Synchronous Condensing

Using Peaking Plant Reactive Power/Spinning Reserve

Greater use of peaking plant

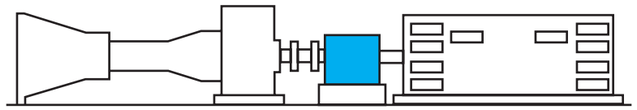
History…

There are many thousands of peak-load gas turbine driven generator sets worldwide and many have stood idle for years. What could be more wasteful?

If an SSS clutch originally had been fitted between the gas turbine and the generator, the generator could have been used for power factor correction, voltage control, or spinning reserve, with the gas turbine at rest, but readily available for peak load generation.

When the gas turbine speed overtakes that of the generator, the SSS clutch automatically engages for electric power generation. When the turbine is shut down, the clutch disengages automatically leaving the generator rotating for power factor correction, voltage control, or spinning reserve. Throughout these changing modes, the generator can remain electrically connected to the grid, thus providing a quick response to system demands.

Where there has been the foresight to order gas turbine driven generating sets with SSS clutches, the sets have continued to have an operating role, even when the driving turbine has been less used than anticipated.

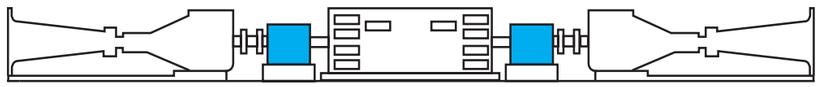


Single ended peak-load set with the gas turbine driving through an SSS clutch

History lesson...

It is impossible to predict the future use of a power plant throughout its entire working life, therefore it is wise to design for operational flexibility. The inclusion of a clutch when specifying or purchasing new gas turbine generator units will provide greater flexibility of use and a better return on capital invested.

Double ended peak-load set. Two SSS clutches allow one, both, or neither, gas turbine to drive the generator.



Principles of the SSS Clutch

The initials 'SSS' denote the 'Synchro-Self-Shifting' action of the clutch, originated by SSS Gears Ltd., whereby the clutch teeth are phased and then automatically shifted axially into engagement when rotating at precisely the same speed. The clutch teeth automatically shift out of engagement as soon as the input speed slows down relative to the output speed. The clutch function is described in more detail in the brochure 'SSS Clutch Operating Principle' reference number 100.

SSS clutches have a very high torque capacity and are suitable for high speeds of operation.

The SSS Semi-Rigid Clutch

This type is suitable where the input and output shafts supporting the SSS clutch are in good alignment. This clutch is relatively low in cost and weight. In general, a semi-rigid clutch is acceptable if, when engaged, it could be replaced by a solid coupling. Most of the parts of this type of clutch are connected to the turbine and are thus stationary when the turbine is stationary. If required, this clutch can incorporate an internal thrust bearing so, for instance, the generator can be located axially through the clutch from the turbine.

The SSS Spacer Clutch

This type is suitable for use between shafts subject to misalignment. A gear-type coupling added to the input of the semi-rigid SSS clutch enables the complete unit to act as a combined clutch and spacer-type flexible coupling to accommodate some radial misalignment. If the turbine and generator each have their own location bearings, axial expansion movements can be accepted by the SSS spacer clutch. Alternatively, axial end stops can be fitted with the clutch if the generator is required to be located from the turbine.

The Encased SSS Clutch

An encased clutch is the best choice for installations where the weight of the SSS clutch cannot be supported by the driving and/or driven shafts or where a modular unit is preferred. An SSS clutch is built into a free-standing assembly complete with input and output shafts and support bearings. The encased SSS clutch has simple interfaces and can be easily aligned on prepared foundations at the installation site. It requires only a pressure oil supply for lubrication and possibly some electrical signal connections for automatic unattended operation.

SSS Semi-Rigid Clutches

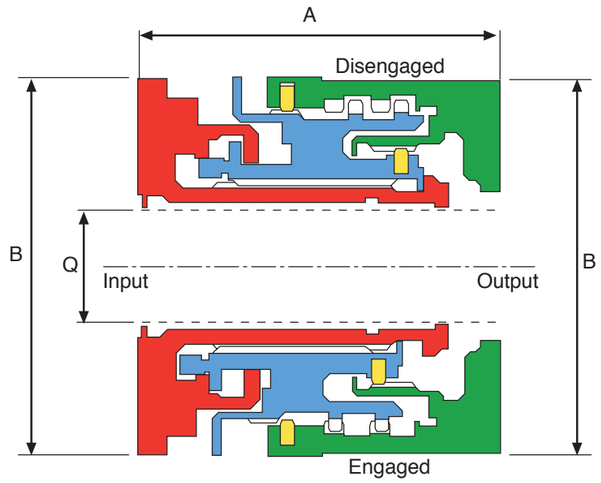
Design features:

