TABLE 6. LOCKED-ROTOR CURRENT OF THREE-PHASE, 60-CYCLE MOTORS AT 220 VOLTS[a,b]

| HP | DESIGN B, C, AND D Amperes | DESIGN F Amperes | HP | DESIGN B, C AND D Amperes | DESIGN F Amperes |
|---|---|---|---|---|---|
| 1 or less | 24[c] | .. | 30 | 435 | 270 |
| 1½ | 35 | .. | 40 | 580 | 360 |
| 2 | 45 | .. | 50 | 725 | 450 |
| 3 | 60 | .. | 60 | 870 | 540 |
| 5 | 90 | .. | 75 | 1085 | 675 |
| 7½ | 120 | .. | 100 | 1450 | 900 |
| 10 | 150 | .. | 125 | 1815 | 1125 |
| 15 | 220 | .. | 150 | 2170 | 1350 |
| 20 | 290 | .. | 200 | 2900 | 1800 |
| 25 | 365 | .. | | | |

[a] The locked-rotor current of three-phase, 60-cycle, constant-speed, induction motors, measured with rated voltage and frequency impressed and with rotor locked, shall not exceed the tabulated values.
[b] Locked-rotor current at other voltages shall be inversely proportional to the voltage.
[c] For 1 hp or less the value is given per hp.

to apply polyphase motors in preference to single phase motors. A typical 5 hp, 1200 rpm capacitor start-induction run single phase motor, for instance, will cost approximately twice as much as the corresponding three phase *Design B* squirrel-cage motor. In addition, the polyphase motor has the advantages of higher power factor and higher efficiency.

## Polyphase Motors

The three types of polyphase motors are: *squirrel-cage induction* motors, *wound rotor induction* motors, and *synchronous* motors.

*Squirrel-cage* motors are specified by NEMA standards providing a variety of speed and torque characteristics. *Design A* motors provide normal starting torque at starting current in excess of *Design B* motors, and are suitable for constant speed application to equipment such as fans and blowers. *Design B* motors provide normal starting torque with *NEMA* starting current values shown in Table 6, which are acceptable by many power companies for full voltage starting. They are used for the same type of application as *Design A*. *Design C* motors provide high starting

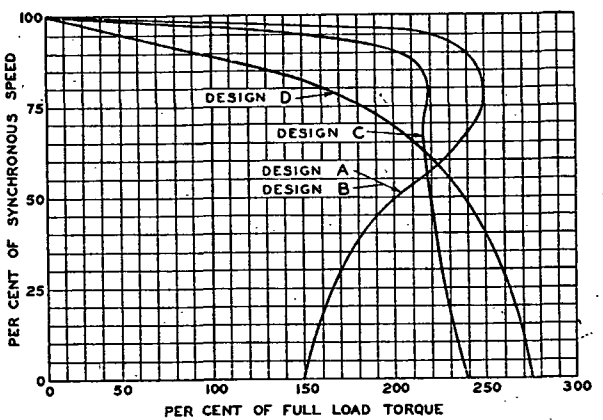



FIG. 5. SPEED TORQUE CHARACTERISTICS OF SQUIRREL-CAGE MOTORS



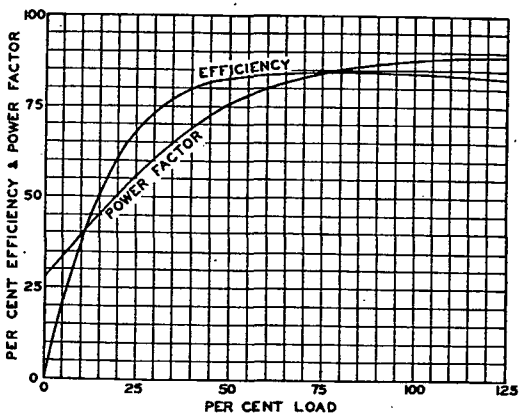



FIG. 6. VARIATION OF EFFICIENCY AND POWER FACTOR WITH LOAD FOR A TYPICAL 5 HP, 4 POLE 60 CYCLE, DESIGN B, SQUIRREL-CAGE MOTOR

torque with starting current same as *Design B*, and are used on compressors started without unloaders, and on reciprocating pumps. *Design D* motors have high slip* and are used with flywheels for widely pulsating loads on equipment such as reciprocating compressors and pumps, where other motors would draw high peak currents.

Figs. 5, 6, 7, and 8 illustrate the characteristics of squirrel-cage motors. It will be noticed by inspection of Fig. 6 that both power factor and efficiency are improved if the motors are operating as near rated load as possible. In addition, as shown in Fig. 8, power factor and efficiency are better for higher speed motors.

Typical specifications for squirrel-cage motors are shown in Specification C at end of chapter.

*Wound Rotor* motors are used for applications requiring high starting

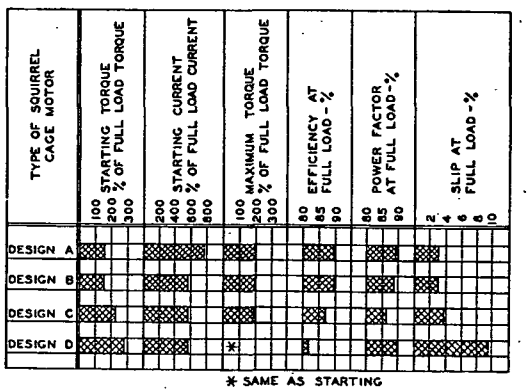



FIG. 7. COMPARATIVE PERFORMANCE OF SQUIRREL-CAGE MOTORS OF 30 HP AND SMALLER SIZES

*Refer to Glossary at end of chapter.