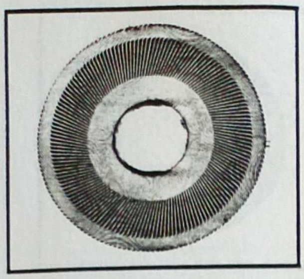
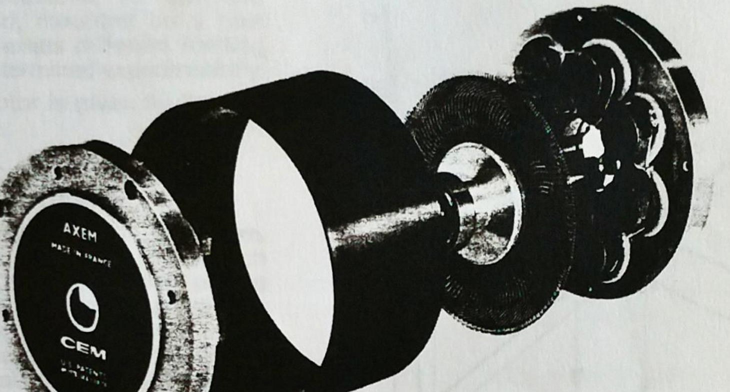


AXEM D.C. Servo Motor

Introduction

The name AXEM is given to a special design of d.c. electric servo motors with a flat air gap and disc shaped armature with lamella winding. The use of this technology enables the production of servo motors with very low inertia even in powers of several kW which are remarkable for their dynamic characteristics in both speed and position servo mechanisms.



Exploded View of AXEM Servo Motor
(F Series)

Method of Construction

As can be seen from the exploded view above, motors to the Axem design consist of two end plates to which are attached permanent magnets, thus producing a flat air gap in which the flat rotor rotates.

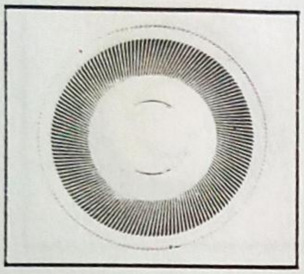
The magnets are usually cast alloy permanent magnets which ensure a stable high flux in the air gap. Because of the material used, it is not possible to dis-assemble and re-assemble a motor without loss of approximately 30 % of the flux. It is therefore necessary to re-magnetise any motor which has been dis-assembled.

Some motors, in particular the series J, are fitted with ferrite magnets and it is possible to dis-assemble motors of this type and re-assemble, without undue loss of flux. Ferrite magnets, however, produce a lower field strength and are subject to a loss of flux of approximately 0.2 % per °C increase in temperature.

The armature is made from several layers of copper lamella conductors, each layer insulated from the next by epoxy glass fibre cloth. Each conductor is connected by its extremity to another conductor, thus forming a series wave winding.

The brushes, generally four in number, bear directly on the inner edges of the armature conductors. The motor is fitted with double shielded, deep groove ball bearings which are lubricated for life. The only exception to this is some motors of the J series which are equipped with pre-lubricated, sintered bronze, solid bearings.

Motors are mounted by means of the end plate flange with clear or threaded holes.



Technical Data

NOMINAL CHARACTERISTICS

The operational limits of AXEM servo motors as variable speed drives, torque motors or direct drives, are solely a function of the maximum permissible armature temperature, which is 150° C. However for a few seconds this temperature can be higher. In the accompanying characteristic curves, this limit is shown by the curve "S" which is the boundary of the torque-speed envelope. N = f (useful torque) (fig. 1).

For different cooling conditions, for example, motor thermally insulated, mounted on a heat sink or ventilated, there exists different limiting values of "S". These are determined experimentally.

The useful power of a motor is given by the formula :

$$Pu = 1.045.Cu \frac{N}{1000} \text{ in W}$$

where Cu is the useful torque in cm.N. N is r.p.m. It is possible, therefore, to draw on a graph such as fig. 1., the curves of constant power output such as Pu_1, Pu_2 etc. For a given set of conditions there will be one curve which is a tangent to the curve "S". The tangent point "T" determines the running conditions to obtain the maximum power (Nn and Cn).

The curve "S" corresponds to a motor mounted on a thermally insulated heat sink, dimensions vary with motor type, and fed with a pure d.c. current at an ambient temperature of 40° C.

1) Rated Torque

Cn in cm.N.

The rated torque is given by that value of Cn corresponding with the point "T" and is defined as the useful torque constantly available at the shaft without overheating the motor.

2) Maximum Pulse Torque

Cimp in cm.N.

Experience shows that it is possible for very short periods to obtain high pulse torques from Axem motors, although these torques must be limited by the mechanical construction of the armature, and demagnetisation.

On the other hand, the length of the torque pulse must also be a function of the frequency of these pulses so that the maximum temperature of the armature does not exceed that given by the curve shown on Fig. 1 as limited by the curve "S". Thus, in general, it is possible to have current pulses of a maximum of 50 milli-seconds providing there is a break of 4.95 seconds between two consecutive pulses, i.e. 1 % duty cycle. The manufacturer's advice should be sought for special pulse conditions.

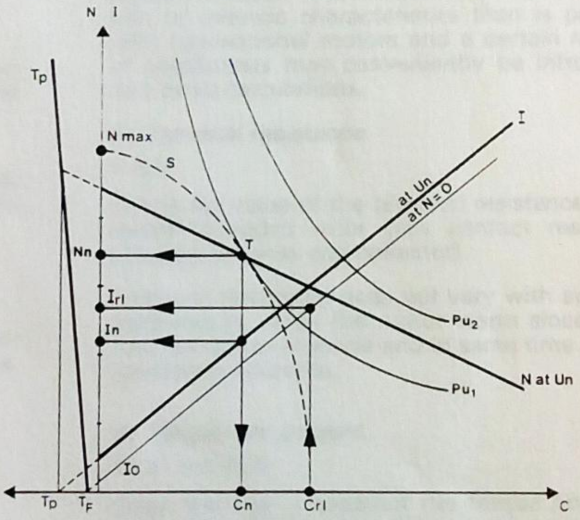


Fig. 1. Motor Performance Curves

3) Rated Speed and Maximum Speed

Nn and N max in r.p.m.

The rated speed Nn is defined as a function of the point "T". Between zero speed and Nn, the motor is able to provide a useful torque of the value of Cn. Above the rated speed the motor must produce a lower than rated torque, but in any case the speed must not exceed the maximum quoted speed, Nmax. The manufacturer should be consulted if it is thought that higher speeds are required.

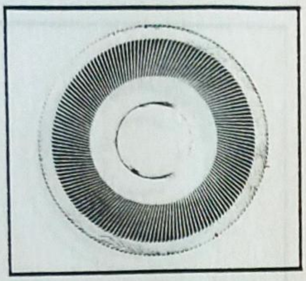
4) Rated Power Output

Pn in Watts

The rated power is defined by the curve Pn as a constant power curve tangential to the curve "S".

$$Pn = 1.045.Cn. \frac{Nn}{1000} \text{ in W}$$

Cn is the rated torque in cm.N., Nn rated speed in r.p.m.



5) Maximum Continuous Current

5.a. Rated current

In in amperes.