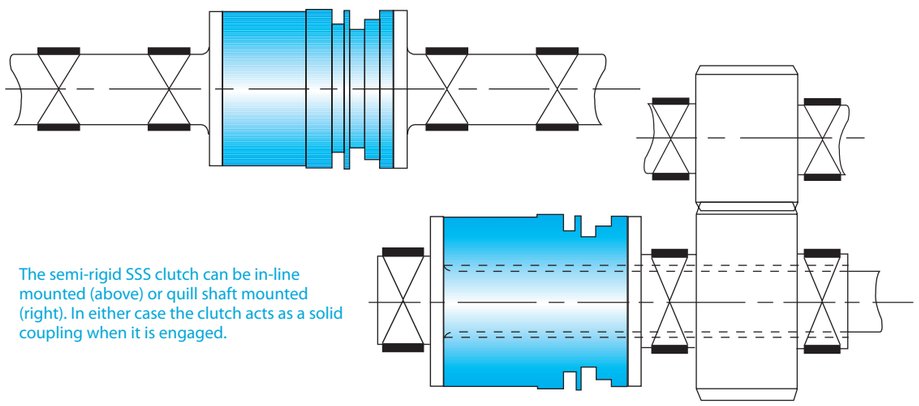
The semi-rigid clutch is suitable for installation where shaft alignment is closely controlled.

- It can engage with some misalignment but will act virtually as a solid coupling when engaged.
- It can be in-line or quill shaft mounted (see diagrams below.)
- It can transmit very high powers and has high overspeed and overload capacity.
- It has low drag torque when disengaged.
- Most of the parts of the clutch are connected to the turbine and are stationary when the turbine is at rest.
- Lubrication oil for the clutch is taken from the main plant lubrication system.

Options:

- Internal thrust bearing to locate output shaft from input shaft.
- Visual mechanical and/or electrical indication of the clutch engaged/ disengaged positions.
- Electrical insulation can be incorporated into the clutch output flange.
- Clutch lock-in to prevent disengagement so, for instance, a gas turbine can be accelerated from the generator.
- The clutch can be supplied in a casing if required.





The semi-rigid SSS clutch can be in-line mounted (above) or quill shaft mounted (right). In either case the clutch acts as a solid coupling when it is engaged.

Typical Semi-rigid Clutch sizes	MW per 1000 rpm	A mm inches	B mm inches	Q mm inches	W kg lbs	F Litres/min Imp galls/min
10T	3.8	365 14.375	375 14.75	117 4.625	152 335	20 4
140T	6.1	324 12.75	422 16.625	165 6.50	210 464	27 6
170T	10	286 11.25	508 20.00	184 7.25	280 617	36 8
194T	16.6	368 14.50	597 23.50	221 8.687	486 1070	60 11
260T	40	581 22.875	760 30.00	265 10.50	1126 2483	120 26
280T	55	670 26.375	813 32.00	280 11.00	1460 3220	145 32
340T	100	710 28.00	1003 39.50	285 11.25	2700 6000	240 53

Q = Maximum diameter of quill shaft.

F = Oil flow required at 3000/3600 rpm. For other speeds consult SSS.

W = Weight

Note: All tabulated details are approximate. Final details are on installation drawing.

SSS Spacer Clutches

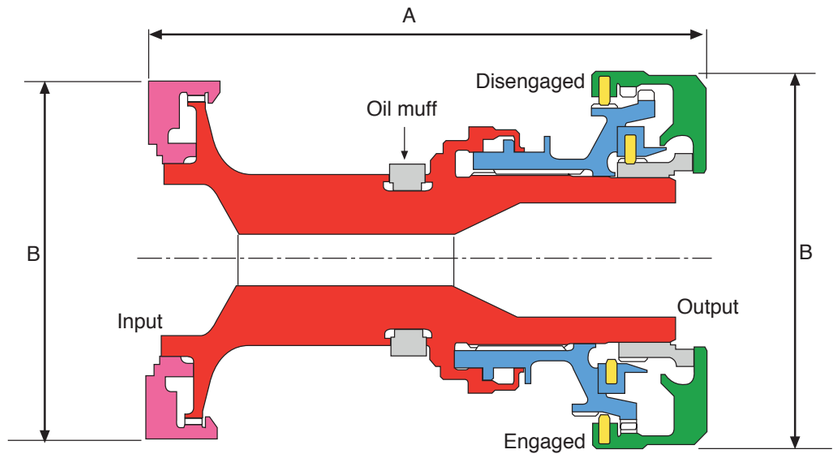
Design features:

The spacer clutch is suitable for use between shafts subject to misalignment.

