Dec. 7, 1965 E. TAGLIASACCHI 3,221,651

MULTI-UNITS SHEET-FED PRINTING MACHINE DRIVE

Filed July 30, 1963 3 Sheets-Sheet 1

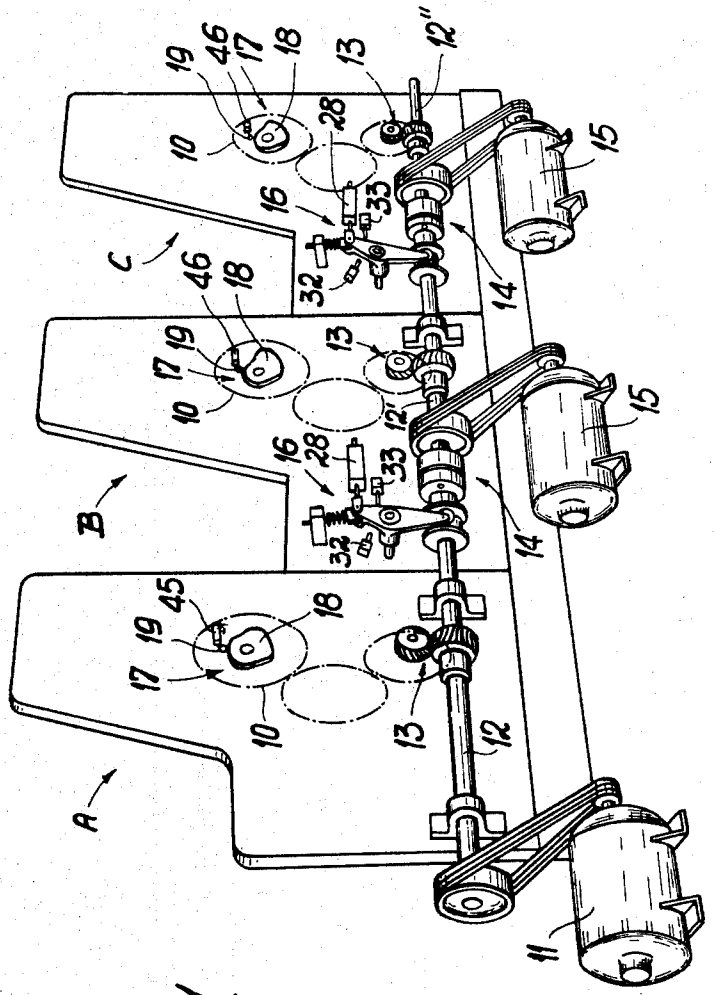


Fig. 1

