INSTALLATION OF MOTORS AND CONTROL EQUIPMENT

Khurshidbek Najmiddinov Karimjon son
Namangan State Technical University, Student of group 16a-21
Muhsinjon Yusufjonov Ayubkhon son
Namangan State Technical University, Student of group 16a-21
Akmaljon Yuldashev Valijon son
Namangan State Technical University, ass. Teacher

Annotatsiya: The amount of knowledge an electrician must possess to be able to install and troubleshoot control systems in today's industry has increased dramatically in recent years. A continuous influx of improved control components allows engineers and electricians to design and install even more sophisticated and complex control systems. Industrial Motor Control presents the solid-state devices common in an industrial environment. This is intended to help the student understand how many of the control components operate, such as solid-state relays, rectifiers, SCR drives for direct current motors, variable frequency drives for alternating current motors, and the inputs and outputs of programmable controllers.

Keywords: Power availability, motor types, squirrel-cage motors, high starting torque, synchronous motors, motor controllers, nema, safety regulations, underwriters laboratories, flywheels, centrifuges, inertia loads, motor starter sizes, manual control systems, semiautomatic control systems.

УСТАНОВКА ДВИГАТЕЛЕЙ И КОНТРОЛЬНО-ИЗМЕРИТЕЛЬНОГО ОБОРУДОВАНИЯ

Хуршидбек Наджмиддинов Каримджон сын, студент группы 16а-21
Наманганский государственный технический университет
Мухсинджон Юсуфжонов Аюбхон сын, студент группы 16а-21
Наманганский государственный технический университет
Акмалжон Юлдашев Валиджон сын, ассистент
Наманганский государственный технический университет

Аннотация: Объем знаний, которыми должен обладать электрик, чтобы иметь возможность устанавливать и устранять неполадки систем управления в современной промышленности, резко возрос за последние годы. Постоянный приток усовершенствованных компонентов управления позволяет инженерам и электрикам проектировать и устанавливать еще более сложные и комплексные системы управления. Промышленное управление двигателем представляет твердотельные устройства, распространенные в промышленной среде. Это призвано помочь студенту понять, как работают многие компоненты управления, такие как твердотельные реле, выпрямители, приводы SCR для двигателей постоянного тока, частотно-

регулируемые приводы для двигателей переменного тока, а также входы и выходы программируемых контроллеров.

Ключевые слова: Доступность электроэнергии, типы двигателей, двигатели с короткозамкнутым ротором, высокий пусковой момент, синхронные двигатели, контроллеры двигателей, NEMA, правила техники безопасности, лаборатории страховщиков, маховики, центрифуги, инерционные нагрузки, размеры пускателей двигателей, системы ручного управления, системы полуавтоматического управления.

Dvigatellar va boshqaruv uskunalarini oʻrnatish

Xurshidbek Najmiddinov Karimjon oʻgʻli
Namangan davlat texnika universiteti, 16a-21guruh talabasi
Muhsinjon Yusufjonov Ayubxon oʻgʻli
Namangan davlat texnika universiteti, 16a-21guruh talabasi
Akmaljon Yoʻldashev Valijon oʻgʻli
Namangan davlat texnika universiteti, assistenti

Annotatsiya: Soʻnggi yillarda zamonaviy sanoatda boshqaruv tizimlarini oʻrnatish va nosozliklarni bartaraf etish uchun elektrik ega boʻlishi kerak boʻlgan bilim miqdori keskin oshdi. Yaxshilangan boshqaruv komponentlarining uzluksiz oqimi muhandislar va elektriklarga yanada murakkab va murakkab boshqaruv tizimlarini loyihalash va oʻrnatish imkonini beradi. Ushbu maqolada sanoat motorini boshqarish sanoat muhitida keng tarqalgan mustahkam holatdagi qurilmalarni taqdim etadi. Bu talabaga mustahmak holatdagi, rektifikatorlar, toʻgʻridan-toʻgʻri oqim dvigatellari uchun SCR drayvlar, oʻzgaruvchan tok dvigatellari uchun oʻzgaruvchan chastotali drayvlar va dasturlashtiriladigan kontrollerlarning kirish va chiqishlari kabi qancha boshqaruv komponentlari ishlashini tushunishga yordam berish uchun moʻljallangan.