The rated current is defined as a function of the point "T". It is that current which will produce the rated torque Cn. in cm.N

$$Cn = K_T . In - K_D \frac{N}{1000} - Tf$$

5.b. Maximum current at very low speed

Irl in amperes

At very low speed and for maximum heating on curve "S" we obtain the rated torque Crl and coresponding current Irl

$$Crl = K_T . Irl - T_f$$

If you need to used motor at zero speed and stall torque please ask CEM who will recomand the right type of brushes.

6) Maximum pulse currents

I imp. in amperes.

The maximum pulse current I is that current necessary to obtain the maximum permitted pulse torque.

7) Nominal voltage

Un in volts

$$Un = R.I + K_E \frac{N}{1000} \quad \text{Nin r.p.m.}$$

The characteristic N = f (C) gives the voltage constant which passes through the nominal point "T" and defines the nominal voltage.

Important Notice :
All the nominal characteristics have been obtained from tests using smoothed direct current. Often motors are driven with unsmoothed rectified alternating current, characterised in particular by having a ripple with peaks and troughs.

The lower value of current, I aver. measured by a moving coil meter, should be used to calculate the useful torque from the motor.

The higher value I R.M.S., measured by a moving iron or a thermal ammeter, should be used to calculate rotor heating.

In continuous service it is this higher value current which limits the speed to that obtainable by reference to the curve "S".

If the ratio $r = \frac{I\ R.M.S}{I\ aver.}$, called the form factor of the current, is different from 1 it is not possible to achieve a torque greater than $\frac{Cn}{r}$ (approximately).

Smoothing of the current pulses will allow the value r to approach 1, thus enabling the motors to be used nearer to their nominal powers.

INTRINSIC CHARACTERISTICS

AXEM servo motors are fitted with permanent magnets and an ironless rotor. The magnetic flux is constant, the self-inductance negligible, and because of these properties the electric characteristics are linear. This allows more precise definition of intrinsic characteristics than is possible with conventional motors and a certain number of coefficients may conveniently be introduced into servo calculations.

8) Terminal resistance

R (Ω)

This is the value of the terminal resistance of the motor (included rotor plus contact resistance between brushes and collector).

Terminal resistance does not vary with armature temperature when the motor warm since armature resistance increase and in same time contac resistance decrease.

9) Torque per ampere

K_T in cm. N/A

Since the flux is constant the torque produced Ct, is a linear function of the current drawn.

$C_T = K_T.I$ in cm. N

K_T in cm. N/A

I in A

C_T is the total torque available

Cu useful torque is equal to total torque minu the loss torque Tp.

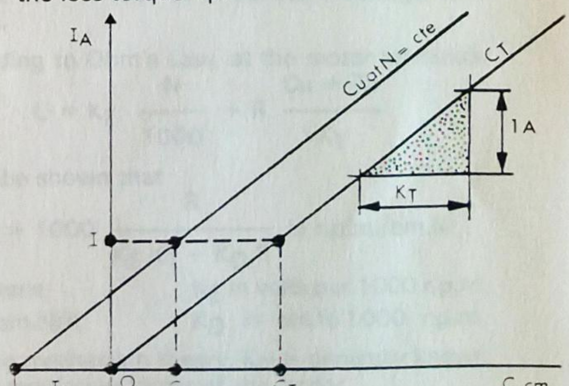
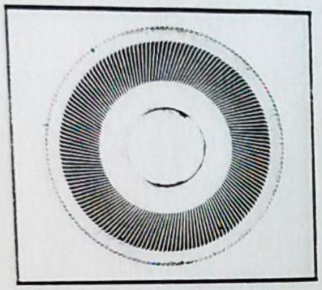


Fig. 2 - Torque per Ampere



10) Electro-motive force per 1000 r.p.m.

K_E in V/1000 r.p.m.

Is the open circuit voltage measured across the terminals of the motor while it is being driven as a generator at a speed of 1000 r.p.m.

Since the flux is constant the emf E is a linear function of the speed N (see Fig. 3)

$$E = K_E \frac{N}{1000} \text{ in volts}$$

N in r.p.m.

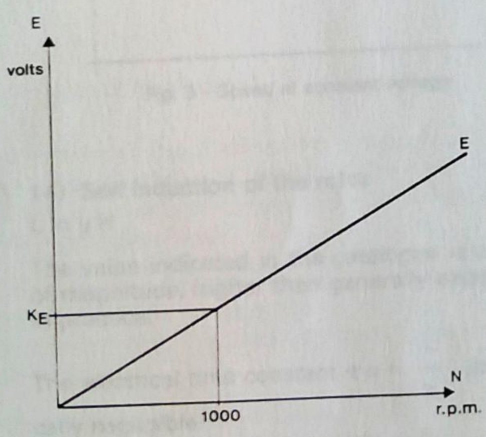


Fig. 3 - Electro-motive force

11) Viscous damping constant

K_D in cm. N/1000 r.p.m.

Is given by the slope of the curve of total torque losses (bearings, brushes, eddy currents) as a function of speed. Tp = f (N) expressed as a constant per 1000 r.p.m. (see Fig. 4).

This coefficient reduces as the motor temperature increases because the eddy currents and viscosity of grease in ball bearings reduce when the motor is warm.

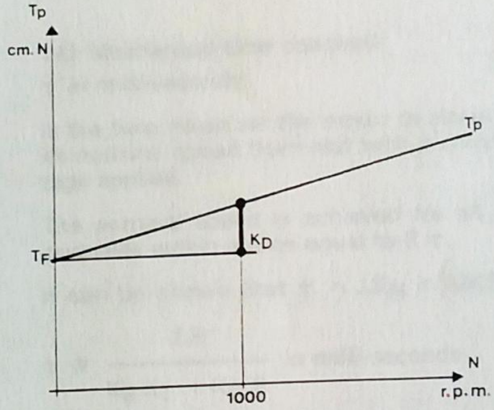


Fig. 4 - Losses

12) Rotor moment of inertia

J in g. cm.^{2}

$$J = \Sigma\, m.r^2$$

Is represented by the sum of the moments of inertia of all rotating parts. It should be noted in passing that confusion can arise between the moment of inertia and the Pd^2.

13) Reduction of speed at constant voltage due to load

K_N in r.p.m./cm.N

Is given by the slope of the curve against useful torque. N = f (Cu) at a constant voltage (see Fig. 5).

According to Ohm's Law, at the motor terminals

$$U = K_E . \frac{N}{1000} + R . \frac{Cu + Tp}{K_T}$$

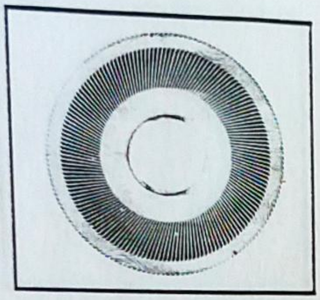
It can be shown that

$$Kn = 1000 \frac{R}{K_E . K_T + K_D . R} \text{ in r.p.m./cm.N}$$

R in ohms — K_E in volts per 1000 r.p.m.

K_T in cm.N/A — K_D in cm.N/1000 r.p.m.

In servo mechanism theory, K_N is generally known as the regulation factor of the motor.



