

FUJI STANDARD KS MOTOR AND CONTROL APPARATUS

Although the cage rotor type induction motor is widely used owing to its simple structure and handiness of operation, its running speed is not adjustable. For services which require variable speed, it is a general way to apply a DC machine, an AC commutator machine, a wound rotor type induction motor with secondary resistor, or a motor coupled with some mechanical speed changing device. However, these driving methods are generally expensive and complicated in its structure and maintenance.

Our "KS motor" is developed to meet a request for a simple and cheap variable speed motor. "KS motor" is our trade name for a variable speed motor which consists of a cage rotor type induction motor and an eddy current coupling.

I. CONSTRUCTION

The construction of our standard KS motor is seen from Fig. 1 and Fig. 2, and the outer view is shown in Fig. 3. It is seen from these illustrations that a cage rotor type induction motor, a KS coupling and a tachometer generator are assembled in one common frame and constitute a KS motor. Details about these elements are as follows.

1. Cage rotor type induction motor

For the purpose of reducing the installation space of the KS motor, the common frame type is adopted as our standard. Therefore the induction motor is of enclosed self-cooled or enclosed fan-cooled flange type and mounted on to the frame of the KS coupling.

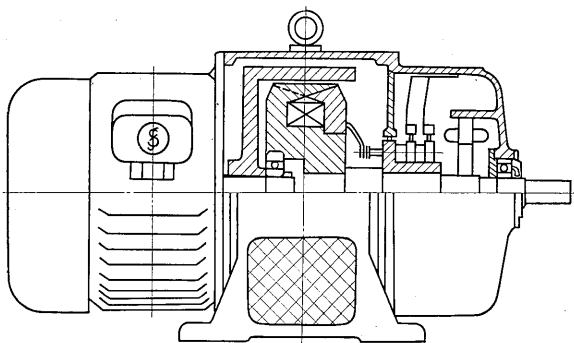


Fig. 1. Section of Fuji standard KS motor

2. KS coupling

As it is difficult to dissipate heat loss which is generated in the KS coupling, the construction of the KS coupling is not of totally enclosed type but of protected type. DC exciting coil of the KS coupling is manufactured with heat resisting magnet wire and carefully selected insulator. The completely insulated coil is packed into a case of brass and is set to the spider of the KS coupling.

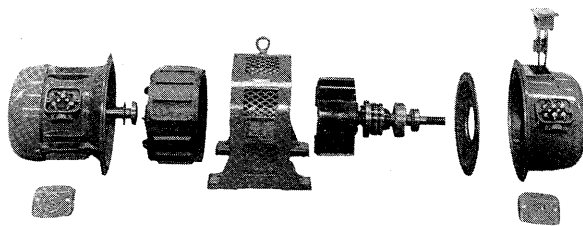


Fig. 2. Parts of standard KS motor

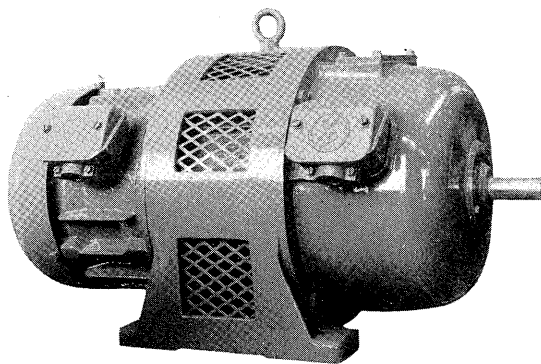


Fig. 3. Fuji standard KS motor

3. Tachometer generator

A tachometer generator is necessary to control the KS motor automatically and to indicate its speed. Our standard of the tachometer generator is the two-phase induction generator. This type of the tachometer generator has so simple and compact construction that it is become possible to assemble it on the common shaft. By means of the directly coupled tachometer, the installation space of the KS motor is much reduced and the accuracy of speed detection is much improved.

4. Dust-proof construction

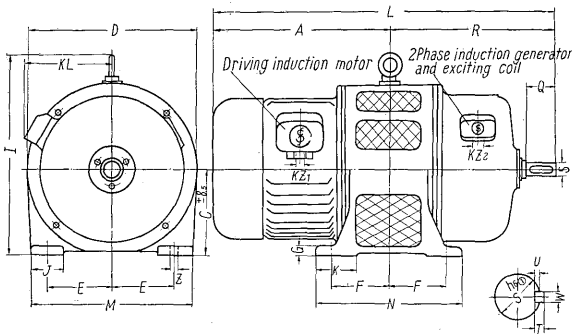
Though the KS coupling is of protected type considering heat dissipation, slip-rings, brushes, brush holders and tachometer generator are covered with an internal shield for the purpose of protecting these bare parts from dust. The exciting coil and the driving induction motor are also of enclosed type so that the KS motor can be used at a place where plenty of moisture and dust exist.

