced[1], the anti-arcing feature of the arcing chamber of electromagnetic switches must be considerable, the precision of the dimensions and the characteristic strength must be high.

Moreover, the material for this must be obtained economically, and the special ceramic Fuji arc-tight should be outstanding for the purpose of reaching these goals. An arc-tight has already being used in a position of the types and favorable comments have been received. Recently the arc-tight has been employed in arcing chambers of overall type models and arcing chambers have been completed which can withstand severe inchings with no effect whatsoever.

III. TYPE MODELS AND THEIR RATINGS

1. Varieties and Ratings

1) Explanation of type models

What are widely known as magnet switches may be classified by type models into the following major categories.

Electromagnetic switch
SRC 3931-□

Electromagnetic switch without case
SRC 3931-□ without case

Reversible magnetic switch
SRC 3938-□ R

Reversible magnetic switch without case
SRC 3938-□ R without case

Electromagnetic contactor
SRC 3631-□

Electromagnetic contactor with cover
SRC 3631-□ C

Reversible electromagnetic contactor
SRC 3938-□

Reversible electromagnetic contactor without case
SRC 3938-□ without case

Auxiliary relay SRC 50-□
SRC 50-□ F

Table 1 **Ratings of S-series Electromagnetic Switch**

Model	When case is attacted									When case is not attached								
	Rated capacity (kw)								Current (amp)	Rated capacity (kw)								Current (amp)
	1φ motor use		3φ squirrel-cage motor use			3φ wound-rotor type motor use				1φ motor use		3φ squirrel-cage motor use			3φ wound-rotor type motor use			
	100 v	200 v	220 v	440 v	550 v	200 v	440 v	550 v		100 v	200 v	220 v	440 v	550 v	220 v	440 v	550 v	
0	0.4	0.9	2.2	2.2	2.2	2.2	2.2	2.2	10	0.5	1.1	2.7	2.2	2.2	2.7	2.2	2.2	12
5-1	0.8	1.6	3.7	3.7	3.7	3.7	3.7	3.7	16	0.9	1.8	4	3.7	3.7	4	3.7	3.7	18
5-1B	0.8	1.6	3.7	5.5	5	3.7	5.5	5	16	0.9	1.8	4	5.5	5	4	5.5	5	18
2	1.2	—	5.5	11	7.5	5.5	11	15	25	1.7	—	7.5	11	7.5	7.5	11	15	35
2T	1.7	—	7.5	11	7.5	7.5	15	15	35	—	—	11	11	7.5	11	15	15	50
3	—	—	11	22	27	11	22	27	50	—	—	15	30	37	15	30	37	60
4	—	—	15	30	37	15	30	37	60	—	—	19*	37*	45*	19*	37*	45*	75*
4T	—	—	19	37	45	19	37	45	75	—	—	22	37	45	22	37	45	90
6	—	—	25	50	60	25	50	60	100	—	—	30	60	75	30	60	75	120
8	—	—	37	75	95	37	75	95	150	—	—	40	80	100	40	80	100	165
10	—	—	50	100	125	50	100	125	200	—	—	55	110	135	55	110	135	220
12	—	—	75	150	190	75	150	190	300	—	—	90	180	225	90	180	225	360
14	—	—	125	250	280	125	250	310	500	—	—	150	250	280	150	300	375	600

※ Note: Indicates values when used as electromagnetic contactor without thermal relay. In the case of thermal relay attached, the value will decrease to those when case is attached.