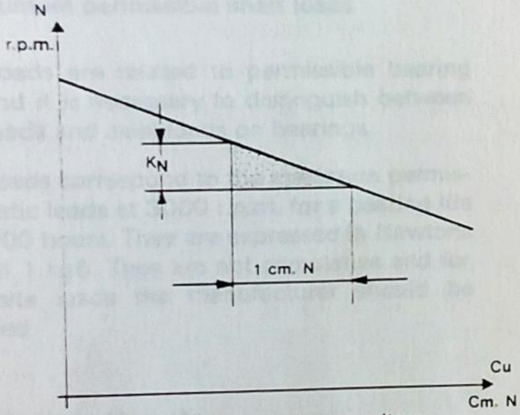


Fig. 5 - Speed at constant voltage

14) Self induction of the rotor

L in μH

The value indicated in the catalogue is an order of magnitude, higher than generally experienced in practice.

The electrical time constant $\tau e = \dfrac{L}{R}$ is practically negligible.

τe in microseconds, L in μH, R in ohms.

15) Friction torque (static)

T_F in cm.N

This is the mechanical loss torque at zero speed (see Fig. 4).

Torque loss is given by the expression :

$$T_P = T_F + K_D \frac{N}{1000} \text{ in cm.N}$$

T_F in cm.N
N in r.p.m.
K_D in cm.N/1000 r.p.m.

16) Mechanical time constant

τ in milli-seconds

Is the time taken for the motor to attain 63 % of its nominal speed from rest with a constant voltage applied.

The nominal speed is achieved for all practical purposes within a time equal to 3 τ.

It can be shown that $\tau = J.K_N$ in MKSA units.

$$\tau \# \frac{J.R}{K_E.K_T + K_D.R} \text{ in milli-seconds}$$

J in g.cm^2 R in ohms K_T in cm.N per ampere

K_E in volts per 1000 r.p.m.

In practice it is possible as a first approximation to disregard the term K_D.R. One then obtains :

$$\tau \# \frac{J.R}{K_E.K_T} \# \frac{J.R}{K_T^2}$$

The value indicated in the catalogue does not vary with the temperature.

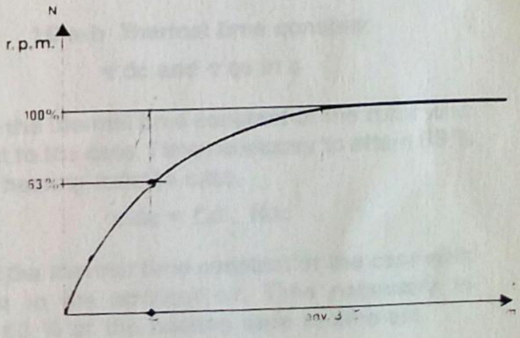
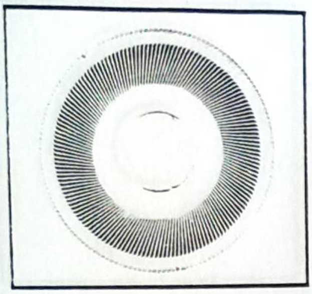


Fig. 6 - Time constant



17) Maximum permissible shaft loads

These loads are related to permissible bearing loads and it is necessary to distinguish between radial loads and axial loads on bearings.

These loads correspond to the maximum permissible static loads at 3000 r.p.m. for a bearing life of 10,000 hours. They are expressed in Newtons (10 N # 1 kgf). They are not cumulative and for composite loads the manufacturer should be consulted.

18) Permanent Magnets

Servo motors of the J series are equipped with ferrite magnets while the motors of the F and M series are equipped with cast metal alloy magnets which give higher fluxes.

The first figure in column 18a indicates that the magnetic structure of the motor is assymetric if 1. or symetric if 2. The second figure gives the number of poles.

The temperature coefficient given in column 18b gives the percentage loss of flux per degree C. This variation has an effect on the constants K_E and K_T. As a first approximation, it can be assumed that this variation is equal to the variation in flux.

19) Thermal Characteristics

Experience has shown that thermal exchange between the rotor of an Axem servo motor and ambient air can be approximated to by the circuit shown in Fig. 7, where D, C and A represent, respectively, the disc rotor, the case and the ambient air.

The performance of the motor is limited by the maximum allowable temperature t of the rotor, which is 150° C.

Resistances Rdc (rotor to case) und Rca (case to ambient) are a function of the speed of the motor Rca is also function of the mechanical mounting of the motor.

Thermal capacities Cd (rotor) and C_C (case) in joules by degre celtius are not depending of the speed C_C vary with the mechanical mounting of the motor.

The thermal characteristics quoted in the catalogue correspond to a stalled motor (the most unfavourable case) not thermally insulated, which is the most frequent case. Manufacturers should be consulted for optimisation of these values with different motor speeds and other cooling methods.

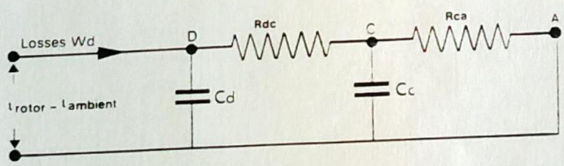


Fig. 7 - Electronic Analogue of Heat Transfer of Axem Motor

19 a-b Thermal time constant

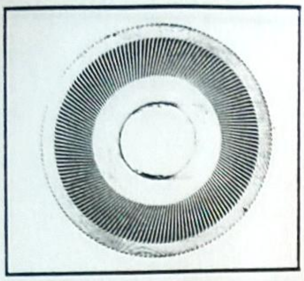
τdc and τca in s

τdc is the thermal time constant of the rotor with respect to the case. Time necessary to attain 63 % of the heating rotor to case.

$$\tau dc = Cd \cdot Rdc$$

τca is the thermal time constant of the case with respect to the ambient air. Time necessary to attain 63 % of the heating case to ambient.

$$\tau ca = Cc \cdot Rca$$



19 c-d Thermal resistance

Rdc and Rca in °C per W

Rdc is the thermal resistance, rotor to case through the shaft and through the air contained in the motor.

Rca is the thermal resistance, case to ambient air, across a metallic mounting plate which is itself thermally insulated. Mounting plate dimensions:

F9 - F12	400 x 200 x 10 mm
M17 - MA17H - M19	400 x 400 x 10 mm
M23 - M26 - M26D	530 x 530 x 13 mm

Values for any other mounting methods or for force cooled motors should be obtained from the manufacturer.

19 e Calculation of thermal losses and heating

These are a function of the maximum permissible temperature t of the rotor. Once the motor has attained thermal equilibrium it is possible to calculate the thermal losses Wd at which point the motor will have attained thermal equilibrium.

$$Wd = \frac{t\ rotor - t\ amb}{Rdc + Rca} \text{ in W}$$

t rotor and t amb in °C.

Rdc and Rca in °C/W.

As already stated, the maximum permissible rotor temperature is 150° C and as a first approximation it may be considered that the motor attains thermal equilibrium in a time equal to three times the thermal time constant of the case to ambient τ ca. During this time the temperature of the rotor increases following an exponential curve.