Kalit soʻzlar: Quvvat mavjudligi, motor turlari, sinkap-kafesli motorlar, yuqori ishga tushirish momenti, sinxron motorlar, vosita boshqaruvchilari, nema, xavfsizlik qoidalari, drayver, volanlar, sentrifugalar, inertsiya yuklari, motor starter oʻlchamlari, qoʻlda boshqarish tizimlari, yarim avtomatik boshqaruv tizimlari.

Industrial Motor Control presents many examples of control logic and gives the student stepby- step instructions on how these circuits operate. There are examples of how ladder diagrams can be converted into wiring diagrams. This is the basis for understanding how to connect control circuits in the field. The concept of how motor control schematics are numbered is thoroughly discussed. Students are also given a set of conditions that a circuit must meet, and then that circuit is developed in a step-by-step procedure. Learning to design control circuits is a very effective means of learning how circuit logic works. It is impossible to effectively troubleshoot a control circuit if you don't understand the logic of what the circuit is intended to do.

Industrial Motor Control is based on the results of extensive research into content, organization, and effective learning styles. Short chapters help the student to completely understand the content before progressing to the next subject, and they permit the instructor to choose the order of presentation. Each chapter contains extensive illustrations, which have been designed for maximum learning. The amount of knowledge an electrician must possess to be able to install and troubleshoot control systems in today's industry has increased dramatically in recent years. A continuous influx of improved control components allows engineers and electricians to design and install even more sophisticated and complex control systems. *Industrial Motor Control* presents the solid-state devices common in an industrial environment. This is intended to help the student understand how many of the control components operate, such as solid-state relays, rectifiers, SCR drives for direct current motors, variable frequency drives for alternating current motors, and the inputs and outputs of programmable controllers. Although most electricians do not troubleshoot circuits on a component level, a basic knowledge of how these electronic devices operate is necessary in understanding how various control components perform their functions.

The term *motor control* can have very broad meanings. It can mean anything from a simple toggle switch intended to turn a motor on or off (Figure 1) to an extremely complex system intended to control several motors, with literally hundreds of sensing devices that govern the operation of the circuit. The electrician working in industry should be able to install different types of motors and the controls necessary to control and protect them and also to troubleshoot systems when they fail. When installing electric motors and equipment, several factors should be considered. When a machine is installed, the motor, machine, and controls are all Interrelated and must be considered as a unit. Some machines have the motor or motors and control equipment mounted on the machine itself when it is delivered from the manufacturer, and the electrician's job in this case is generally to make a simple power connection to the machine. Other types of machines require separately mounted motors that are connected by belts, gears, or chains. Some machines also require the connection of pilot sensing devices such as photo switches, limit switches, pressure switches, and so on. Regardless of how easy or complex the connection is, several factors must be considered.