Table 2 **Application for Inching and Plugging**

Model	Case of 50% inching		Case when 75 to 100% inching and plugging relay is used to stop the motor quickly	
	100,000 times (kw)	500,000 times (kw)	100.000 times (kw)	500,000 times (kw)
0	1.7	0.6	1.1	0.4
5-1	3.7	1.5	3	1.1
5-1B	3.7	1.5	3	1.1
2	5.5	3	5.5	2.7
2T	5.5	3	5.5	2.7
3	11	5.5	8	4
4	13	7	11	5.5
4T	13	7	11	5.5
6	22	12	19	11
8	30	19	25	15
10	40	25	37	22
12	52	30	45	26
14	60	37	50	30

Table 3 **Rated Capacity of SRC 50-2F**

Max. Continuous Current Flow	Rated Making Current	Rated Breaking Current ($\cos\phi=0.3\sim1$)
		24~550 v
6 amp	10 amp	2 amp

The electromagnets used for all of the above are ac types. For dc applications, suffix/GS to the end of the Model No. For off delay types, add /D or /DR (for instance, SRC 3931-4/GS, or SRC 3931-4/DR, etc.)

2) Ratings

The already introduced RC series were not simply remodeled, but five new types added were 02 type (SRC 50-2F), 5-1B type (SRC 3931-5-1B), 3 type (SRC 3931-3), 12 type and 14 type. With these additions, a set has been completed of abundant variety and long life and with current ratings from 2 amp to 600 amp. The standard rating capacities of the S-series are shown in *Table 1*. *Table 2* indicates the capacity with respect to inching. The ratings of SRC 50-2F are shown in *Table 3*.

3) Performance

The S-series electromagnetic switches with respect to the standard rated usage shows performance which surpasses the high performance A-1-1, designated by Japan Industrial Standards JIS C 8325. Refer to *Table 4* for rated voltages and the electrical life with respect to capacity.

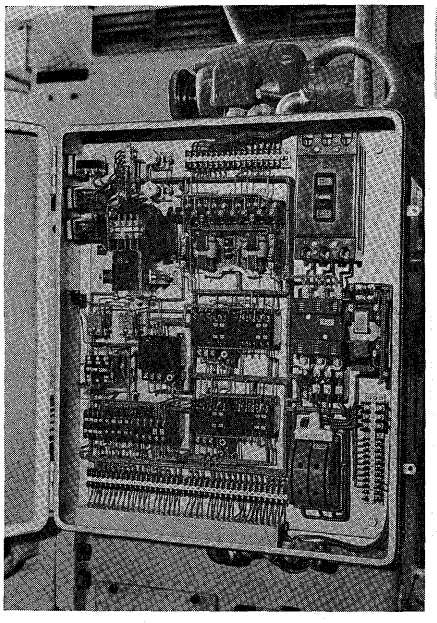
2. When Using Without Case Cover

If temperature rise can be tolerated, it is possible to apply much higher ratings because of the great improvement of performance with respect to the life span as well as the capacity for making and breaking through the usage of silver alloy contacts. The current capacity is limited because the ordinary electromagnetic switch is installed in a compact box. However, in case the non-covered electromagnetic switches and contactors are generally installed inside the control and distribution panels, there is marginal space to decrease the temperature rise, so that the current capacity may be increased. With the condition that the temperature inside the panel is to be below 50°C, the ratings of motors and the resistive loads shown in *Table 1* become applicable.

Whether the temperature inside the panel will be lower than 50°C or not is related to the load ratio or usage ratio and the size of the box. In a much stricter sense, actual experiments must be conducted to determine this. As for the actual problem of application, it is most appropriate to decide based on experience in panel design. When uncertain in the case of limitations, it is recommended that the selection be made with the rating of those with case

Table 4 **Characteristics of S-Series Electromagentic Contactors**

Type Model		Making & Breaking Capacity	Opening & Closing Frequency (exceeding times/hr)	Voltage (v)	Electrical Life (depend on the application of *Table 1*)		
					Electrical		Mechanical
					Case attached	Without case	
SRC 3631	0~10	More than 10 times the rated load current	1800	220	Over two million times, however 1,5 million times for Models O & 4T	Over one million times	Over ten million times
				440	Over one million times		
SRC 3931 SRC 3938	12	More than 10 times the rated load current	1200	220	Over one million times	Over one million times	Over five million times
				440		Over 500,000 times	
	14	More than 10 times the rated load current	1200	220	Over 500,000 times	Over 500,000 times	
				440			
JIS C 8325 A-1-1		More than 10 times the rated load current (Class A)	1200 (Class 1)	—	Over 500,000 times		Over five million times



A sample name plate
ENCL : Application when case cover is attached
OPEN : Application when case cover is not attached

Fig. 4 Control box for machine tool

covers. An example of the control box used for machine tools is shown in *Fg. 4* for reference. (In this case, the temperature rise inside the box is 9 degrees lower.)