II. SPECIFICATION

Table 1 shows the specification of the standard KS motor and Table 2 the standard dimensions.

Table 1. Specification of Fuji standard KS motor

Output of induction motor	750 W 1.5 KW 2.2 KW 3.7 KW 5.5 KW 7.5 KW
No. of poles (induction motor)	4
Synchronous speed	1,500/1,800 rpm
Speed of KS motor	125~1,250/ 150~1,500 rpm
Speed control range	10 %
Permissible lower limit of load torque	1:10
Speed regulation	2%
Rating	Continuous



III. TORQUE CURVE OF KS MOTOR

Relation between torque of the KS motor and its speed is influenced not only by the structure of the KS drum, but also by number of poles and length of air gap. The torque characteristics of the standard KS motors are of almost equal shape regardless their rated output, and similar to that of high resistance cage rotor type induction motor which has large starting torque. As an example, the torque curve of the 1.5 kW KS motor is shown in Fig. 4.

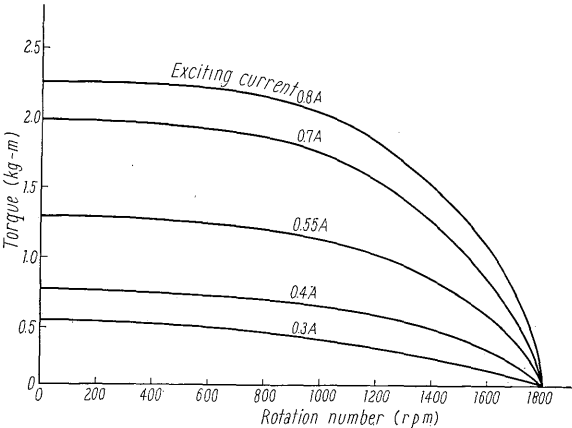


Fig. 4. Torque curve of standard KS motor

IV. CONTROL APPARATUS

As the torque of the KS motor can be controlled by adjusting its exciting current, speed control can be carried out within a narrow range near the synchronous speed without any speed control apparatus. It is generally indispensable, however, to use some control apparatus for the purpose of reducing speed regulation due to load fluctuation. Though there are two types of control apparatus, the magnetic amplifier type and the vacuum tube type, we have adopted the former as the standard.

Table 2. Dimensions of Fuji standard KS motor

Type	Torque kg/m	rpm	A	C	D	E	F	G	I	J	K	KL	L	Z	M	N	R	Q	QR	S	T	U	W	KZ ₁	KZ ₂
KS 18/7+ SPRC 362-4	0.48/0.4	125~1,250/ 150~1,500	315	135	280	110	90	20	325	50	60	170	610	11	270	230	295	40	1	22	7	4	7	20	20
KS 25/11+ SORC 551-5	0.97/0.81	125~1,250/ 150~1,500	375	180	370	140	120	25	420	80	90	205	730	15	360	310	355	60	1	28	7	4	7	20	20
KS 25/11+ SORC 552-4	1.45/1.21	125~1,250/ 150~1,500	395	180	370	140	120	25	420	80	90	205	730	15	360	310	355	60	1	28	7	4	7	20	20
KS 34/14+ SORK 751-4	2.42/2.0	125~1,250/ 150~1,500	515	220	460	180	160	35	535	90	100	215	955	19	450	380	440	80	1.5	32	8	4.5	10	20	20
KS 34/14+ SORK 752-4	3.63/3.12	125~1,250/ 150~1,500	545	220	460	180	160	35	535	90	100	215	985	19	450	380	440	80	1.5	32	8	4.5	10	20	20
KS 37/15+ SORK 951-4	4.8/4.0	125~1,250/ 150~1,500	570	250	520	200	200	45	620	100	120	270	1040	22	580	470	470	90	1.5	35	8	4.5	10	20	20

All demensons are shown in mm

1. Features of magnetic amplifier type control apparatus

1) Being solid in mechanical structure and having no moving parts and wearing parts, the magnetic amplifier type control apparatus can be used for a long time without any change of its characteristic and trouble of maintenance.

2) The magnetic amplifier type control apparatus has no heaters as the vacuum tube type, so that it can start immediately and is free from troubles about heaters.

3) The magnetic amplifier type control apparatus can be provided many separately insulated input windings, so that various signals of different potentials can be mixed with ease.

4) Using specially selected core and metal rectifier, the magnetic amplifier has large gain with effective damping, so that speed regulation of the KS motor becomes very small within the wide speed control range and stable operation is assured even in the case of sudden load change.