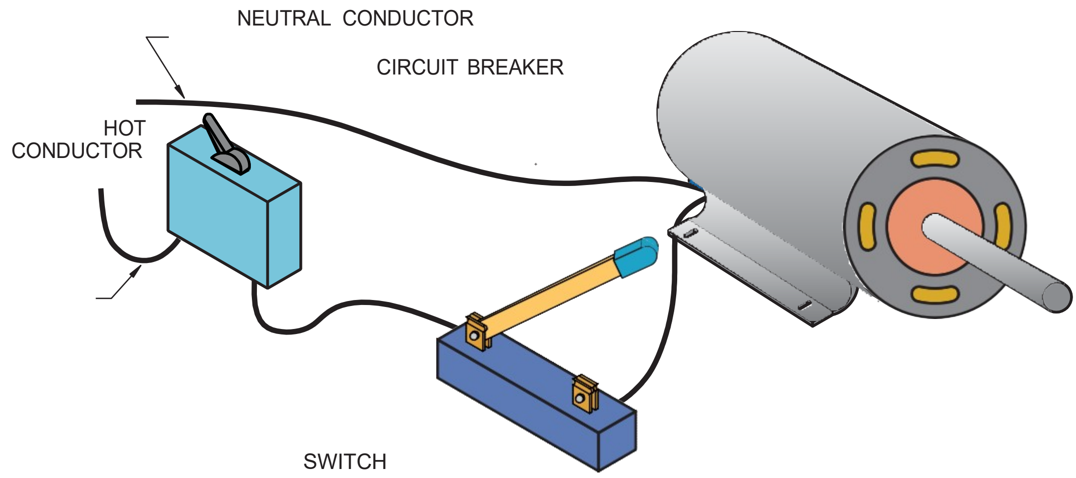


Figure 1. Motor controlled by a simple toggle switch.

The availability of power can vary greatly from one area of the country to another. Power companies that supply power to heavily industrialized areas can generally permit larger motors to be started across-the-line than companies that supply power to areas that have light industrial needs. In some areas, the power company may permit a motor of several thousand horsepower to be started across-the-line, but in other areas the power company may require a reduced voltage starter for motors rated no more than 100 horsepower.

The type of motor best suited to operate a particular piece of equipment can be different for different types of machines. Machines that employ gears generally require a motor that can start at reduced speed and increase speed gradually. Wound rotor induction motors or squirrel-cage motors controlled by variable frequency drives are generally excellent choices for this requirement. Machines that require a long starting period, such as machines that operate large inertia loads such as flywheels or centrifuges, require a motor with high starting torque and relatively low starting current. Squirrel-cage motors with a type A rotor or synchronous motors are a good choice for these types of loads. Synchronous motors have an advantage in that they can provide power factor correction for themselves or other inductive loads connected to the same power line. Squirrel-cage motors controlled by variable frequency drives or direct-current motors can be employed to power machines that require variable speed.

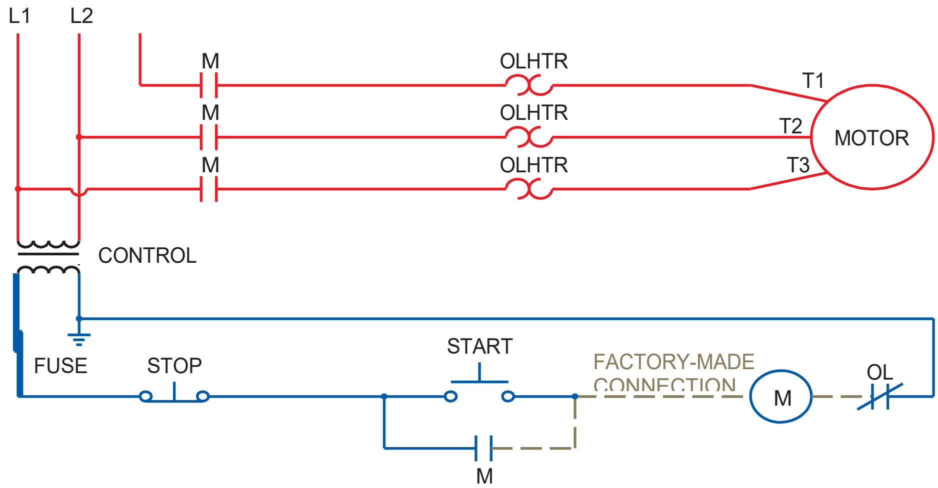
Squirrel-cage induction motors are used to power most of the machines throughout industry. These motors are rugged and have a proven record of service unsurpassed by any other type of power source.

