



PRODUCT INFORMATION



SYNCROSNAP® CENTRIFUGAL SWITCHES FOR SINGLE-PHASE ELECTRIC MOTORS

A split-phase motor is a single-phase induction motor equipped with an auxiliary winding to start the motor turning (Fig. 1). This auxiliary winding, often called the start-winding, must be cut-out of the electrical circuit before the motor reaches nominal speed. The typical design calls for the start-winding circuit to be cut-out between 75% and 80% of the nominal speed of the motor. This is accomplished by using a speed governor which is typically a centrifugal switch. A centrifugal switch consists of two parts, (1) a centrifugal mechanism which rotates on the motor shaft and interacts with (2) a fixed stationary switch with electrical contacts which controls the start-winding circuit.

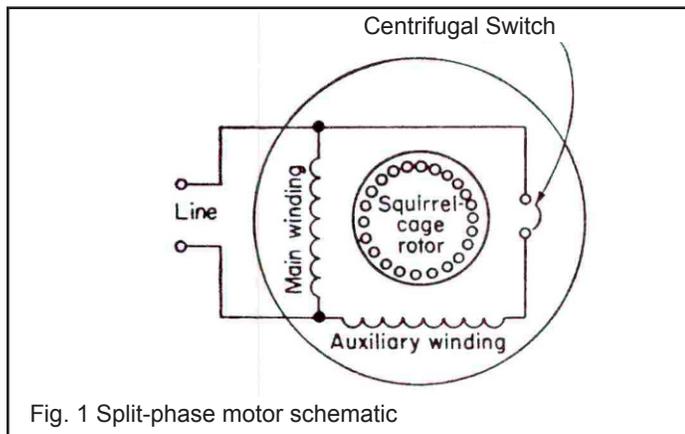


Fig. 1 Split-phase motor schematic

Switches which control the start-winding are a critical component of single-phase electric motors. Many customers select a brand of motor depending upon the design and reputation of the switch mechanism which controls the start-winding.

From a theoretical “Best Design” standpoint, the ideal centrifugal switch should meet the following objectives:

- Frictional components must be negligible and predictable at all times.
- Centrifugal action must be uniform throughout the life of the equipment being controlled.
- Number of parts must be minimized for simplicity and low cost production.
- Operation must be uniform throughout the life of the equipment being controlled.

- Cut-out/Cut-in ratio must be changeable without major design modifications. This ratio is obtained by dividing the cut-out by the cut-in speed to determine the “A” curve from which the operating characteristics of the unit can be determined. (See Fig. 5 on page 3.)

The Torq Syncrosnap® Centrifugal switch achieves these objectives of the “ideal” design. It is unique in its simplicity of construction and friction-free operation. Its one moving part is a conical formed spring disk (1) as shown in Fig. 2. To the base section (2) of this disk are mounted calibrated weights (3) which are supported by a steel retaining plate (4) designed to be press fit on the rotating shaft. The actuating arms of the spring disk (1) are connected to a free-floating insulating spool (5). Clearance is provided between the spool and the shaft to avoid friction which could result from dirt, rust, or other interference. By reducing frictional components to a negligible minimum, uniformity of operation is assured and obtained.