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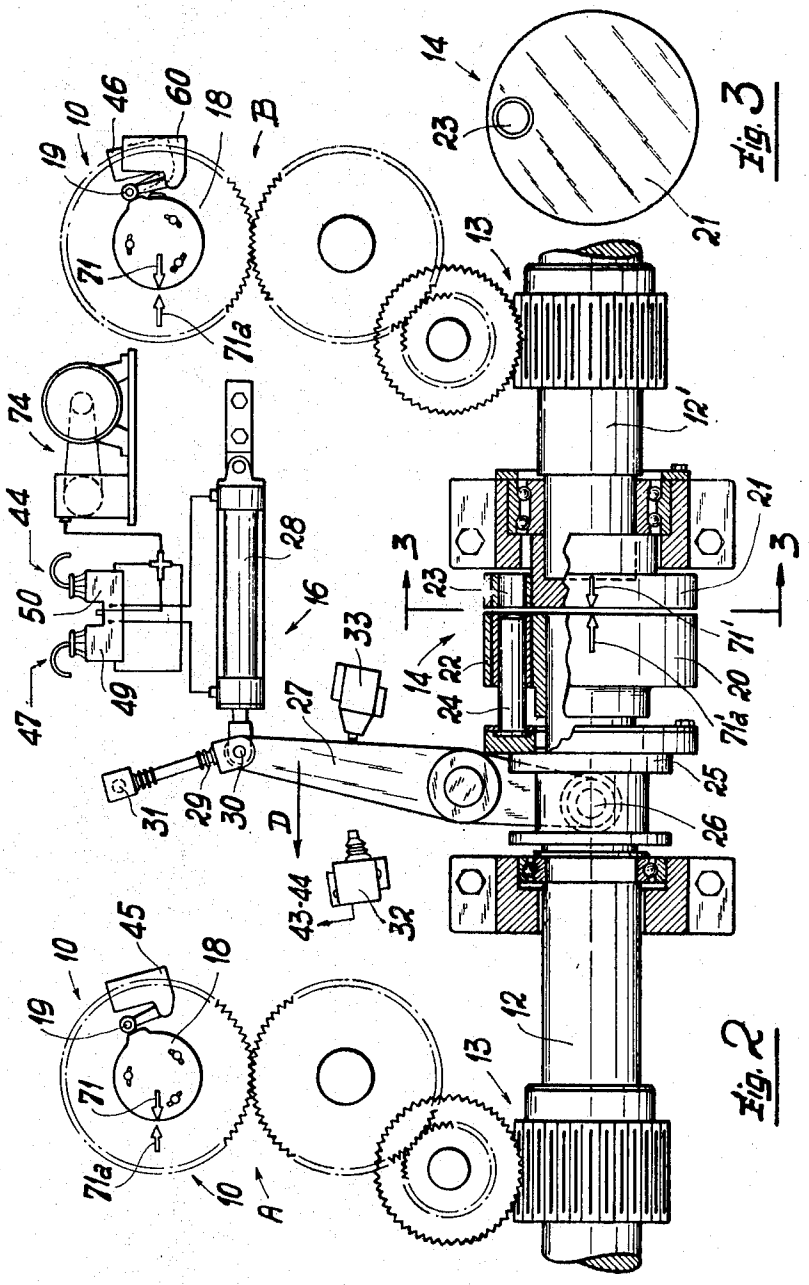
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MULTI-UNITS SHEET-FED PRINTING MACHINE DRIVE