The type of controller can vary depending on the requirements of the motor. Motor starters can be divided into two major classifications: NEMA (National

Electrical Manufacturers Association) and IEC (International Electrotechnical Commission). NEMA is an American organization that rates electrical components. NEMA starter sizes range from 00 through 8. A NEMA size 00 starter is rated to control a 2-horsepower motor connected to a 460-volt, three-phase power supply. A size 8 starter will control a 900-horsepower motor connected to a 460-volt, three-phase power source. IEC starter sizes range from size A through size Z. Size A starters are rated to control a 3-horsepower motor connected to a 460-volt, three-phase source. Size Z starters are rated to control a 900-horsepower motor connected to a 460-volt source. It should be noted that the contact size for an IEC starter is smaller than for a NEMA starter of the same rating. It is common practice when using IEC starters to Increase the listed size by one or two sizes to compensate for the difference in contact size.

Another important consideration is the safety of the operator or persons that work around the machine. In 1970, the Occupational Safety and Health Act (OSHA) was established. In general, OSHA requires employers to provide an environment free of recognized hazards that are likely to cause serious injury. Another organization that exhibits much influence on the electrical field is Underwriters Laboratories (UL). Underwriters Laboratories was established by insurance companies in an effort to reduce the number of fires caused by electrical equipment. They test equipment to determine whether it is safe under different conditions. Approved equipment is listed in an annual publication that is kept current with bimonthly supplements. Another previously mentioned organization is the *National Electrical Code.* The *NEC* is actually part of the National Fire Protection Association. They establish rules and specifications for the installation of electrical equipment. The *National Electrical Code* is not a law unless it is made law by a local authority. Two other organizations that have great influence on control equipment are NEMA and IEC. Both of these organizations are discussed later in the text.

Motor control systems can be divided into three major types: manual, semiautomatic, and automatic. Manual controls are characterized by the fact that the operator must go to the location of the controller to initiate any change in the state of the control system. Manual controllers are generally very simple devices that connect the motor directly to the line. They may or may not provide overload protection or low-voltage release. Manual control may be accomplished by simply connecting a switch in series with a motor (Figure 1). Semiautomatic control is characterized by the use of push buttons, limit switches, pressure switches, and other sensing devices to control the operation of a magnetic contactor or starter. The starter actually connects the motor to the line, and the push buttons and other pilot devices control the coil of the starter. This permits the actual control panel to be located away from the motor or starter. The operator must still initiate certain actions, such as starting and stopping, but does not have to go to the location of the motor or starter to perform the action. A schematic and wiring diagram of a start–stop push button station is shown in Figure 2. A schematic diagram shows components in their electrical sequence without regard for physical location. A wiring diagram is basically a pictorial representation of the control components with connecting wires. Although the two circuits shown in Figure 2 look different, electrically they are the same.