IV. CONSTRUCTION AND ITS MERITS

The original RC 3931 series are constructed with special features which incorporate many patents. Furthermore, after the type change into the SRC 3931 series, these special features were applied without alteration. Some explanations of the main items will be given here.

1. Electromagnetic Contactor Main Body

1) Electromagnets

(1) The coupling method of electromagnet and contacts

The smaller electromagnetic contactors are of box type. The electromagnet and the contacts are directly coupled, the direction of movement of these parts being perpendicular to the panel. However, in the larger types of electromagnetic contactors, transfer of the shocks from the electromagnet to the panel cannot be avoided in this type of construction and will probably give rise to secondary problems. Subsequently, the electromagnet is made to move parallel to the panel, as shown in *Fig. 5*. Its construction is such that mutual coupling is possible through a lever which can change position by 90 degrees, so that the position of contact can be changed 90 degrees and thereby move in a direction perpendicular to the panel. Because of this, the undesirable influence on the panels can be eliminated. At the same time, the contact play has been greatly reduced, thus prolonging the electrical life to a great degree.

(2) Alleviation of electromagnet impact.

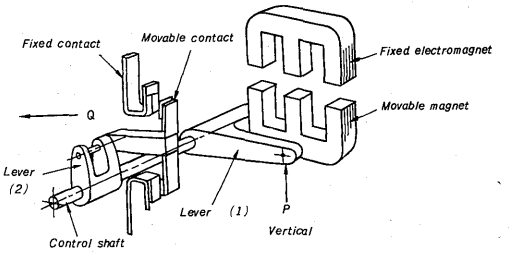


Fig. 5 Link mechanism of large electromagnetic contactor

It is no exaggeration to say that the life of an electromagnetic contactor is determined by the construction method of reducing and holding down the impacts of electromagnet during its attraction. In the S-series, a principle analogous to the catching operation of a catcher in baseball has been recapitulated mechanically, succeeding in alleviating the impact thereby making it possible to obtain contactors with very long life. This operating principle will be explained briefly.

The fixed electromagnet differs from the original ones and the mobility is retained by the top and the bottom springs. The movable electromaget will be attracted in the direction of the fixed iron core when the coil is excited. However, the fixed electromagnet will also resist the force of the cushion spring, no matter how small, and move in the direction of the movable iron core. Since the impact of the fixed and the movable iron cores occur at a position away from the base, the impact has been alleviated greatly because of the construction employing a simple spring board as shock absorber. As a result, it became possible to lengthen the life of contacts by prolonging the mechanical life as well as decreasing the contact jumping.

(3) Electromagnetic coil

In this country, there are districts which differ in frequency, such as 50 cps and 60 cps areas. Furthermore, in a 60 cps area, there are two kinds of ratings, 200 v and 220 v. In other words, the operational ratings of the electromagnetic switches in the 200 v class must be prepared with ratings of 50 cps 200 v, 60 cps 200 v and 60 cps 220 v. The idea of using one coil in common for these three ratings may be possible in the smaller switches but for the medium and the large types, it becomes very difficult to completely satisfy the inherent contradictions in the temperature rise, the operating voltage and the mechanical life. On the other hand, the skillful employment of 2 terminals common usage, 3 terminals, and 4 terminals dual-purpose coil in the S-series solved the above problems at the same time avoiding increase of the coil varieties.