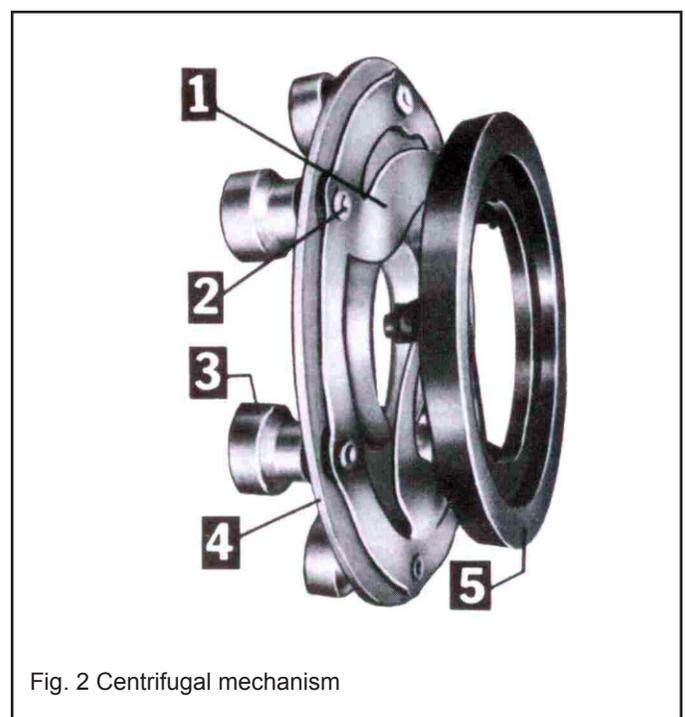


Fig. 2 Centrifugal mechanism

TORQ SYNCROSNAP® CENTRIFUGAL

In operation, the speed of the rotating shaft causes the centrifugal force of the weights to overcome the spring force of the conical disk in a specified speed range, resulting in an instantaneous axial snap-action of the spring disk and the attached insulating spool. This snap-action is a key concept in the Torq centrifugal switch. Snap-action is positive and operation is precisely synchronized with shaft speed. This snap-action makes the Torq Syncrosnap® Centrifugal switch the best choice for single-phase electric motor applications where a precise cut-out or cut-in point is required. Three factors combine at the critical operating point to provide for the positive switching action up to the tripping point:

1. Spring force is reducing at a linear rate.
2. Centrifugal force is increasing at a rate proportional to the square of the speed.
3. The radius of the weights is increasing, thereby multiplying the effects of centrifugal force.

Torq Syncrosnap Centrifugal switches are virtually frictionless. There is no “creeping” or “fluttering” movement of the spring. This makes the mechanisms highly effective for motors with high starting torque load. The configuration of the assembly and the process of manufacturing assure uniformity in production and low manufacturing costs. Depending upon the application, the centrifugal switch may be used to make or break contacts of one or more circuits. Life expectancy ranges through 1,000,000 cycles depending upon the application and design.

In Fig. 4 horizontal spring deflection is plotted against the centrifugal factor expressed in RPM. The instant of switching action is at point X. At point Y, reverse action takes place, where centrifugal force decreases, spring force increases, and the radius of the weights decreases, thus causing return of the switch to its original position.

Fig. 3 Syncrosnap® Centrifugal Switch

Centrifugal mechanism shown in relation to the Stationary switch. Left view: mechanism at rest. Right view: mechanism actuated, breaking contacts on the switch.



The operation of the switch is best described by dividing the range of travel into three sections. Range A provides the initial overtravel of the stationary switch contacts to maintain a positive closing force. Range B is the snap-over portion of the curve. It is in this range that the electrical contacts are snapped open with increasing rotational speed and snapped closed with decreasing rotational speed. Points X and Y indicate the start of snap out and snap back respectively. Range C of the curve provides running clearance between the rotary actuator spool and the stationary switch. This operating curve is representative of a type of centrifugal switch with a wide range of possible cut-in/cut-out speeds. Fig. 4 shows these divisions for a switch with a cut-out/cut-in ratio of 1.929 (Cut-out = 1350 RPM; cut-in = 700 RPM). However, an infinite variety of actuation patterns are available, as shown in Fig. 5. For the sake of simplicity, intermediate curves are not shown, but can be obtained. Once manufactured, only minor speed adjustments can be made to a Torq centrifugal switch, since the pattern of actuation is determined by a fixed curve.

ACTUATING SPEEDS

The speed (RPM) at which the Torq Syncrosnap Centrifugal switch is snapped closed and snapped open is almost unlimited. For typical applications, they can be furnished with minimum/maximum ratio of 1.5 to the wide range of 2.75. Ratios of less than 1.5 and greater than 2.75 can be supplied for special applications. The ability to choose a specific range of cut-in and cut-out speeds makes these switches highly effective for two-speed motor applications. They are also used in high frequency motors with speeds up to 10,000 RPM.