SCHEMATIC DIAGRAM OF A START–STOP PUSH BUTTON CONTROL

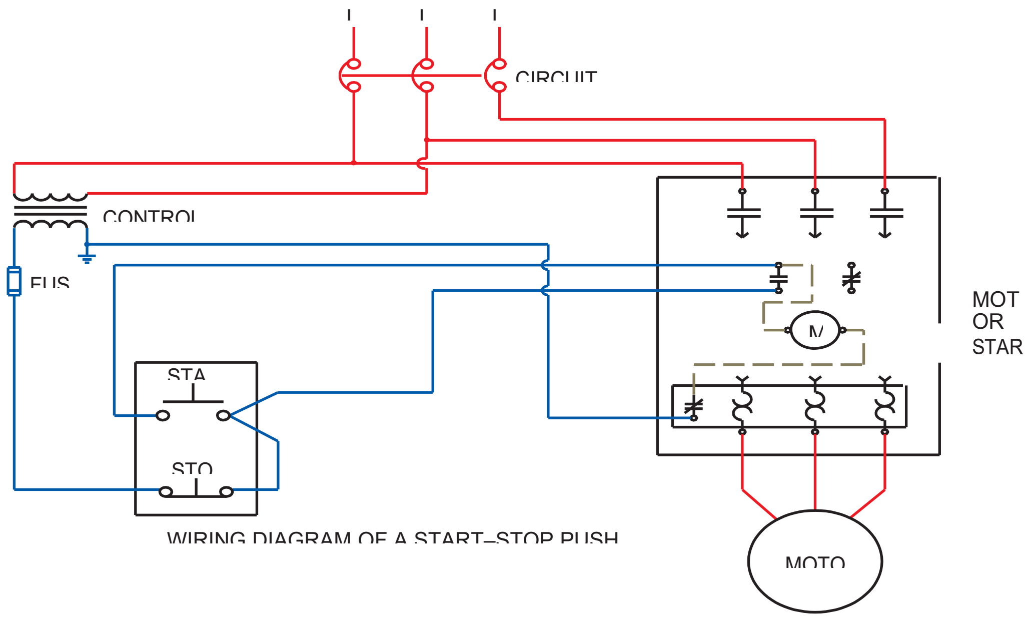


Figure 2. Schematic and wiring diagram of a start-stop push button control.

Automatic control is very similar to semiautomatic control in that pilot sensing devices are employed to operate a magnetic contactor or starter that actually controls the motor. With automatic control, however, an operator does not have to initiate certain actions. Once the control conditions have been set, the system will continue to operate on its own. A good example of an automatic control system is the heating and cooling system found in many homes. Once the thermostat has been set to the desired temperature, the heating or cooling system operates without further attention from the home owner. The control circuit contains sensing devices that automatically shut the system down in the event of an unsafe condition such as motor overload, excessive current, no pilot light or ignition in gas heating systems, and so on.

Probably the most important function of any control system is to provide protection for the operator or persons that may be in the vicinity of the machine. These protections vary from one type of machine to another, depending on the specific function of the machine. Many machines are provided with both mechanical and electrical safeguards.

References

1. Patrick, D. R., & Fardo, S. W. (2014). Industrial Motor Control. Delmar Cengage Learning.
2. Wildi, T. (2013). Electrical Machines, Drives, and Power Systems (6th ed.). Pearson.
3. El-Sharkawi, M. A. (2004). Fundamentals of Electric Drives. Thomson Learning.
4. Beaty, H. W., & Kirtley, J. L. (2004). Electric Motor Handbook (3rd ed.). McGraw-Hill.
5. Hughes, A. (2013). Electric Motors and Drives: Fundamentals, Types, and Applications. Newnes.
6. Janis, R. R., & Tao, W. K. Y. (2005). Mechanical and Electrical Systems in Buildings (3rd ed.). Pearson.
7. Petruzella, F. (2011). Industrial Automation and Control System Design. McGraw-Hill.
8. O‘Connell, D. W. B. (2007). Electric Motors and Drives: A Technological Guide. Newnes.
9. Y.A.Valijon o‘g‘li, Saydulla o‘g‘li, N. Y., Shavkat o‘g‘li, N. S., & Ubaydulla o‘g‘li, X. S. (2023). FUZZY MODULI YORDAMIDA NOQAT’IY BOSHQARISH SISTEMALARNI QURISH. TADQIQOTLAR. UZ, 28(5), 31-37.
10. Y.A.Valijon o‘g‘li, Davlat o‘g‘li, X. R., & Tirkash o‘g, I. G. A. (2023). FUZZY LOGIC YORDAMIDA SISTEMANI SUGENO TIPIDA LOYIHALASH. Journal of new century innovations, 43(2), 97-106.
11. Yo‘ldashev A. V. (2024). OB’YEKT HOLATLARINI TASHXISLASHNING INTELLEKTUAL MODELINI SHAKLLANTIRISH TAMOYILI. Экономика и социум, (3-2 (118)), 436-440.
12. Y.A.Valijon o‘g‘li, Shavkat o‘g‘li, J. E., Hakimjon o‘g‘li, S. H., & Farxod

o‘g‘li, M. F. (2023). SUN’IY INTELLEKTDA BILIMLARNI TASVIRLASH MODELLARI. TADQIQOTLAR. UZ, 28(5), 22-30.