Filed July 30, 1963 3 Sheets-Sheet 2



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MULTI-UNITS SHEET-FED PRINTING MACHINE DRIVE

Filed July 30, 1963 3 Sheets-Sheet 3

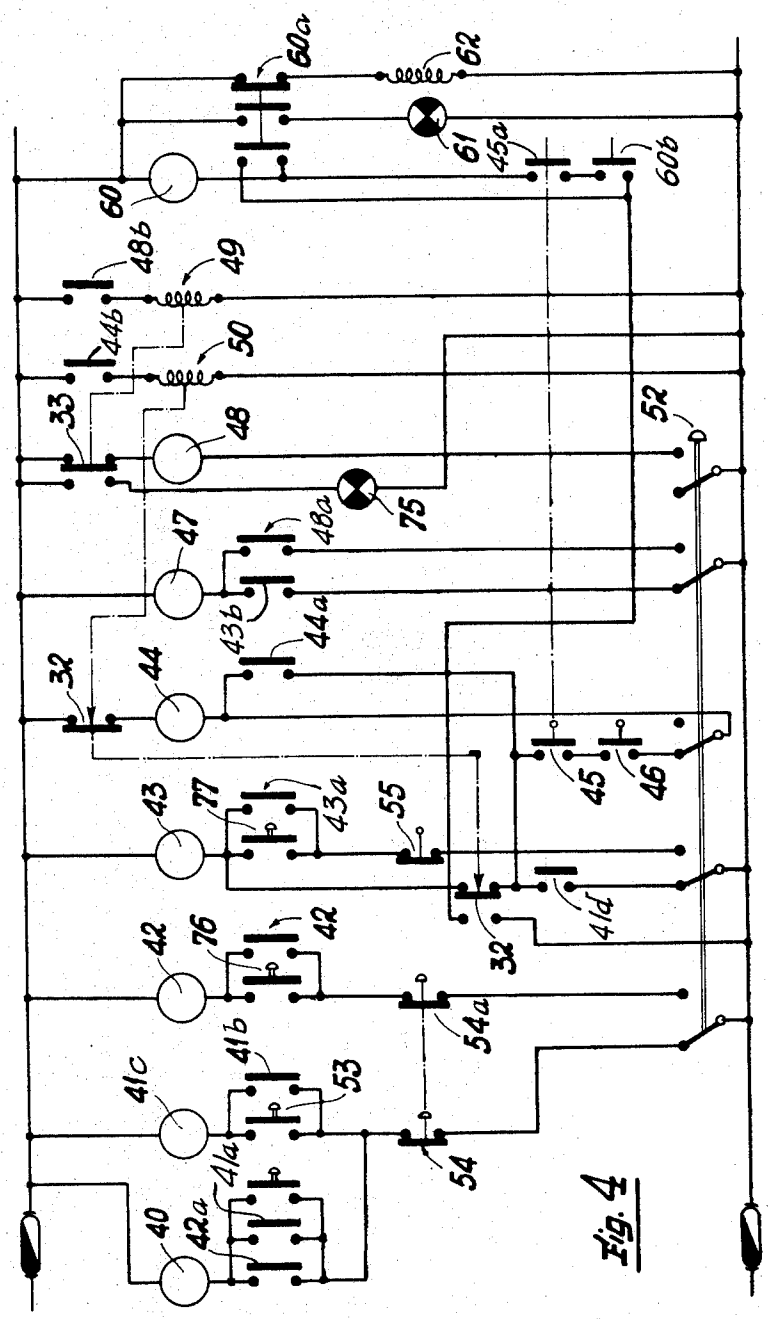


Fig. 4

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3,221,651

Patented Dec. 7, 1965

3,221,651

MULTI-UNITS SHEET-FED PRINTING MACHINE DRIVE

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Claims priority, application Italy, Aug. 3, 1962, 15,679/62
2 Claims. (Cl. 101—183)

This invention generally relates to rotary printing machines or presses of the type including a sheet-feeding mechanism adapted to successively feed sheets to be printed, a plurality of printing rotary units each provided with inking means, transfer and/or direct impression cylinders adapted for one-color printing on the successively fed sheet, and a stacking mechanism for the printed sheets adapted to receive the sheets conveyed off the last one of said printing units upon passage of the sheets through the various units for purposes of multi-color printing.

It is known to those skilled in the art to which this invention appertains that multi-color printing machines of the type referred to above require the provision of linking means adapted to interconnect the various printing units in proper angular relationship so that the various colors will successively print on each sheet as it successively passes through the various units. According to one known construction, the various units are mechanically interconnected. According to another construction, electrical means are provided for phasing individually motor-driven units. A typical example of an improved multi-unit printing machine of such latter construction has been disclosed in my prior U.S. Patent No. 3,073,997, assigned to Officine Meccaniche Cigardi S.p.A.—O.M.C.S.A.—of Milan, Italy.

While such improved construction has proved very advantageous in big and costly high-speed machines, the simpler mechanical interconnection of the various printing units, particularly by means of a single transmission shaft arranged alongside the multi-unit machine and of gear means connecting said shaft to the rotary components of each individual unit, is deemed preferable in simpler construction, particularly where the machine consists of two or few units. Such simpler machines are generally provided with one variable speed motor drivingly connected to said one drive shaft for driving all units of the machine.

It is however known that individual operation of each unit in such multi-unit machines is sometimes desirable. For example, such individual operation is required or desired for facilitating assembling or disassembling of printing plates, for thorough washing and cleaning of the inking devices and of the various cylinders, and for other purposes. The possibility to perform such operations on the units individually will lead to a substantial time-saving, for example, however, since each until will have been individually rotated, the entire printing equipment must then be carefully re-phased. In addition, manual rotation of the heavy rotary components of the machine is generally fatiguing and difficult.