- It can accommodate large axial movements if necessary.
- It can transmit very high powers and has high overspeed and overload capacity.
- Most of the parts of the clutch are connected to the turbine and are stationary when the turbine is at rest.
- Lubrication oil for the clutch is taken from the main plant lubrication system.

Options:

- Internal thrust bearing to locate output shaft from input shaft.
- Electrical insulation can be incorporated into the clutch output flange.
- Clutch lock-in to prevent disengagement after automatic engagement so, for instance, a gas turbine can be accelerated from the generator.
- The clutch can be supplied in a casing containing bearings if required (see diagrams below.)

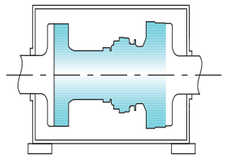


Typical Semi-rigid Clutch sizes	MW per 1000 rpm	A min mm inches	B mm inches	W kg lbs	F Litres/min Imp galls/min
92FT	1.5	483 19.00	430 13.40	117 258	20 5
120FT	3.2	686 27.00	438 17.25	223 490	28 6
160FT	5.7	658 26.00	464 18.30	495 1010	50 11
200FT	8.6	800 31.50	578 22.75	759 1673	60 13
260FT	16.2	790 31.00	724 28.50	892 1966	110 24
285FT	20	800 31.50	813 32.00	993 2188	110 24
300FT	32	900 35.50	854 33.62	1920 4230	265 58
360FT	46.1	883 34.75	1022 40.25	2626 5567	258 57

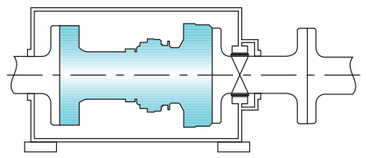
F = Oil flow required at 3000/3600 rpm. For other speeds consult SSS.

W = Weight.

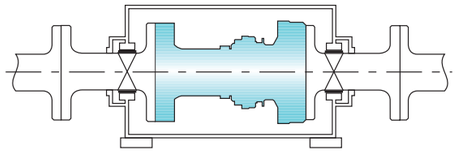
Note: All tabulated details are approximate. Final details are on installation drawing.



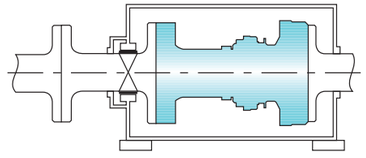
Clutch weight supported entirely by the driving and driven machines.



Clutch weight shared between the driving machine and a bearing within the clutch casing.



Clutch weight supported entirely by bearings within the SSS clutch casing.



Clutch weight shared between the driven machine and a bearing within the clutch casing.

The SSS clutch

PROVEN DESIGN — SSS clutches transmit over 20 million kW in turbo-driven generating sets in 55 countries. The maximum power transmitted through a single SSS clutch is 320,000 kW at 3,000 rpm.

HIGH RELIABILITY — Proven by its selection for vital applications such as the transmission of propulsive power in nearly 1000 Naval ships for 44 Navies of the world.

POSITIVE NO-SLIP DRIVE — Through surface hardened gear teeth.

AUTOMATIC ACTION — A true freewheel device, requiring no friction plates, hydraulic or electromagnetic devices, nor any operator action to control engagement or disengagement.

NEGLIGIBLE WEAR — Clutch synchronization components are inoperative during torque transmission and when the clutch is overrunning at high speed.

HIGH EFFICIENCY — Negligible power loss. Lubricating oil requirements are small, and taken from the normal turbine or generator low pressure system.

SSS Gears Limited

Synchro House, Park Road,
Sunbury-on-Thames,
Middlesex, TW16 5BL, England
Tel: +44 1932 780644
Fax: +44 1932 780018

SSS Clutch Company, Inc.

610 West Basin Road,
New Castle,
DE 19720 USA
Tel: (1) 302 322 8080
Fax: (1) 302 322 8548

SSS Publication No. NR2201

Revised Edition 2009