The smaller types with 2 terminals coils are designed so that there is absolutely no hindrance with respect to the above three ratings. In the

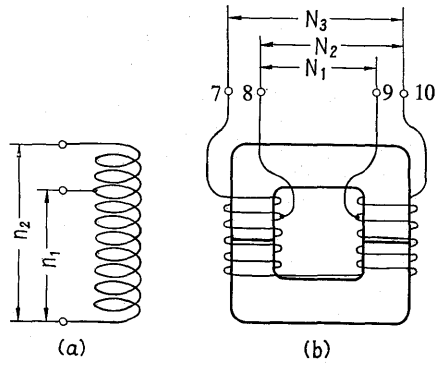


Fig. 6 Coil with 4 terminals

medium type switches, where the magnet is somewhat larger, a 3 terminal dual purpose coil is used to properly function in 50 cps and 60 cps applications, the 60 cps being arranged for 200 to 220 v. While they satisfy the various ratings and perform their respective functions sufficiently, an increase in coil varieties was avoided and they are proving their usefulness.

When it comes to the large type magnets, it is difficult to make it last long in common 200 to 220 v, 60 cps, even with 3 terminals. Therefore, a newly designed 4 terminal coil was used. In this coil, the two coils were each made to function as 3 terminals coils at the U shaped magnet shown in *Fig. 6*, their winding ratios becoming $n_1 : n_2 = 5 : 6$. When line connections are made according to the figure, $N_1 : N_2 : N_3 = 10 : 11 : 12$ is obtained. When connected in the following manner, the attractive force becomes the same and one coil can satisfy any of the three ratings.

Terminal 7–10 : 200 v 50 cps
8– 9 : 200 v 60 cps
8–10 : 220 v 60 cps

2) Contacts and the arcing chamber

In order to prolong the life of the contact, the quality of the contact material must be investigated and the arcing at the surface of the contact must be made to occur rapidly to prevent its residual effect. It must be led to the arcing chamber more effectively and the arcing time must be shortened. The following points, which were under consideration for the RC 3931 series using silver contacts, were applied without change to the S-series and coupled with the renewal of contact material, they contributed to prolonging the electrical life.

(1) Fixed contacts

In general, the available shapes of the ffxed contacts are the three types shown in *Fig. 7* (*a*), (*b*) and (*c*). The movment of the arc from the electromagnetic force is shown by dotted lines. The shape shown in (*a*) is extremely simple and very easy to manufacture, but the arc on the fixed side is driven internally while the arc of the movable contact side is driven to the outside and has the flaw of not being driven enough compoundedly. Consequently, this type is not suitable

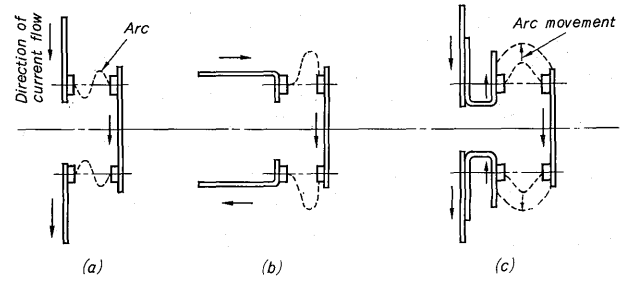


Fig. 7 Arc driven by electromagnetic force on each contact form

for anything other than small capacity and in the S-series, this system being used up to the model 0.

The movable contact side is also driven outward in the shape shown in (*b*) but is not suitable for large capacity although it is much better than the one shown in (*a*) because the fixed contact is not driven as much. In the S-series, this is in effect up to model 5–1B.

The support of the fixed contact is bent into ⊐ shape in those shown in (*c*) and installed with the opening facing outward. The cost of material and the processing may be increased, but the effect of driving the arc outward is greatly improved. In the S-series, all those above model 2 use this shape.