CUSTOM - DESIGNED ASSEMBLIES

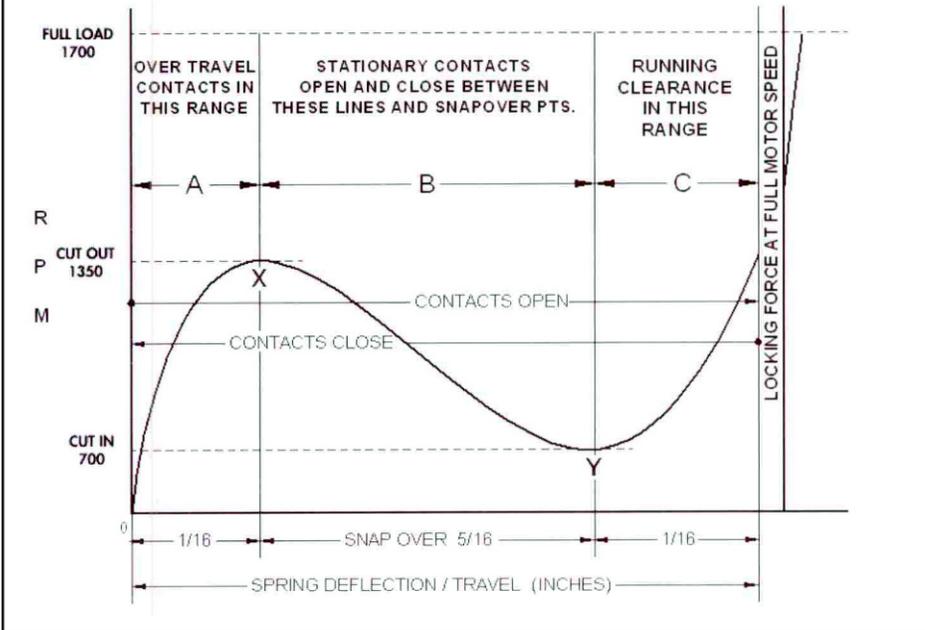
Torq Syncrosnap Centrifugal switches are normally furnished as a complete 2-part combination set, as shown in Fig. 3. (1) The centrifugal mechanism and (2) the matching stationary switch are designed specifically for the application with special emphasis on ease of assembly under high -production methods. These applications include 2-Pole, 4-Pole, 6-Pole, and 8-Pole motors for 50 Hz and 60 Hz. A selection of typical centrifugal mechanisms and stationary switch combinations is shown on page 4 by motor size.

OTHER APPLICATIONS

Torq Syncrosnap Centrifugal switches are ideally suited for any application where the detection of speed is essential to the performance and protection of the machine, device,

SWITCHES HAVE MANY APPLICATIONS

Fig. 4 Operating characteristics of one type of Torq Syncrosnap® Centrifugal switch.



or equipment. The simple and fool-proof action in sensing and responding to changes in rotary speed makes it particularly useful for control of the start-winding in single-phase electric motors. These switches have also been used in many different applications such as overspeed protection for engines, power generator sets, DC motors and motorized equipment, conveyors, escalators, vehicles, elevators, etc. Torq Syncrosnap® Centrifugal switches are equally effective in detecting and instantly responding to underspeed on such applications as blowers and fans, conveyors and other equipment where loss of speed would cause extensive equipment damage and material loss.

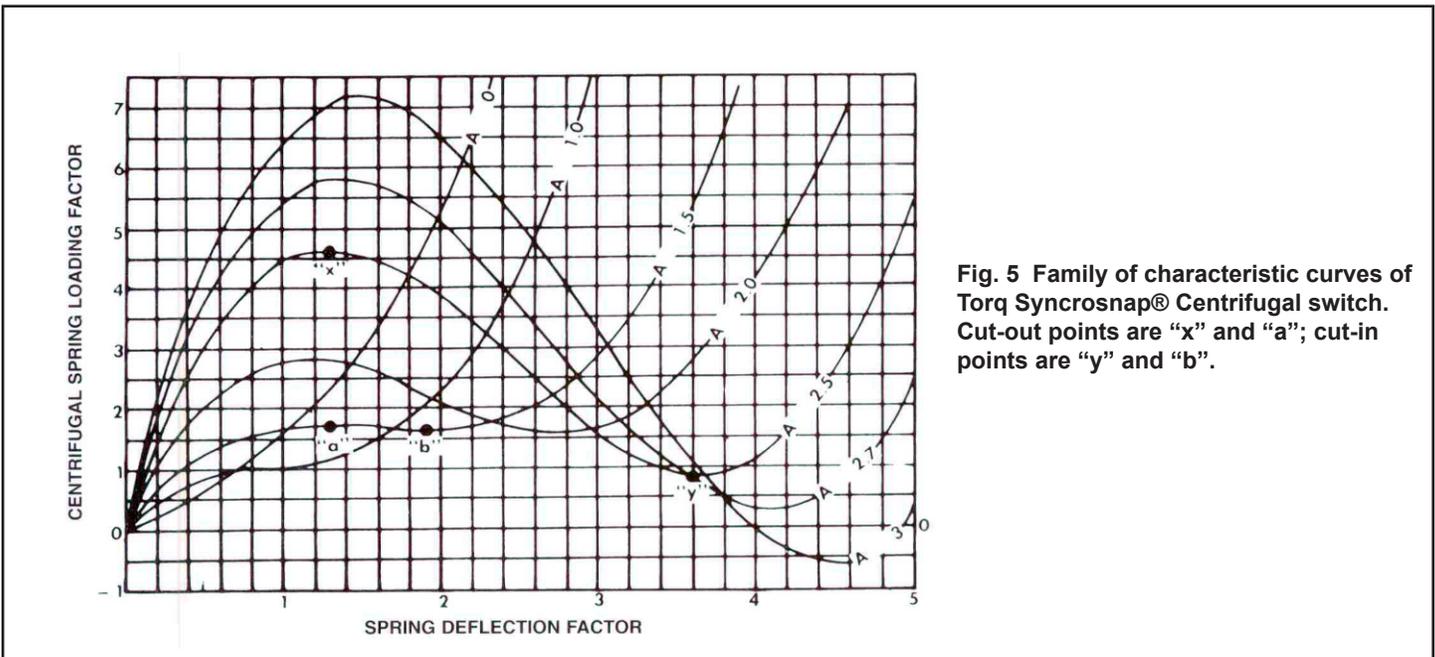
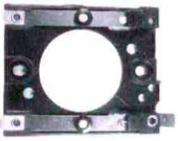
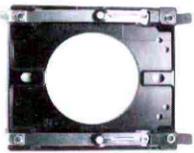
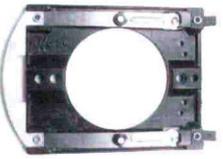
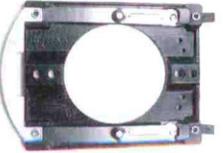


