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Kita

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[54] **FULLY AUTOMATIC FORGING PRESS**

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[52] **U.S. Cl.** **72/405,** 72/24, 72/421, 219/7.5

[51] **Int. Cl.** **B21j 11/00**

[58] **Field of Search** ..... 72/405, 420, 421, 23, 24, 72/27; 219/7.5, 154, 150 R, 149

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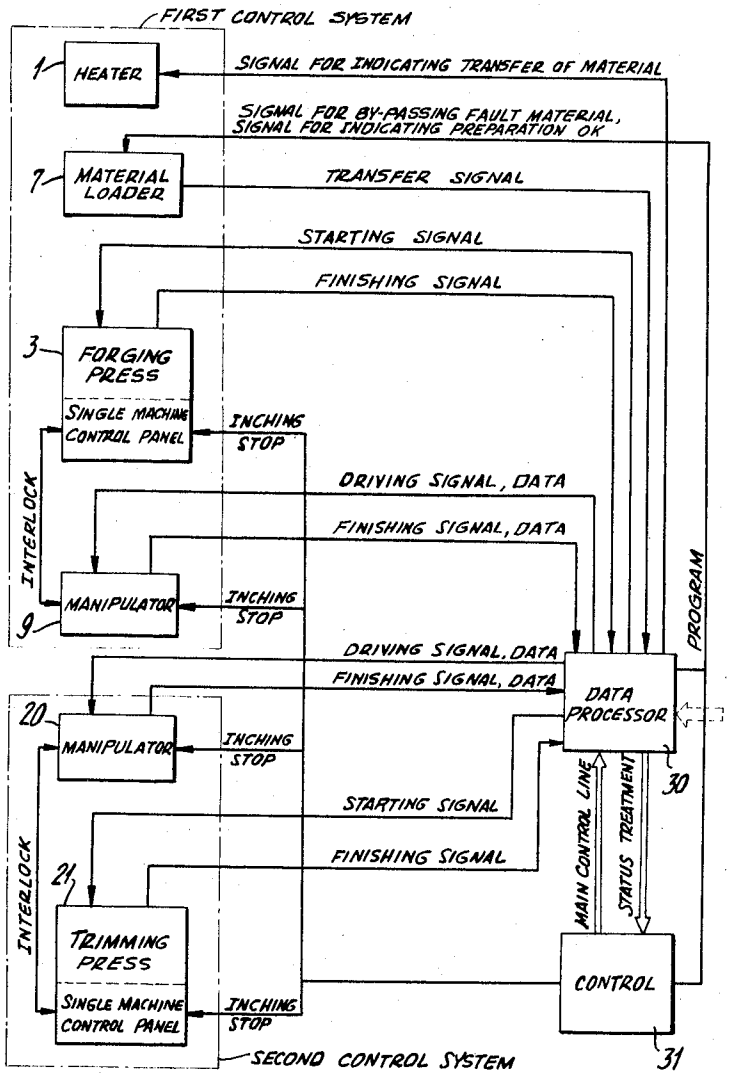
Assistant Examiner—Carl E. Hall
Attorney, Agent, or Firm—Toren and McGeady

[57] **ABSTRACT**

This forging press is adapted to operate fully automatically, based on complete control by computers, the process including the heating of a material to be forged, introduction of the heated material, transferring successively to a plurality of metal molds provided in the body of the forging press and reversing of the material, removing the forged material from the forging press, and performing finishing work after the material has been carried into a trimming press.