It is therefore a principal object of this invention to provide a new and advantageous drive system for multi-unit printing machines of the type referred to above, including mechanical components for phasing and interconnecting the several units of the machine, and whereby an improved multi-unit machine not subject to the above and other objections is provided.

More particularly, it is an object of this invention to provide, in a multi-unit printing machine of the above character including a number of individual printing units, a like number of individual motors each drivingly connected to the rotary components of one individual unit and adapted for individually driving said unit, mechanical coupling means for mechanically interconnecting all such units in one given predetermined angular relationship, coupling control means for self-adjustment of the various units in said angular relationship, and coupling actuator means for operating said coupling means as said relationship is attained and in response to instruction received from said coupling control means.

An object of this invention is to provide also a new and improved drive system for mechanical interconnection of the several printing units in a multi-unit printing machine of the above type, such system being combined with safety means adapted to indicate the attainment of said predetermined angular or phase relationship, to warn of the occurrence of possible mechanical interconnection in which said relationship is not attained, and to prevent the printing operation by said machine in the latter occurrence.

According to one embodiment of this invention, a multi-unit machine is provided with one main driving motor of such power as is required for driving all units in the machine at any required service speed thereof, said main motor being permanently drivingly coupled to one unit of the machine, as other auxiliary motors as many remaining units are included in the machine and each coupled to one of said remaining units, said auxiliary motors being of such power as is required for driving the respective units coupled thereto at a speed substantially alike to one speed, preferably the lowest speed, at which said main motor can drive all the units, and mechanical coupling means adapted for coupling together all said units upon attainment of said phase relationship, the regular service driving of all units being then performed by said main motor. In such embodiment, the said auxiliary motor or motors (according to the provision of two or more printing units in the machine) being intended for individually running the said remaining units, for their preparation to service, for example.

According to another embodiment of this invention, a multi-unit machine is provided with service driving motors each coupled to one printing unit and each capable of driving the unit coupled thereto at any required service speed, and mechanical coupling means adapted for coupling together all printing units of the machine for causing all said units to phasedly and synchronously run together when the combined drive of all said motors is applied to all units, while each individual unit may be driven by the individual motor coupled thereto for its preparation to service, for example.

The first said embodiment has been proved as best adapted in the construction of relatively light and simple multi-unit printing machines including few units, such as two or three printing units, and wherein a slight out-of-phase run due to the variable torque applied to the mechanical components of the interconnection and coupling of the various units, may be admitted without prejudice of the regular service for which the machine is intended. The latter embodiment, on the other hand, has been proved as best applied to more heavy and high-speed printing machines including a substantial number of units, and when a very precise phase relationship is required. As matter of fact, while such latter embodiment requires the provision of as many variable speed drive motors as there are units included in the multi-unit machine, the torque applied to the couplings and to the various components of the mechanical interconnection of said units will be essentially a very small percent of the power applied to each unit, said couplings and components being actually directed to balance the individual power of the several motors throughout the entire machine in regular service.

In consideration of the fact that the essential features and components of this invention are common to both said embodiments, this invention will be hereinafter described as applied to the first embodiment only, it being understood that the following description of the invention be comprehensive of said latter embodiment too, which may be readily carried out by applying and adapting the teaching of the invention in the light of the following disclosure.

Other objects and advantages of the invention are in part obvious and in part will be made apparent as this description proceeds, and the features which are considered as characteristic of the invention will be in particular set forth in the appended claims. The invention itself, however, both as to its construction and to its mode of operation, will become best apparent from the following detailed description of a preferred form of embodiment thereof, when taken in conjunction with the accompanying drawing, forming an essential component of this disclosure.

In the drawings:

FIGURE 1 is a simplified perspective view of a three-unit printing-machine drive mechanism according to the invention, the printing units' components being only diagrammatically indicated as being not characteristic of the invention and well known in the art;

FIGURE 2 illustrates partly in side elevation and partly in sectional view the essential components of one mechanical coupling means included in the machine and the correlated devices;

FIGURE 3 is a front view, taken from the plane and in the direction indicated by arrows 3—3 in FIG. 2, of the driven component of said coupling means; and

FIGURE 4 diagrammatically shows the wiring and the electrical components of circuitry related to the first two units of the machine.