Fig. 5 Family of characteristic curves of Torq Syncrosnap® Centrifugal switch. Cut-out points are "x" and "a"; cut-in points are "y" and "b".

These Switch Features Add Value And Performance To Your Product...

- Instant, snap-action switching action.
- No creeping, fluttering, chattering, or arcing of contact points.
- "Frictionless" operation, with one moving part, suspended in free air.
- Speed tolerances held to precise limits.
- Uniform performance parameters.
- Speed detection from 500 RPM through 10,000 RPM
- Wide range of standard and special sizes as shown on page 4.
- Designed for easy assembly on the production line.

CENTRIFUGAL AND MATCHING STATIONARY SWITCHES BY MOTOR FAMILY

Frame Size	NEMA 42 IEC 63	NEMA 48 IEC 71	NEMA 48 or 56 IEC 71 or 80	NEMA 180 IEC 112	NEMA 210 IEC 132
Centrifugal Mechanisms					
Torq Model Code	SERIES 150	SERIES 170	SERIES 200	SERIES 250	SERIES 300
Outer Diameter	2.25 inches	2.42 inches	2.61 inches	2.78 inches	3.56 inches
Stationary Switches					
Torq Model Code	SERIES 100	SERIES 200	SERIES 200	SERIES 300	SERIES 300
Inner Diameter	1-13/32 inches	1-11/16 inches	1-11/16 in. or 1-15/16 inches	2-1/4 inches	2-1/4 in. or 2-15/16 inches
Mounting Center	2-1/8 inches	2-9/16 in. to 2-3/4 inches	2-9/16 in. to 2-3/4 inches	2-3/4 in. or 3-3/8 inches	2-3/4, 3, or 3-3/8 inches
Button Centers	1-3/4 inches	2 inches	2 in. or 2-9/16 inches	2-5/8 inches	2-5/8 in. or 3-1/16 inches
Length & Width in inches	2-9/16 L x 2-1/8 W	3-7/16 L x 2-1/2 W	3-7/16 L x 2-1/2 W or 3-7/16 L x 3-1/16 W	3-13/16 L x 3-1/4 W	3-13/16 L x 3-1/4 W or 3-15/16 L x 3-11/16 W
Bearing (Typical)	6202	6203	6203 or 6204	6205	6205 or 6206



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STATIONARY CONTACT SWITCHES

This is the current-carrying component of the Torq assembly. These stationary switches are designed to fit within the equipment with a minimum of assembly time required. They can also be furnished to perform secondary functions when the equipment attains full speed. Each unit size can be utilized for single contact, dual contact, multi-speed and added features of multiple circuitry when needed.

TYPICAL ELECTRICAL CONFIGURATIONS

LEFT SIDE	RIGHT SIDE
SPNO	---
SPNO	SPNO
SPNO	SPNC
SPNO	SPDT
SPDT	SPDT