(2) Shape of the arc quenching plate

The previous paragraphs mentioned considerations concerning the prevention of residual arcs at the contact from the arc movements due to the electromagnetic force, an effect conspicuous especially with respect to the fixed contact. In other words, the arc on the fixed contact side moves rapidly outward and is introduced to the arc horn. However, installation of a large arc horn is not possible at the movable contact side (it defeats the purpose of making the contact lighter) and wearing at the movable side is unavoidable. Therefore, as shown in *Fig. 8*, the arc quenching grid interval near each side of the contact bridge is left connected and after the arc enters into the arc quenching plate, the arc from the movable contact disappears. The wearing of the movable contact can be decreased considerably if the arc is made to follow a path from the fixed contact support through the arc quenching grid, reaching the fixed contact support on the opposite side.

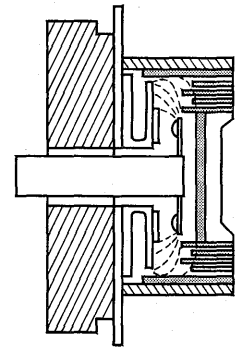


Fig. 8 Arcing chamber

3) Construction of newly developed electromagnetic contactors

The general design features were mentioned above. The construction of the varieties newly added at this time will be described concretely.

(1) SRC 50–2F

This model was introduced as an auxiliary relay with compactness as its aim The contact composition is 3NO–3NC and the construction of the terminal is almost the same as that for SRC 50–3F. Compactness is achieved by decreasing the number of contacts. Because unnecessary curtailment is not effected in the terminal construction, the wiring can be done easily as in the past. Also, with 3NO–3NC contacts, it is sufficient for ordinary auxiliary relay use and a good portion of the auxiliary relay functions can be fulfilled with this device. Furthermore, when additional contacts are required, models SRC 50–3F or 4F may be used. The sectional view of this is shown in *Fig. 9*. Transparent dust protective covering has been attached to the contact portion to prevent defective connections from articles such as wiring scraps through considerations for lessening the incipient defects.

(2) SRC 3631–5–1B

As shown in *Fig. 10*, a special barrier has been attached to the fixed contacts for the type SRC 3631–5–1 and extension of arc to the outside has been prevented to increase the rated capacity, especially for the 440 v class, thus creating this type through these considerations. Although the internal spaces of model 5–1 have been insulated completely for assurance, shorts may occur at the spaces outside the barrier when the voltage is high and large currents are broken in the 440 v class. Consequently, it stands to reason that it is suitable for large capacity if the arc does not extend externally. In order to accomplish this, metallic barrier has been attached near the exit point of arc, successfully raising the capacity.

(3) SRC 3631–3

This model is the one between the SRC3631–2T and the 4 type. The arcing chamber is made arc-tight and the arc quenching plate is used; the construction is very similar to the model 4 including the construction of the connections. On the other hand, the construction of the body is the direct coupling type similar to model 2T. The complete common usage of 50 cps and 60 cps with an operating coil becomes difficult in this large class and therefore a 200 v 50 cps terminal and 200–220 v 60 cps terminal are separately provided as 3 terminal type,

(4) SRC 3631–12

The construction of this model is similar to that of SRC 3631–10 except slightly larger. The electromagnet is made to move parallel to the installation panel surface and perpendicular to the