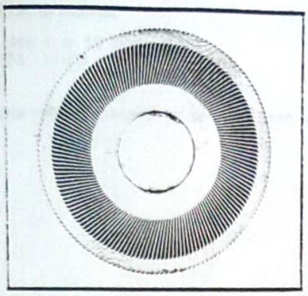
The manufacturer should be consulted for all calculations of losses in incremental modes.

MAINTENANCE

Maintenance of AXEM servo motors is limited to an inspection of the brushes and their eventual replacement. Replacement is a function of total number of revolutions and speed of rotation. (Further advice on expected brush life under particular conditions can be obtained from the manufacturer).

Warning

Do not try to open the motor. Any change in the air gap brought about by moving the end plates promotes de-magnetisation and consequent important losses in torque and back emf. Stripping the motor, de-magnetising, and re-magnetising must be done in the manufacturer's workshop.



Ratings and constants for AXEM D.C. servo motors

Motor Type	Rated torque	Maximum pulse torque (1)	Rated speed	Maximum speed	Rated power output	Rated current	Maximum current at very low speed	Maximum pulse current (1)	Nominal voltage	Terminal resistance at 25° C c)	Torque per ampere	E.M.F. per 1000 r.p.m.	Viscous damping constant	Rotor moment of inertia	Rec of co vc tc
§	1	2	3a	3b	4	5a	5b	6	7	8	9	10	11	12	
Symbol	C_n	C_{imp}	N_n	N_{max}	P_n	I_n	$\lvert I_r \rvert$	I_{imp}	U_n	R	K_T	K_E	K_D	J	
Unit	cm.N	cm.N	r.p.m.	r.p.m.	W	A	A	A	V	ohm	cm.N/A	V/kr.p.m	cm.N/ kr.p.m	g.cm²	r.p.
J 9 ZF	4,00	40	3700	–	15	2,8	–	20	12	1,38	2,2	2,3	0,29	320	2
J 9 ZFG ··	200	–	80	80	–	3,0	–	–	13	1,38	2,2	2,3	–	–	
J 12 ZF	12	107	2100	–	26	4,8	–	30	12	0,95	3,4	3,5	0,59	1500	
J 12 ZFG ··	700	–	60	60	–	5,2	–	–	16,5	0,95	3,9	4	–	–	
J 12 ZFTG ··	900	–	60	60	–	5,2	–	–	21	0,95	5,2	5,3	–	–	
J 16 ZFF	51	380	2500	–	130	7,3	–	40	30	1,00	8,56	8,8	1,6	6300	
UGPMEG 07 A12	3,4	17,4	1800	5000	6,5	1,8	–	8,1	8,9	1,26	2,3	2,4	0,14	200	2
UGPMEE 09 B12	7,15	36	4000	6000	30	2,8	–	13	18	1,10	3,1	3,3	0,14	340	1
UGPMFE 12 ABB	33	166	3600	5000	125	8,0	–	36	26	0,65	5,1	5,3	0,75	1500	
F 9 M 4 R ·	14	115	4800	9000	70	6,4	6,7	40	22	1,10	2,96	3,1	0,5	350	1
F 9 M 2 ·	28,2	173	3000	8500	88	11	11	60	14	0,43	2,96	3,1	0,7	290	
F 9 M 4 ·	34,6	345	3000	8000	108	6,7	6,7	60	26	1,10	5,92	6,2	0,8	350	
F 9 M 4 H ·	53,7	490	3000	8000	168	6,5	6,75	55	35	1,10	8,8	9,2	0,8	340	
F 9 M 2 HA ·	30,9	264	3000	9000	97	8	7,9	57,5	20	0,85	4,4	4,6	0,6	100	
F 12 M 4 R ·	42	290	4800	9000	210	8	8,3	50	37	0,93	5,90	6,2	0,7	1500	
F 12 M 2 ·	61	430	3000	6000	190	11,7	11,7	75	24	0,47	5,73	6,0	1,6	1050	
F 12 M 4 ·	77	860	3000	5000	240	7,7	8,2	75	43	0,93	11,46	12,0	2,7	1500	
F 12 M 4 H ·	110	1300	3000	5000	345	7,2	8,2	75	61	0,93	17,2	18,0	3,3	1600	
F 12 M 4 HA ·	95	950	3000	5000	300	6	6,6	55	63	1,40	17,2	18,0	2,5	670	
IPS 213 ·	24,5	250	3900	5000	100	6	6,5	57	25	1,1	4,4	4,6	0,3·	38,4	
IPS 221 ·	32,5	325	4000	8000	135	5	5,3	47,5	38	1,8	6,90	7,2	0,25	47,7	
M 17	96	900	3000	5000	300	6	6,5	50	70	1,8	18,6	19,5	3,5	7900	
MA 17 H · (closed)	160	1400	3000	5000	500	6,5	6,6	50	105	1,8	28,6	30	6	7900	
MA 17 H · (cooled)	260	1400	3000	5000	800	10	9,7	50	110	1,8	28,6	30	6	7900	
M 19 P · (closed)	320	2440	3000	5000	1000	14,4	5	100	83	0,46	24,4	25,5	8	12000	
M 19 P · (cooled)	510	2440	3000	5000	1600	22,2	22,3	100	87	0,46	24,4	25,5	8	12000	
M 19 S · (closed)	320	2440	3000	5000	1000	7,2	8,5	100	164	1,6	48,8	51	8	12000	
M 19 S · (cooled)	510	2440	3000	5000	1600	11,1	11,4	50	171	1,6	48,8	51	8	12000	
M 23 · (closed)	637	5000	3000	5000	2000	13,6	11	50	170	0,9	50,6	53	13	23000	
M 26 · (closed)	960	8400	3000	4000	3000	25	25	200	140	0,25	42	44	28	36000	
M 26 · (cooled)	1600	8400	3000	4000	5000	40	40	200	145	0,25	42	44	28	36000	
M 26 D · (cooled)	2850	16240	3000	4000	9000	37,5	38	200	272	0,50	81,2	85	50	73000	

FOR FURTHER DETAILED INFORMATION PLEASE ASK FOR TECHNICAL D

Data indicated in this file are for reference pu

*) Integral tachometer can be mounted

**) Gear motor with ratio 1 to 50 other ratios available 1/25 - 1/75 - 1/100

(1) Cycle S 3 50 ms 1 %, see § 2

a) IP 44/IP 00 means motor is protection IP 44 but terminals who are IP 00

b) For life time 10000 hours at 3000 r.p.m.