4 Claims, 4 Drawing Figures



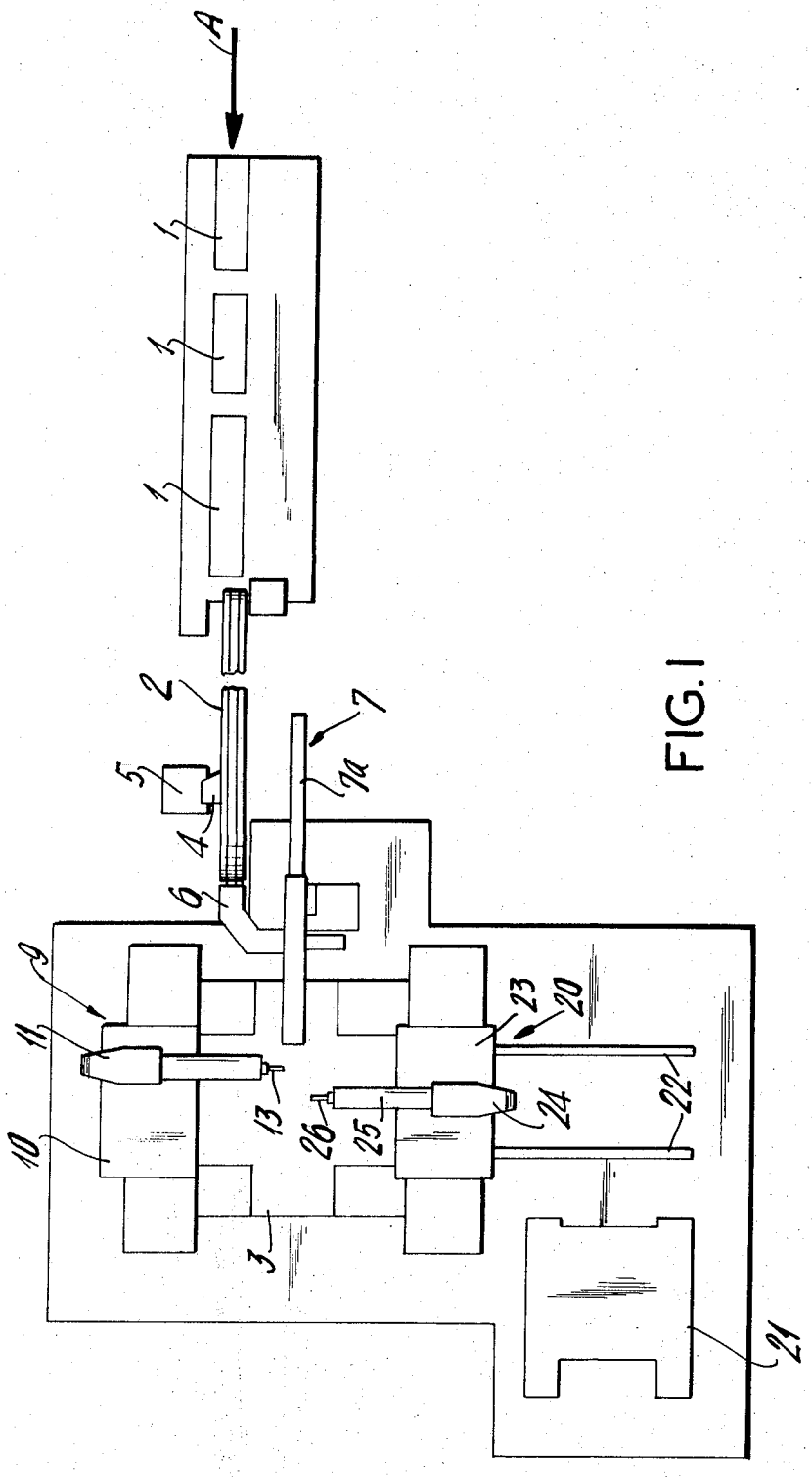


FIG. 1

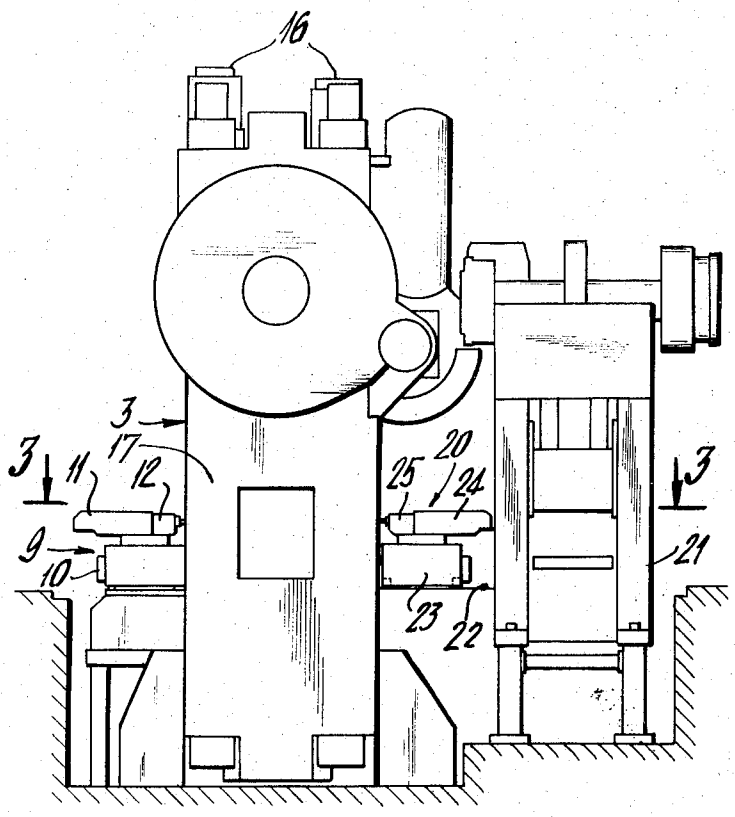

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FIG.2

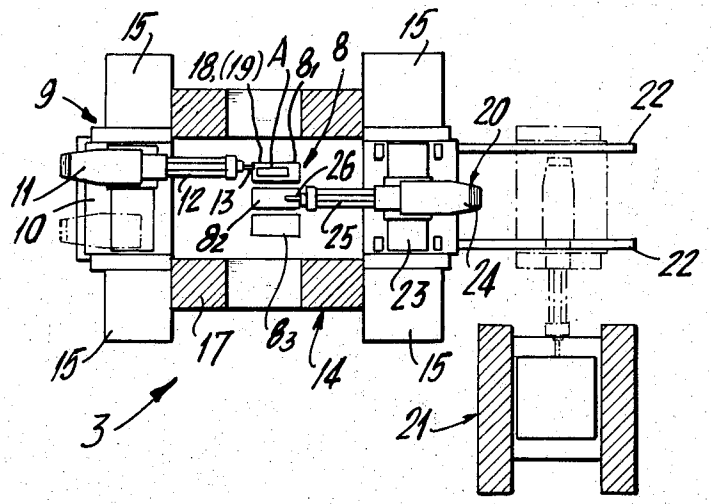
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FIG.3