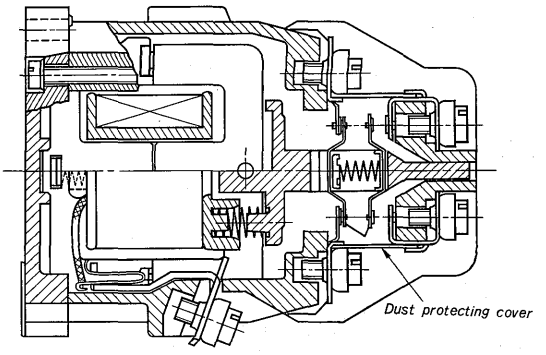


Fig. 9 Construction of SRC 50–2F

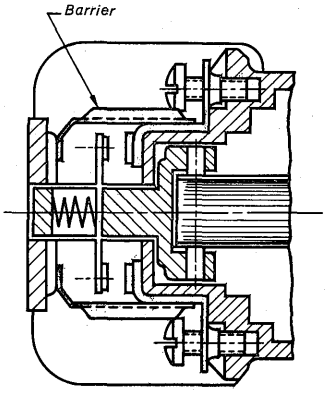


Fig. 10 Construction of SRC 3631–5–1B

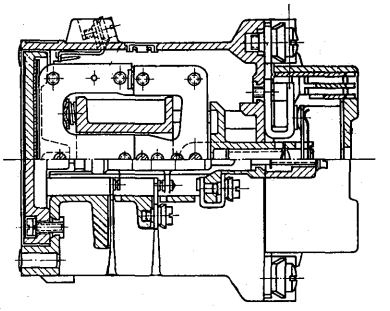


Fig. 11 Construction of SRC 3631–3

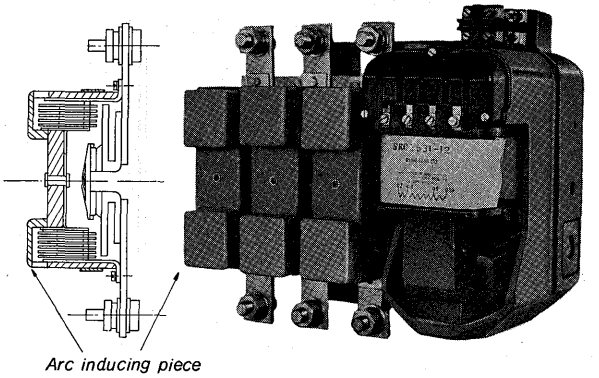


Fig. 12 Construction of SRC 3631–12

contacts by the switching action of a link in order to alleviate the impact force to the other mechanism as well as to prevent quick action of contacts. The contact utilized arcing chambers which have been made independent in various phases; each is equipped with an arc covering plate. When it becomes as large as this device, the surge current when breaking the contact

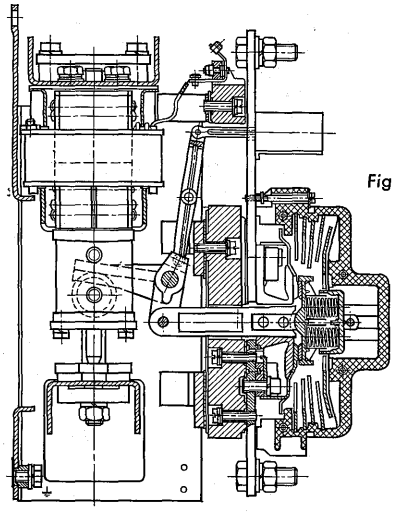


Fig. 13 Construction of SRC 3631-14

creates a large arc and because this leaks out of the arcing chamber, control panel space is necessary. An arc inducing piece has been attached at the point where the arc leaks out and reduction of panel space is thus obtained by conversion of direction to make the arc leak out in the up and down direction. Also, a newly devised 4 terminal coil is used in this model. It can be wired to the fixed terminals accordance to the requirement of 200 v 50 cps, 200 v 60 cps or 220 v 60 cps.

(5) SRC 3631-14

This model, shown in *Fig. 13,* employs a new kind of constuction which was never before available. A U-shaped iron core moves vertically inside a sturdy fram made of steel plate. The contacts are operated by changing the motion of this plunger to horizontal motion by means of a link. Ideas along this line are contributing greatly in prolonging the life as well as in preventing quick action of the contacts, because of its consistency compared to the model 4.

The contacts are constructed similarly, with double breaking and with the arcing chamber independent in various phases. Furthermore, an arc covering plate is not required because of the sufficient distance between the poles as well as the greater use of magnet driving due to the special fixed contact supports. Also, since the arcing chamber of this model is completely enclosed to prevent arc leakage during current breaking the dimensions of the control panel can be reduced.

4) Compatibility of the installation dimensions with the electromagnetic contactor made by the Siemens Company.