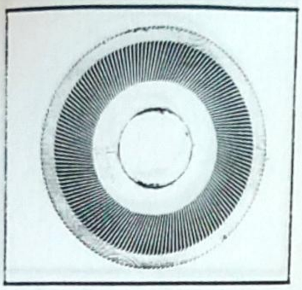
c) See § 8

Nota : cooled : Motor must be cooled by an external Fan minimum 10 Liter/second under 18 mm H_2O (80 L.p.s. for M26D)

Self induction of the rotor	Friction torque (static)	Mechanical time constant	Maximum permissible shaft loads b)		Permanent magnets	Magnets temperature coefficient	Thermal characteristics: Thermal time constant		Thermal characteristics: Thermal resistance		Protection a)	Weight	Diameter	Motor Type
14	15	16	17		18a	18b	19a	19b	19c	19d	20	21	22	§
L	T_F	τ	RADIAL ONLY	AXIAL ONLY	–	–	τ_{dc}	τ_{ca}	R_{dc}	R_{ca}	–	–	–	Symbol
µH	cm.N	ms	N	N	–	%/°C	s	s	°C/W	°C/W	–	Kg	mm	Unit
100	1,00	47	3	3	1 F 8	0,20	30	–	–	–	IP44	0,6	120	J 9 ZF
100	–	–	250	100	1 F 8	0,20	–	–	–	–	IP44	2	128	J 9 ZFG **
100	2,3	87	7	7	1 F 8	0,20	60	–	–	–	IP44	1	152	J 12 ZF
100	–	–	350	150	1 F 8	0,20	–	–	–	–	IP44	3,5	157	J 12 ZFG **
100	–	–	350	150	1 F 8	0,20	–	–	–	–	IP44	3,8	157	J 12 ZFTG **
100	5	72	60	60	1 F 8	0,20	70	–	–	–	IP44	3,5	215	J 16 ZFF
50	0,33	46	20	10	1 F 8	0,20	–	–	–	–	IP44	0,3	96	UGPMEG 07 A12
70	0,52	37	20	10	1 F 8	0,20	–	–	–	–	IP44	0,6	120	UGPMEE 09 B12
60	1,95	38	35	35	1 F 8	0,20	–	–	–	–	IP44	1,3	152	UGPMFE 12 ABB
< 100	2,5	39,6	150	170	1 S 8	0,02	30	–	1,2	0,90	IP44/IP00	1,1	110	F 9 M 4 R *
< 25	2,5	13,2	205	190	2 S 8	0,02	30	1080	1,2	0,90	IP44/IP00	2,3	110	F 9 M 2 *
< 100	2,5	10,2	205	190	2 S 8	0,02	30	1080	1,2	0,90	IP44/IP00	2,3	110	F 9 M 4 *
< 100	2,5	4,5	205	220	2 S 8	0,02	30	1080	1,2	0,90	IP44/IP00	2,8	110	F 9 M 4 H *
< 25	2,5	4,1	205	220	2 S 8	0,02	30	1080	1,2	0,90	IP44/IP00	2,8	110	F 9 M 2 HA *
< 100	3	37,6	150	170	1 S 8	0,02	50	–	0,95	0,68	IP44/IP00	1,9	140	F 12 M 4 R *
< 25	3	14	220	190	2 S 8	0,02	50	1630	0,95	0,68	IP44/IP00	3,85	140	F 12 M 2 *
< 100	3	10	220	190	2 S 8	0,02	50	1630	0,95	0,68	IP44/IP00	3,85	140	F 12 M 4 *
< 100	3	4,7	220	220	2 S 8	0,02	50	1630	0,95	0,68	IP44/IP00	5,00	140	F 12 M 4 H *
< 100	3	3	220	220	2 S 8	0,02	50	1630	0,95	0,68	IP44/IP00	5,00	140	F 12 M 4 HA *
< 120	0,8	2,05	–	–	1 S 4	0,02	–	–	1,72		IP44/IP00	2,5	101	IPS 213 *
< 250	0,8	1,7	–	–	1 S 4	0,02	–	–	1,72		IP44/IP00	2,5	101	IPS 221 *
< 200	7	40	400	380	2 S 10	0,02	77,5	1670	0,6	0,64	IP41	4,5	184	M 17
< 200	9	17,2	400	380	2 S 10	0,02	62	2800	0,78	0,50	IP44	9	205	MA 17 H * (closed)
< 200	9	17,2	400	380	2 S 10	0,02	24	700	0,32	0,1	IP32	9	205	MA 17 H * (cooled)
< 100	10	9,2	600	380	2 S 10	0,02	65	2970	0,45	0,48	IP44	13,5	228	M 19 P * (closed)
< 100	10	9,2	600	380	2 S 10	0,02	41	900	0,30	0,067	IP32	13,5	228	M 19 P * (cooled)
< 400	10	8	600	380	2 S 10	0,02	65	2970	0,45	0,48	IP44	13,5	228	M 19 S * (closed)
< 400	10	8	600	380	2 S 10	0,02	41	900	0,30	0,067	IP32	13,5	228	M 19 S * (cooled)
< 250	12	8	600	380	2 S 10	0,02	87	4250	0,437	0,283	IP44	25	272	M 23 * (closed)
< 100	15	5,1	900	500	2 S 10	0,02	84	5500	0,36	0,275	IP44	30	315	M 26 * (closed)
< 100	15	5,1	900	500	2 S 10	0,02	42	1530	0,2	0,051	IP32	30	315	M 26 * (cooled)
< 200	50	5,5	900	500	4 S 10	0,02	–	–	–	–	IP32	58	340	M 26 D * (cooled)

HEET ASK TOO FOR GEAR MOTOR CATALOG AND ELECTRONIC DRIVES

y and can be amended without notification.



Dimensions
Series J - UGPM - F - IPSEM

SERIES J - UGPM

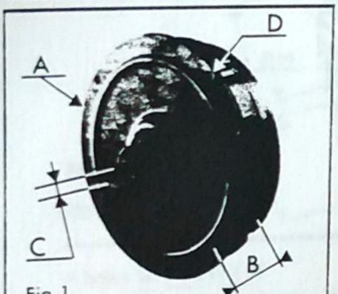


Fig. 1

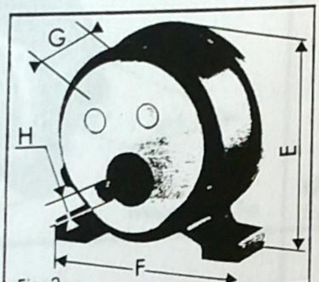


Fig. 2

Type	Dimensions (mm)				Weight kg	Fig.
	A	B	C	D		
J9ZF	120	17	7	4 holes Ø 5,5 on Ø 110	0,6	1
J12ZF	152	20	8	4 holes Ø 5,5 on Ø 142	1	
J16ZFF	215	58	12	4 holes Ø 7 on Ø 200	3,1	
UGPM07	96	22,5	6	4 holes Ø 3,3 on Ø 88	0,3	1
UGPM09	120	22,5	6	4 holes Ø 4,5 on Ø 110	0,6	
UGPM12	152	55	10	4 holes Ø 5,5 on Ø 142	1,3	
	E	F	G	H		
J9ZFG	131	130	78,5	12	2	2
J12ZFG J12ZFTG	167	160	111	16	3,8	