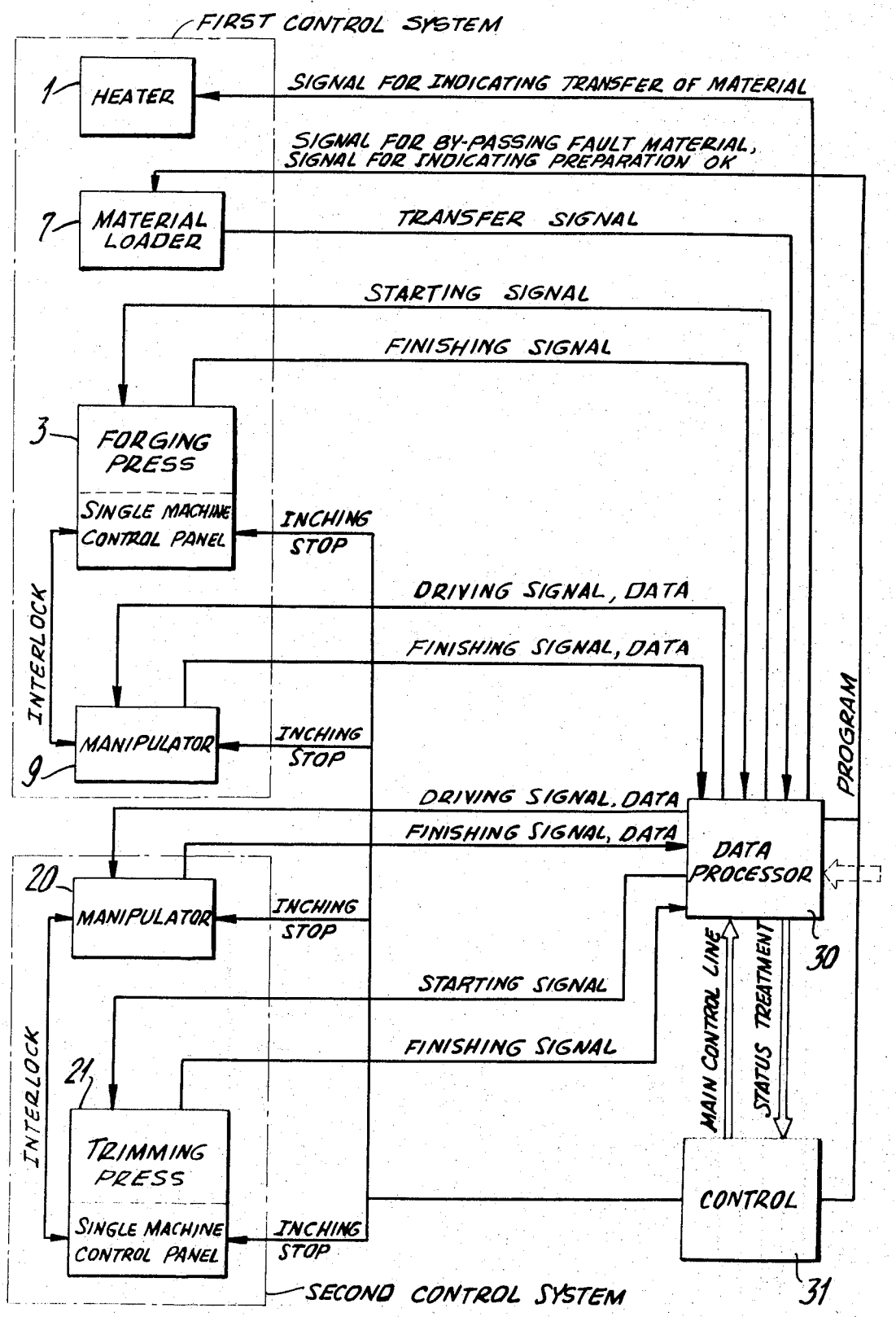
FIRST CONTROL SYSTEM
1
HEATER
SIGNAL FOR INDICATING TRANSFER OF MATERIAL
SIGNAL FOR BY-PASSING FAULT MATERIAL,
SIGNAL FOR INDICATING PREPARATION OK
7
MATERIAL LOADER
TRANSFER SIGNAL
STARTING SIGNAL
FINISHING SIGNAL
3
FORGING PRESS
SINGLE MACHINE CONTROL PANEL
INCHING STOP
INTERLOCK
DRIVING SIGNAL, DATA
FINISHING SIGNAL, DATA
9
MANIPULATOR
INCHING STOP
PROGRAM
DRIVING SIGNAL, DATA
FINISHING SIGNAL, DATA
DATA PROCESSOR
20
MANIPULATOR
INCHING STOP
30
STARTING SIGNAL
FINISHING SIGNAL
MAIN CONTROL LINE
STATUS TREATMENT
INTERLOCK
21
TRIMMING PRESS
SINGLE MACHINE CONTROL PANEL
INCHING STOP
CONTROL
SECOND CONTROL SYSTEM
31

FIG. 4

FULLY AUTOMATIC FORGING PRESS

BACKGROUND OF THE INVENTION

In the conventional forging press, there has been carried out manually the respective processes, such as heating of a material to be forged, supplying of the heated material into a forging press, successively transferring of the supplied material into a plurality of metal molds provided in the body of said forging press, reversing of the material when the material is transferred into a plurality of said metal molds, removing the forged article from the body of said forging press and supplying of said forged article into a trimming press.