The SRC 3931 series match the type K 915 of Siemens but there are some types which differ slightly in construction due to the conditions of the countries. For instance, in order to make it applicable to 50 cps and 60 cps usage, the size of the electromagnet had to be increased and consequently, the enlargement of the case and the installation dimensions were unavoidable. However, the idea is very advantageous, for making the installation dimensions compatible with those of Siemens. The installation dimensions of the model 4 and model 10 die cast frames of the present S-series have been set without relation to the electromagnet and are therefore compatible in installation with those of Siemens. However, in the case of models 0 to 2T, the magnet is housed inside the molded casing and the installation dimensions are slightly larger. Therefore, the mounting holes of the SRC 3631-0 have been elongated as shown in *Fig. 14* to accommodate the mounting dimensions of the RC 3631-0 as well as to match the mounting dimensions of those made by Siemens. Furthermore, the same provisions were made for models 5-1, 5-1B, 2 and 2T to make their installation dimensions compatible with the electromagnetic contactors of Siemens.

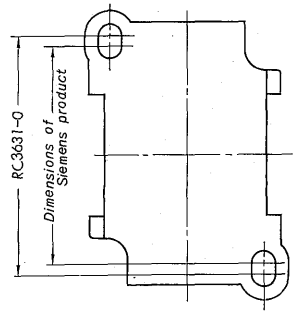


Fig. 14 Mounting hole of RC 3631-0

2. Thermal Overload Relay

1) Type models and special features.

The thermal relays of the S-series electromagnetic switches employ the type models shown in *Table 5.* Their special features are as follows.

(1) Accurate movement characteristics
(2) 2 pole elements are standardized but may be made into 3 poles according to the demand (this excludes the model 0)
(3) Ambient temperature assurance provided
(4) Very wide range of adjustability, 1 : 2
(5) Contacts are 1C (excluding models 0 and 5-1)
(6) Easily applicable to motors due to RC scales (matching the scale current to the rated current of the motor)

2) Thermal overload relays newly applied to S-series

(1) RC 3737-10

These have been applied to the S-series electromagnetic switches in place of RCa 3737-II due to the possibility of attaching 3 pole element as well as not having delayed characteristics. This is the type model previously announced[2]. Its construction is almost the same as the model RC 3737-4; the internal construction is shown in *Fig. 15* and its characteristics are shown in *Fig. 16.*

(2) RCa 3737-20N

Table 5 **Thermal Overload Relay for Ss-eries Electromagneric Switches**

Thermal Relay Type Model	Electromagnetic Switches Type Model	Heat Element				Contact
		No. of poles	Insertion phase	Rated range	VA/pole	
RC 3737-0	SRC 3931-0	2	R. S.	0.125~12	2,1	1NC or 1NO as required
TH-0	SRC 3931-1	2	S. T.	0.125~18	3.1	1NC or 1NO as required
RCa 3737-1	SRC 3931-5-1	2	R. T.			
		3	R. S. T.			
TH-1 as required	SRC 3931-5-1B	2	R. T.			1C
		3	R. S. T.			
RC 3737-4	SRC 3931-2~ SRC 3931-4	2	R. T.	0.125~60	4	1C
		3	R. S. T.			
RC 3737-10	SRC 3931-4T~ SRC 3931-8	2	R. T.	8~170	8.5	1C
		3	R. S. T.			
RCa 3737-20N	SRC 3931-10	2	R. T.	2.5~240	8	1C
		3	R. S. T.			
RC 3737-30N	SRC 3931-12	2	R. T.	100~360	10	1C
		3	R. S. T.			
RC 3737-60N	SRC 3931-14	2	R. T.	200~600	12	1C+1NO, 1NC
		3	R. S. T.			