5) Using the two-phase generator as a tachometer generator, which generates the signal voltage of line frequency in proportion to speed, the accuracy of the control system is much increased.

2. Standard control apparatus

The standard control apparatus, prepared for the standard KS motors, is of the magnetic type and consist of three parts as shown in Fig. 5. They are a magnet contactor box, a controll panel and an operating panel.

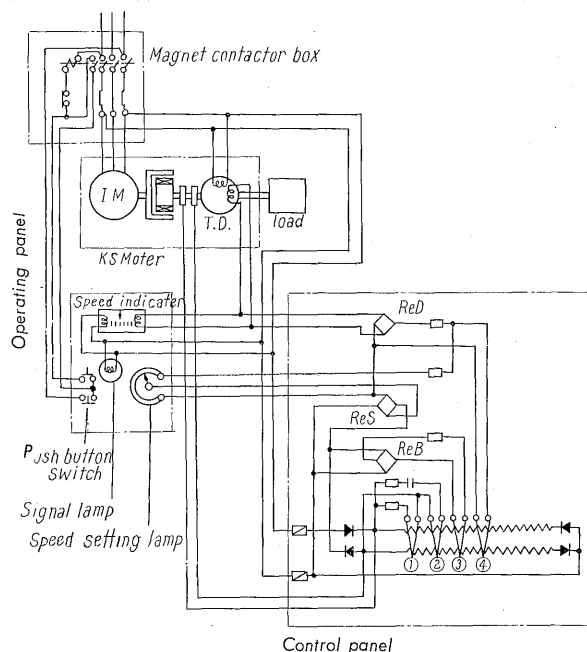


Fig. 5. Connection of standard KS control apparatus

1) Magnet contactor box

The magnet contactor is of our standard type which has the reputation of reliable operation.

2) Control panel

Control panel is of protected wall-hanged type of steel and contains a magnetic amplifier, rectifiers and condensers which are used for excitation control of the KS motor. Specification of the panel and characteristics of the KS motor using this panel are as follows.

Type: ATR-KSI

Power source: AC 200/220 V 50/60 c/s

Output: DC 120 W continuous

Permissible variation of load torque: 100~10%

Speed control range: 1:10 (1,250/1,500~125/150 rpm)

Speed regulation: 2% (ratio to top speed 1,250/1,500 rpm)

3) Operating panel

The operating panel is also of protected wall-hanged type of steel and is used to control the KS motor. In this panel, a speed indicator, a speed setting resistor, a push button switch for start and stop and signal lamps are provided.

V. FEATURES OF KS MOTOR

1) Speed of the KS motor can be varied within the wide speed range by means of a simple control apparatus. The KS motor has so simple structure that it is more economical and more convenient comparing to the other variable-speed motors. As the KS motor can be controlled with small exciting current, it is suitable for remote control and program control with auxiliary control apparatus.

2) The KS motor is of common frame type, assembling an induction motor, a KS coupling and a tachometer generator in a compact frame, and it can be handled easily. Moreover all electrical parts are protected by dust proof cover, so that the KS motor can be used where a good deal of dust and moisture are present.

3) Adopting the magnetic amplifier type controlling apparatus which are made of specially selected core, and metal rectifier, reliable operation is expected for a long time without maintenance trouble. The accuracy and stability of speed control are assured by means of these apparatus and the two-phase tachometer generator.

4) Besides speed control, the KS motor can be applied to cushion start, start of large inertia and so on, as the disturbance to the supply line can be eliminated.

VI. SERVICES

The Fuji standard KS motor, provided many features as described above, is fitted for automatic

control, remote control, program control and so on. Moreover the KS motor has so large starting torque that it can be used for starting of large inertia-loads. When frequency starting and braking of a load are required, these processes can be carried out by controlling the exciting current of the KS motor, and switching of the induction motor is unnecessary. Thus the capacity of the contactor is reduced and disturbance to the supply line due to rush current of the induction motor can be avoided. The KS motor is considered to be suitable for various services as shown in Table 3.

However, it must be regarded that the KS motor can not generate braking torque and can not stop the load of large inertia quickly, unless the driving motor is stopped or reversed.

We are ready to manufacture larger KS motors than these in Table 1 and KS brakes at your request.

Table 3. Application of KS motor

	Services
Speed control (constant speed control program control etc.)	conveyor, feeder, fan, coal feeder, pump, compressor, winding machine of small capacity, crane, power shovel, paper machine dryer, printing machine, etc.
Start control (cushion start start of large inertia)	fan, blower, ball mill, winding machine, dredger, centrifugal machine, etc.
Torque control (tension control torque limit dynamic brake)	winding machine, crane, elevator, etc.

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