SERIES F

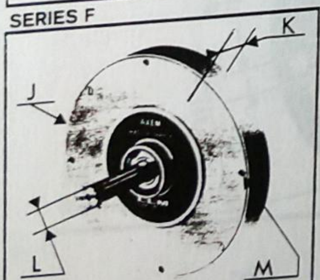


Fig. 3

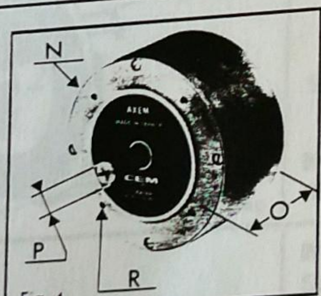


Fig. 4

Type	J	K	L	M	Weight kg	Fig.
F9M4R	110	20,5	12,7 j 5	4 holes Ø 3,5 on Ø 102	1,1	3
F12M4R	140	20,5	12,7 j 5	4 holes Ø 3,5 on Ø 129	1,9	
	N	O	P	R		
F9M2	110	53	12,7 j 5	4 holes M4 on Ø 88	2,3	4
F9M4	110	53	–	4 holes M4 on Ø 88	2,3	
F9M4H	110	64	–	4 holes M5 on Ø 88	2,8	
F9M2HA	110	64	–	4 holes M5 on Ø 88	2,8	
F12M2	140	61	–	4 holes M4 on Ø 116	3,9	
F12M4	140	61	–	4 holes M4 on Ø 116	3,9	
F12M4H	140	74	–	4 holes M5 on Ø 116	5,0	
F12M4HA	140	74	–	4 holes M5 on Ø 116	5,0	

SERIES IPSEM

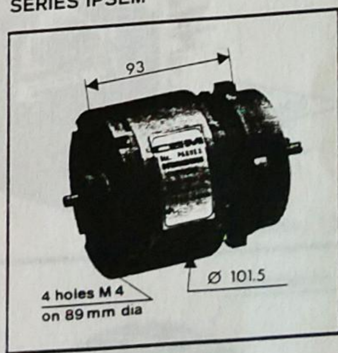
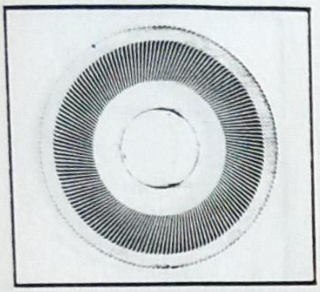
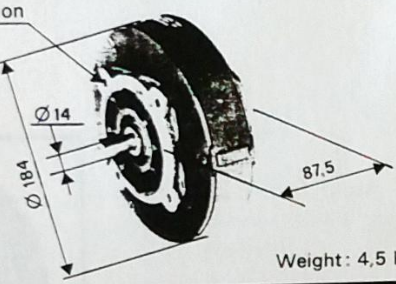


Fig. 5

TYPE	Weight	Fig.
IPS 213	2,5	5
IPS 221		

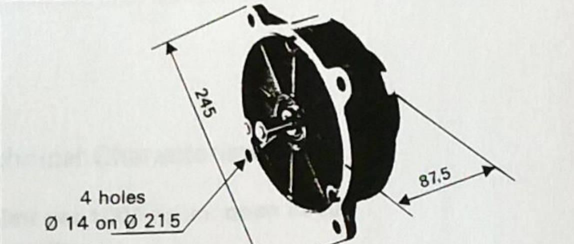


Dimensions
Series M



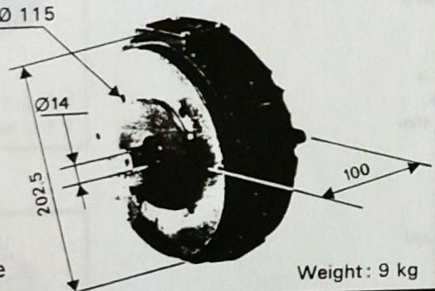
M 17
Round flange

Weight: 4,5 kg



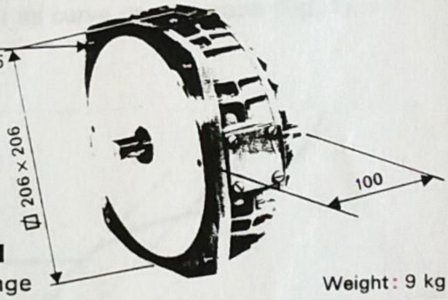
M 17
Square flange

Weight: 4,5 kg



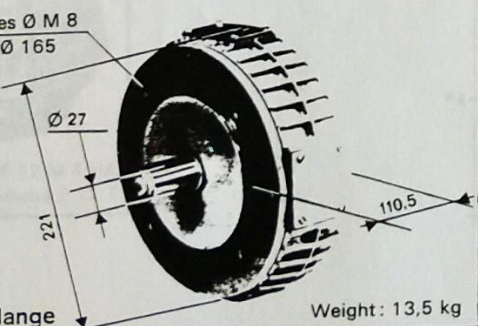
M 17 H
Round flange

Weight: 9 kg



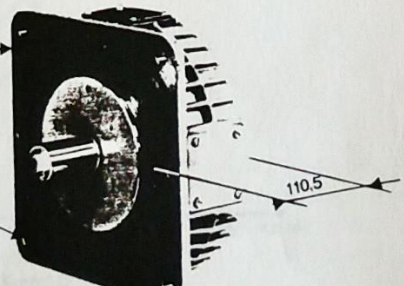
M 17 H
Square flange

Weight: 9 kg



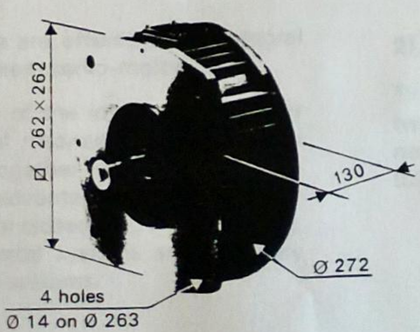
M 19
Round flange

Weight: 13,5 kg



M 19
Square flange

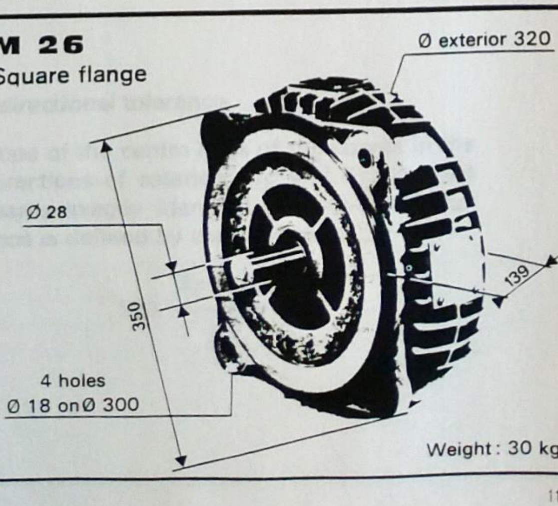
Masse: 13,5 kg



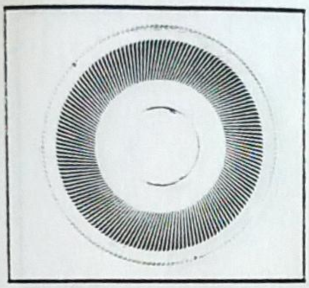
M 23
Square flange

Weight: 25 kg

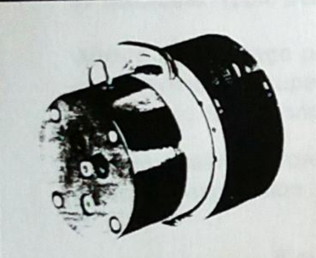
M 26
Square flange



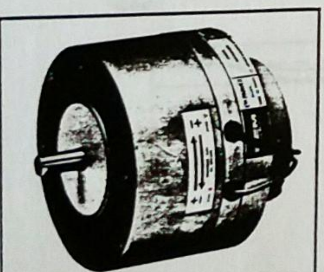
Weight: 30 kg



AXEM
Integral Tachometers



Servo-motor F 9 M 4
with tachometer U 6 T



Servo-motor F 12 M 4 HA
with tachometer F 12 T

General

Our d.c. tachometers are offered as an integral part of any type of Axem servo-motor.