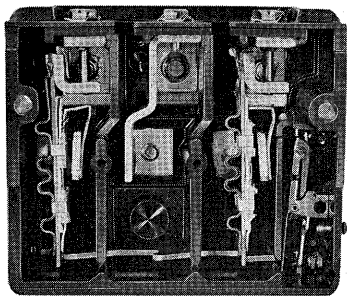


Fig. 15 Thermal relay construction of RC 3737-10

This model is one in which the speed characteristics of the delayed type thermal relay RC 3737-20 have been slightly increased. The resistance in the heater circuit has been reduced in order to decrease the degree of saturation of the saturable CT.

It has a 3 pole base. In the case of 2 poles, the center phase is removed and only the connection plates are attached. (Refer to *Fig. 16* for characteristcs.)

(3) RC 3737-30N

This is composed of a combination of CT and RC 3737-4. The characteristics are shown in *Fig. 16,* When this is used in an electoromagnetic switch such as SRC 3931-12, a portion is modified before installation. Also, for the convenience of the electromagnet VA of SR C 3631-12, SRC 50-2F is used for the purpose of amplification of contact capacity for those below 100 v class.

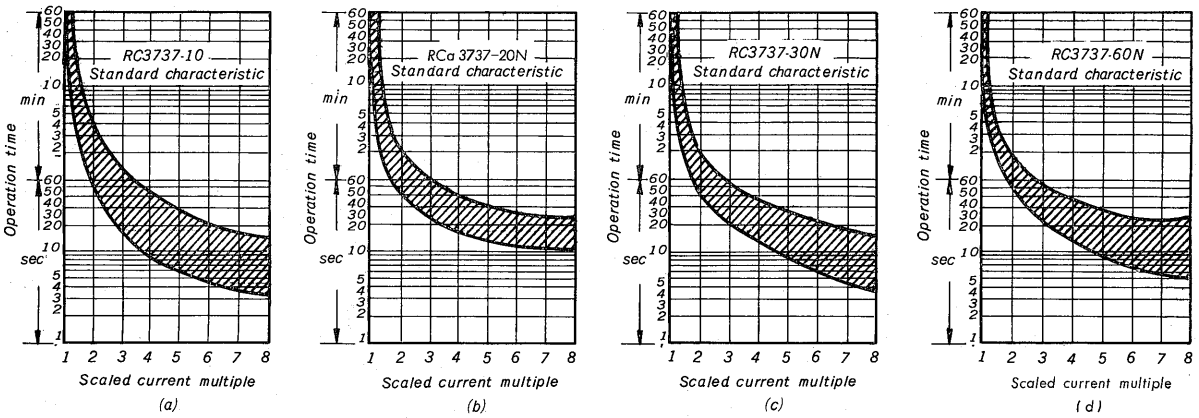


Fig. 16 Standard characteristic curves of new thermal overload relay

(4) RC 3737–60N

This model has been specially made to be assembled into SRC 3631–14. It is composed of the CT which has been assembled into the connecting conductor, the SRC 3737–4 positioned on the lower part as well as SRC 50–2F for amplification of contact capacity.

3. Assembling as an Electromagnetic Switch

When assmbling a thermal relay as an electromagnetic switch in the past, the method practiced was to assemble the electromagnetic contactor and thermal overload relay on a common base for models 4T and above. However, in the case of the S-series, the construction has been made much more logically, as described in the following.

The electromagnetic contactor and the thermal relay have been directly installed to the box, thereby eliminating the common base for the cases with and without a box provided by simply coupling it to the electromagnetic contactor frame by means of the installation attachment on the thermal relay. Consequently, the panel installation has been improved in appearance and at the same time, much space was conserved.

Also, the past thermal relays with change over contacts were not usable for external alarm cicruits due to the conditions of connections, but this has been modified in the S-series to improve its applicability.

V. CONCLUSION

An outline of the S-series electromagnetic switches has been given here. Through the comments offered by individual users of this device in the future, we hope to improve the products even further.

References:

(1) Iwata and Ómichi, Fuji arc-tight porcelain, *Fuji Electric Journal*, 37 No. 2 (1964)

(2) Iwata: Characteristics and special application of the thermal overload relay, *Fuji Electric Journal*, 37 No. 6 (1964)