The present invention is to propose the fully-automatical operation of a forging press by controlling systematically and automatically the respective processes as mentioned above.

SUMMARY OF THE INVENTION

A main object of the present invention is to provide a forging press which is adapted to operate fully-automatically, based on a complete control by computers, all the processes including the heating of a material to be forged, introduction of the heated material, transferring successively to a plurality of metal molds provided in the body of the forging press and reversing of the material, removing the forged material from the forging press, and performing finishing work after the material has been carried into a trimming press.

Another object of the present invention is to improve the operating efficiency, and to seek an improvement in working conditions for the workers by eliminating manual operation in a harmful environment and at the same time to reduce the bulky installation heretofore required for preservation of environment, whereby forged products can be obtained economically.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a general constitutional view in a schematic form of an example embodying the present invention,

FIG. 2 is a side elevation showing a forging press and a trimming press,

FIG. 3 is a cross sectional view of the same, and

FIG. 4 is a block diagram of the control system.

DETAILED DESCRIPTION OF THE INVENTION

The invention will now be described referring to an embodimental example shown in the drawings. The apparatus according to the present invention is constituted by each of the devices shown schematically in FIG. 1. Namely, the numeral 1 designates a heating device for a material to be forged, and in general, a high-frequency induction heating furnace is used therefor. The material A which had been carried in from an entrance (right side in the drawing) side of the heating device 1 and has been heated to a forging temperature is carried to the body 3 of the forging press by means of a chain conveyer 2 provided at the exit (left side in the drawing) side of the heating device 1. An inspecting mechanism 4 is provided on the way to the chain conveyer 2 for checking the temperature and the form of the heated material A, and the material A which is detected to be faulty by the inspecting mechanism 4 is dropped off to a material-discharging palette 5. A loading chute 6 bent substantially to an L-shape along the side surface of the press 3 is provided at the end of the chain conveyer 2, and the loading chute 6 reaches up to a material loader 7 provided laterally of the body 3. The material loader 7 is provided with a piston-cylinder means 7*a* for pushing out the material A one by one which has been dropped off the loading chute 6, and the material A pushed out by the piston-cylinder means 7*a* is fed to a metal mold 8_1 of the first stage in among a plurality of metal molds 8 provided in the forging press 3. A transferable industrial manipulator 9 is provided along the side of the body 7 at the side (generally, a position 90° apart from said material loader is preferable) of the forging press 3. The industrial manipulator 9 is formed of a rotary head 11 projectingly provided on a base 10 which is transferrable along the side surface of the forging press 3, and an arm 12 is protruded horizontally from the front surface of the rotary head 11 towards the metal molds 8 of the body 3. The arm 12 is made freely to advance and retreat by a driving means (not shown) arranged in the rotary head 11, and a grip means 13 is provided at the tip end of the arm 12 for gripping the material A. The first-stage metal mold 8_1 fed by the material loader 7 is gripped by said industrial manipulator 9, and the material A is set at a right position of the first-stage metal mold 8_1 for the forging thereof. The forging press 3 is provided with four supporting posts 15 provided around a bolster 14, and an oil-pressure producing means (not shown) and a plurality of oil pressure cylinder means 16 driven by said oil-pressure producing means are provided on the top end of the supporting posts 15, and an upper mold die set 18 which is movable freely up and down along a guide post 17 provided on said bolster 14 is driven up and down by means of said oil-pressure means. The metal molds 8 are arranged between the upper surface of the lower mold die set 19 and the lower surface of the upper mold die set 18 on said bolster 14 as shown in FIG. 3.