Principle advantages of the integral tachometer are the low torsional resonance occasioned by the integral design, together with a very low residual ripple. These advantages result in much better performance for closed loop servo systems, closed loop incremental systems and generally for all variable speed systems.

Technical Characteristics

1) Emf per 1000 r.p.m. open circuit

K_E in volts.

The tacho output is represented by the slope of the centre line of its curve on the graph (Fig. 1).

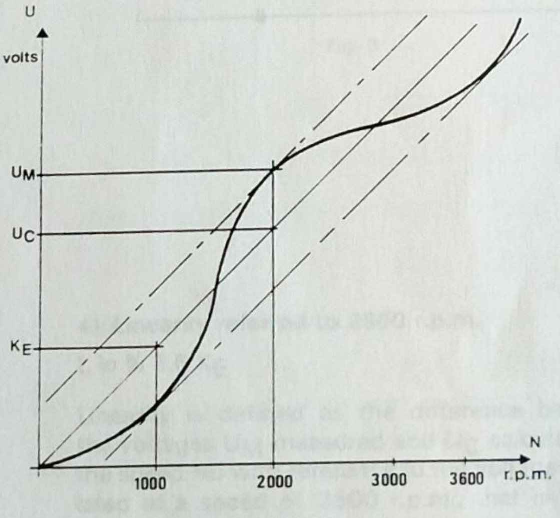
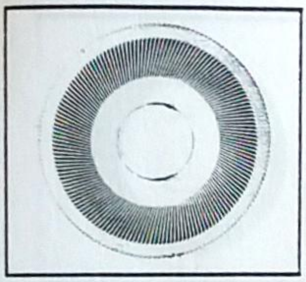


Fig. 1 - Emf/1000 r.p.m.

2) Bi-directional tolerance

The slope of the centre lines of the curves in the two directions of rotation (K_E and K'_E) are not necessarily exactly identical. The bi-directional tolerance is defined by the expression :

$$100.\ \frac{K'_E - K_E}{K_E}$$



3) Residual ripple peak to peak

With a d.c. voltage proportional to speed, there is, nevertheless, superimposed a noise which is inherent to the technology of tachometry.

The residual ripple peak to peak is defined by the following expression :

$$B = 100. \frac{\Delta U}{U}$$

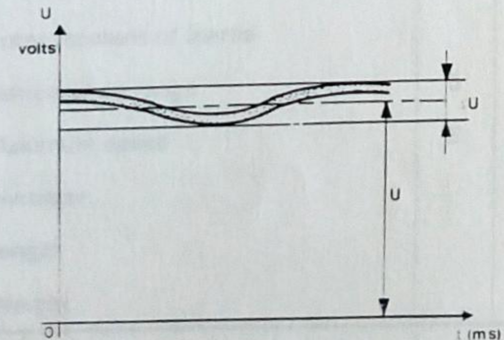


Fig. 2 - Residual peak to peak ripple

The values of residual ripple given in the table of General Characteristics have been measured for each type with the value of filters given in the table below (see Fig. 3).

	F2TC	U6T	F9T	F12T
R_1 KΩ	10	10	10	10
R_2 KΩ	100	10	10	10
C_1 nF	3,2	32	8	8

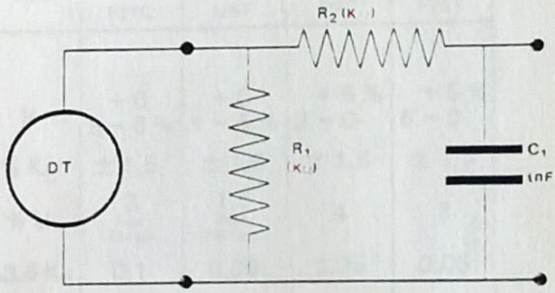


Fig. 3

4) Linearity referred to 3600 r.p.m.

L in % 3.6 K_E

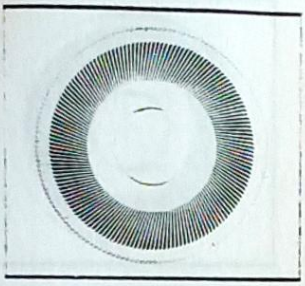
Linearity is defined as the difference between the voltages U_M measured and U_C calculated at the speed No with reference to the voltage calculated at a speed of 3600 r.p.m., that is to say 3.6 K_E, (see Fig. 1).

It is expressed in % by the formula

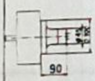
$$L = 100. \frac{U_M - U_C}{3.6\ K_E}$$

5) Permissible temperature range and speed range

This is the area where the characteristics of tachometers are guaranteed. It is always possible to use these tachometers at lower speeds. In case of doubt, manufacturers should be consulted.



General Characteristics of AXEM Tachometers

Parameter		Symbol	Units	Tachometer			
				F2TC	U6T	F9T	F12T
Emf/1000 r.p.m. open circuit	1	K_E	V	+ 0 3 − 5 %	+ 0 1 − 5 %	+ 5 % 3 − 0	+ 5 % 6 − 0
Bi-directional tolerance	2		% K_E	± 1,5	± 1,5	± 1,5	± 1,5
Residual ripple peak to peak	3	B	% U	3 From 100 r.p.m.	1,5 From 200 r.p.m.	4	3
Linearity referred to 3600 r.p.m.	4	L	%3,6 K_E	0,1	0,05	0,05	0,05
Output impedance		R	Ω	120	5	1	1
Rotor moment of inertia		J	g cm²	7	35	350	1500
Temperature range	5		° C	0 à + 70	−25à+70	−25à+70	−25à+70
Maximum speed	5		tr/mn	4000	4000	4000	4000
Diameter			mm		86	110	140
Length			mm		58	21,5	22
Weight			gr	700	675	1000	1500

FOR FURTHER DETAILED INFORMATION ASK FOR TECHNICAL DATA SHEET

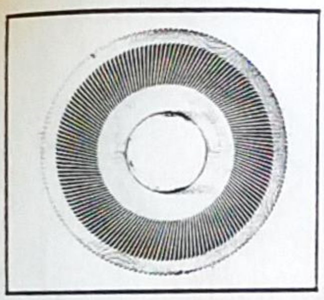
Table of available tachometers

The table below gives the range of tachometers available for various motors in the series.

TACHO / MOTOR	F2TC	U6T	F9T	F12T
Series J UGPM				
Series F	YES	YES	YES	YES
Series M				YES

Electric speed control

A range of electronic speed controllers using either thyristors or transistors in either one or four quadrants, manufactured by C.E.M., allows the resolution of many speed control problems. The manufacturer should be consulted.



Application examples

Applications of AXEM servo motors with or without tachometers covers many markets and the following examples give an idea of several uses which have become classic examples.

TAPE TRANSPORTS FOR PERIPHERAL EQUIPMENT

Because of their low inertia and their extremely short response time in the incremental mode, AXEM servo motors with tachometers are a natural choice for paper or magnetic tape transports and optical or magnetic card readers.

Among the many uses can be cited :

Actuators :

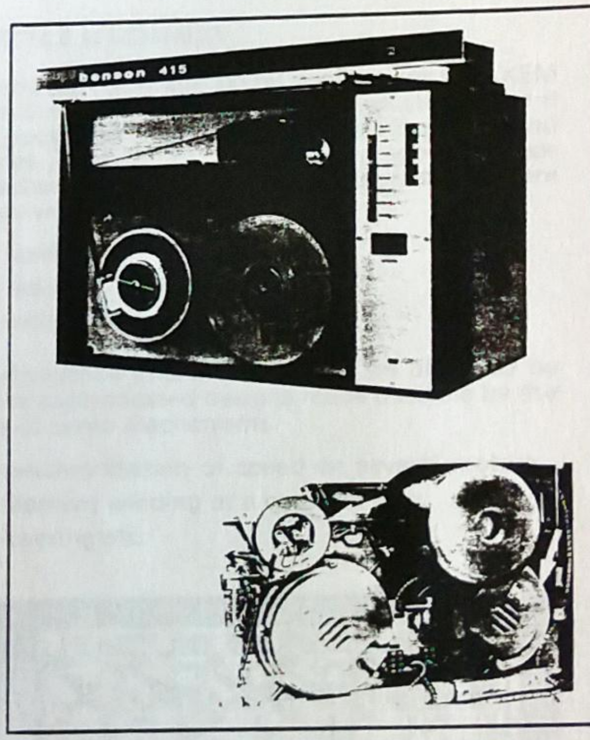
- for perforated card readers
- readers for magnetic cards, reading heads and magnetic discs
- teleprinters.

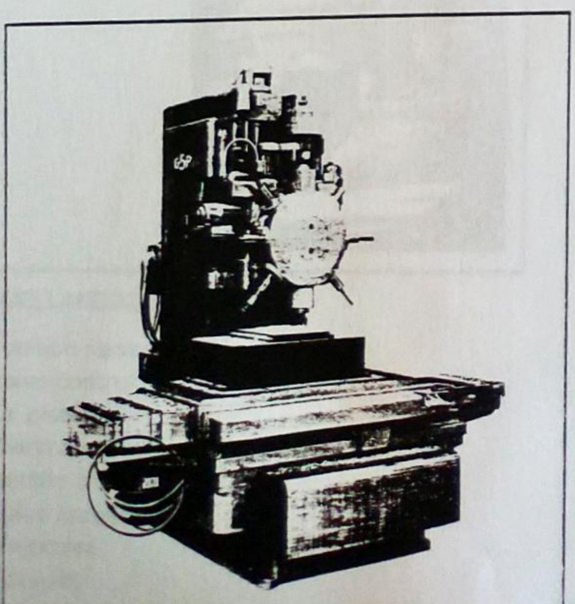
Drive and spool motors :

- for magnetic tape memories
- for perforated paper tape readers

Motors for paper transport :

- for rotating machines
- rapid printing

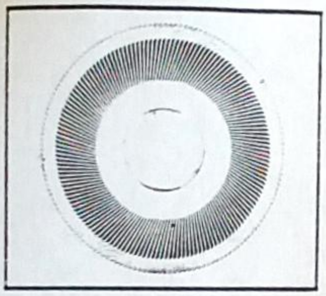




MACHINE TOOLS

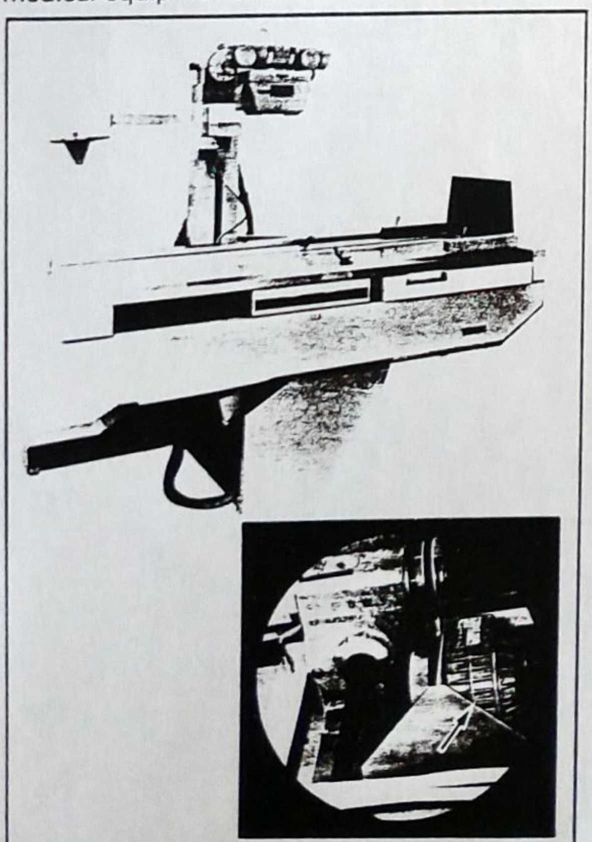
The particular performance of AXEM motors which allows variable speed control over a large range of speeds, and assures a constant torque both at high and low speed, enables high accuracy to be achieved in all positioning problems. It follows that AXEM servo motors, often equipped with integral tachometers, will find increasing numbers of applications in the positioning mechanisms of numerical control or conventional machine tools :

- positioning of tool holders
- position of milling machine tables
- table advance on grinding machines.



RADIOLOGIE

AXEM servo motors are particularly useful in radiography applications, as well as in machine tools, because their noise level is much lower than that of conventional motors used so far in medical equipments.



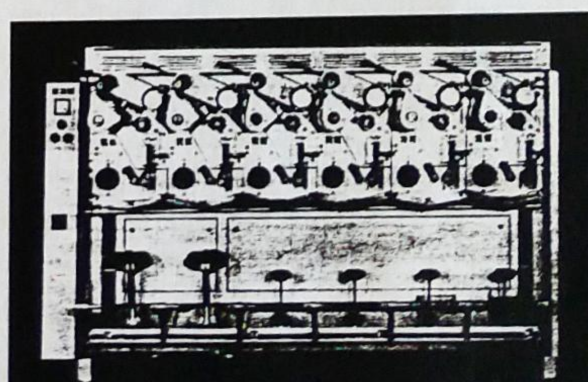
TEXTILE MACHINERY

There are many and varied applications for AXEM servo motors within the textile industry where it is necessary to reel and de-reel filaments and tapes. They can be used to advantage to replace mechanical variable speed equipments where they will :

- increase throughput
- reduce weight
- simplify kinematic chains

Performance improvements can be obtained by more sophisticated designs made possible by the use of servo mechanisms.

- synchronisation of speed on several motors
- filament winding at a constant rate,
- layering etc.



MISCELLANEOUS

- Position servos
- Valve control
- XY plotters
- Positioning of turrets and radar antennas
- Electric propulsion for invalid carriages
- Video recorders
- Projectors
- Cameras
- Coil winders, etc.

A number of application notes and articles which have appeared in the review "Technique C.E.M.", concerning AXEM servo motors and integral tachometers have been reprinted. They are available on application to the manufacturer.