Another industrial manipulator 20 is provided opposite said industrial manipulator 9 and the group of metal molds 8. While said industrial manipulator 9 places the material A carried by the material loader 7 in position relative to each of the metal molds 8 and transfers the material from the first-stage metal mold 8_1 to the intermediate-stage metal mold 8_2 and to the final-stage metal mold 8_3 with each of the forging processes, the industrial manipulator 20 operates to take out the material A which has been forged from the metal molds 8, and to carry the material into a trimming press 21 provided laterally of the forging press 3. The industrial manipulator 20 has a base 23 which is retreatable on rails 22, and rotary head 24 is projectingly provided on the base 23. An arm 25 is retreatably protruded in front of the rotary head 24. A grip means 26 which can grip the material A is provided at the tip end of the arm 25. Said trimming press 21 is installed laterally of the rails 22, which cuts protruded portions from the material A which has been forged and introduced by the arm 25 of the industrial manipulator 20 thereby to complete the work. For this purpose, a conventional type of trimming press can be used.

Each of the devices constituted as above are completely controlled by a controlling device as will be described in the following. Namely, as shown in FIG. 4, said controlling device is adapted to control various devices in accordance with a program which has been es-

tablished previously. In order to improve the efficiency, the control system is divided into two groups: the first control system comprises a material loader **7**, a heating device **1**, the forging press **3**, and a traversible industrial manipulator **9**, and the second control system comprises a trimming press **21** and an industrial manipulator **20**. Each of the control systems can reduce the cycle time by carrying out the program independently, and each of the control systems can carry out simultaneously the program in synchronism when necessary. The previously established program is first applied to the data processing device **30**. The data processing device **30** analyzes the given program, and at first, transmits a take out signal for the material A to the heating device, and at the same time transmits a preparation completion signal to the material loader **7**. The material A carried out of the heating device **1** is transferred to the side of the forging press **3** by a chain conveyer **2**, and is fed to the material loader **7** through a loading chute **6**. When a fault of the material A, for example, inadequacy of forging temperature, or inferiority of the shape, is detected during these processes, a bypass instruction of the material is transmitted from the data processing device to the material loader **7**, thereby the material is caused to drop into the material discharging pallet **5** without being operated to carry the material. When the forgeable material A is fed into the material loader **7**, a loading signal is transmitted from the material loader **7** to the data processing device **30**, and at the same time the material loader **7** starts the operation to push the material A into the forging press **3**. The material A fed into the forging press **3** is gripped by a gripping means **13** provided at the tip end of the arm **12** with the operation of the industrial manipulator **9**, and the material A is placed at an appropriate position relative to the first-stage metal mold 8_1. Upon the completion of the operation of the industrial manipulator **9**, a completion signal is transmitted to the data processing device **30**, and the device **30** transmits an operation order signal to the forging press **3** basing upon said completion signal. Hereupon the forging press **3** commences the operation, and when the forging of the material A fed to the first-stage metal mold 8_1 is finished, transmits an operation completion signal to the data processing device, and the device transmits a driving order to the industrial manipulator **9** in accordance with the program, and causes said manipulator to transfer the material A, which has been forged in the first-stage metal mold 8_1, to the metal mold 8_2 of the following stage while reversing the material A. All this while, a lock signal is applied to the forging press **3**, and the press is not operated during the operation of the industrial manipulator **9**. At this time a compensating operation due to an inching and stopping to the industrial manipulator **9** can be effected by a control panel **31** directly connected to the data processing device **30**. When the forging is finished at the final-stage metal mold 8_3 by repeating the above-mentioned operations, a completion signal is transmitted from the forging press **3** to the data processing device **30**, thereby all the operations in the first control system is completed, and a signal is delivered to the second control system. In the second control system, with the completion of operations in the first control system, a driving order of ON-OFF is first transmitted from the data processing device **30** to the industrial manipulator **20**, thereby the operation of the industrial manipulator **20** is commenced. The industrial manipulator **20** grips the material A which has been forged in the final-stage metal mold 8_3 and retreats with the material A, and after causing the rotary head **24** to rotate by 90°, causing the arm **25** to extend thereby to carry the material A gripped at the end of the arm into the trimming press **21**. Upon completion of the carrying, a completion signal is transmitted to the data processing device **30**. Next, the data processing device transmits an operation order signal to the trimming press **21** to operate it, which cuts off excess portions protruding out of the circumference of the material A, and works to finish the material A as a forged product. The product, having been finished by the trimming press **21**, is carried outside of the trimming press **21** by a delivery means which is not shown. In this second control system, as in the first control system, the industrial manipulator **20** is locked during the operation of the trimming press **21**, and conversely, the trimming press **21** is interlocked during the operation of the manipulator **20**. The mutual correction between the industrial manipulator **20** and the trimming press **21** can be effected by the inching and stopping instructed by the control panel **31**.

As described above in detail, the present invention comprises a heating furnace for heating the material to be forged to a forging temperature, a material loader for carrying the heated material into a forging press, an industrial manipulator for locating, reversing and transferring the introduced material to a position relative to a metal mold in the press, an industrial manipulator for taking out the forged material and feeding it into a trimming press installed laterally of the forging press, a trimming press for effecting finish work by removing protruding portions from the forged material, and a data processing device for transmitting order signals based on previously established programs for each of the above-mentioned machines and devices and for instructing succeeding operations by operation completion signals sent back from each of the devices. Thus, it is possible to carry out a forging operation, which heretofore has all been performed artificially, by manless automatic operation, whereby a remarkable improvement in the working efficiency can be obtained, and at the same time safety of the workers can be maintained because of the elimination of artificial working in an unfavorable environment. Especially, an enormous installation for preserving favorable environment, which has been required for improving working condition, becomes almost unnecessary, and the forged products can be produced more economically.

What is claimed is:

1. A fully-automatic forging press characterized in that it comprises a heating furnace for heating a material to be forged to a forging temperature, a material loader for carrying the material heated by the heating furnace into a forging press, a first industrial manipulator for positioning the carried material relative to a metal mold in the press, a second industrial manipulator for taking out the material which has been forged and feeding the material into a trimming press provided laterally of the forging press, a trimming press for finishing work by removing protrusions of the forged material, and a data processing device for supplying control signals based on predetermined programs to each of the above-named devices and controlling succeeding operations by operation termination signals sent back from each of said devices.

2. A fully-automatic forging press characterized in that it comprises a heating furnace for heating a material to be forged to a forging temperature and having a means for moving the material from an inlet to an outlet of said furnace, a material loader for carrying the material heated by the heating furnace into a forging press, a means for transferring the material from the heating furnace to the material loader, a first industrial manipulator for positioning the carried material relative to a metal mold in the press and reversing and transferring the material, another industrial manipulator for taking out the material which has been forged and feeding the material into a trimming press provided laterally of the forging press, a trimming press for finishing work by removing protrusions of the forged material, and a data processing device for supplying control signals based on predetermined programs to each of the above-named devices and controlling succeeding operations by operation termination signals sent back from each of said devices.

3. A fully-automatic forging press characterized in that it comprises a heating furnace for heating a material to be forged to a forging temperature and having a means for moving the material from an inlet to an outlet of said furnace, a material loader for carrying the material heated by the heating furnace into a forging press, a means for transferring the material from the heating furnace to the material loader, an inspecting mechanism for taking out unsatisfactory material provided on the transferring route of the material, a first industrial manipulator for positioning the carried material relative to a metal mold in the press and reversing and transferring the material, a second industrial manipulator for taking out the material which has been forged and feeding the material into a trimming press provided laterally of the forging press, a trimming press for finishing work by removing protrusions of the forged material, and a data processing device for supplying control signals based on predetermined programs to each of the above-named devices and controlling succeeding operations by operation termination signals sent back from each of said devices.

4. A fully-automatic forging press as claimed in claim 3, characterized in that said industrial manipulator comprises a rotary head and a gripping and releasing means.

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