Referring now to the drawings, wherein like characters and reference numerals refer to like parts and elements throughout the several figures: As to its broadest aspect, the invention will be now described with reference to a multi-unit printing machine as diagrammatically shown in FIG. 1, including three either individually or jointly operatable printing units generally indicated at A, B and C, respectively, each conventionally constructed, and provided with rotary printing cylinders such as diagrammatically indicated at **10**. In the form of the embodiment shown, the machine is provided with a main motor **11** capable of driving all said units for the service of the machine. Such motor is preferably of the variable speed type and/or drivingly connected to the transmission components, described below, by means of a stepless variator (not shown), according to current art. In view of the operation of the new drive system of the invention, it is assumed that such motor is capable of driving said components and units with at least one given speed, which will be preferably considered the lowest speed at which such motor may operate.

The mechanical interconnection of all units A, B and C, according to a feature of the invention, is provided by a compound drive shaft consisting of a number of coaxial sections **12**, **12'** and **12''**, corresponding to the number of the units; that is of three sections in the embodiment shown. Each section is drivingly connected, such as by conventionally constructed gearings **13**, to one printing unit and, therefore, each one of said shaft sections actuates a rotary component of one printing unit. In addition, each shaft section may be mechanically coupled to the adjacent section or sections by means of a mechanical coupling or clutch means, generally indicated at **14**, designed for rigidly connecting said adjacent sections for exactly concurrent, synchronous and phased rotation in one given angular relationship.

The said main motor **11** is assumed to be permanently coupled to unit A, preferably by means of said shaft section **12**. The remaining units B and C are each drivingly coupled to an auxiliary motor, such as indicated at **15**, preferably by means of their respective shaft sections **12'** and **12''**. Such auxiliary motors are sized and powered for running the respective unit at a speed adequate for individual operation thereof, particularly for maintenance and preparation for service purposes, said speed being not equal but approximate to the said one given speed at which said main motor **11** may run all said units upon actuation of said coupling means at **14**. Each coupling means **14** is connected to, and may be actuated by, an actuator means such as generally indicated at **16**, which will engage the driving and the driven components of each coupling means upon attainment of the given angular relationship of the adjacent shaft sections.

The above essential mechanical components are combined, according to the invention, with relative-position signalling devices as generally indicated at **17**, each device including, preferably, a cam **18** fixedly connected to and rotating with the impression cylinder **10** of the relative printing unit, and a cam follower **19** adapted to actuate an electrical contactor, such as indicated at **45** in relation with first unit A and at **46** in relation with the remaining units B and C.

According to conventional construction of multi-unit printing machines including one longitudinally arranged shaft for driving all units, the gearings (such as indicated at **13**) are constructed to greatly reduce the speed from said shaft to the rotary cylinders of the units. Therefore, a complete revolution of said cylinders will correspond to a plurality (such as six to ten, for example) of revolutions of the shaft. Therefore, since said coupling means **14** of the invention are designed, as described below, for coupling shaft section **12** to section **12'**, and section **12'** to section **12''**, in a given angular relationship of said sections, such relationship might not correspond to the required angular relationship between the impression cylinders of the various units A, B and C which is necessary for phasing the multi-unit machine. The said relative-position signalling devices **17** are designed for indicating an approximate relative position of said cylinders at which the actuation of said coupling means will lead to the desired phase relationship of the various units.

The preferred construction of one of said coupling means at **14** is shown in FIGS. 2 and 3. The coupling means shown in said figures is assumed to be the one arranged to couple section **12** to section **12'** of the compound shaft, but it will be further assumed that any other coupling means arranged to interconnect any subsequent section to the adjacent one is similarly constructed and operated.

Such coupling means at **14** includes a driving disk-like component **20** and a co-axial and facing driven disk-like component **21**, said components being secured to or integrally formed with respective shaft sections **12** and **12'**. The driving component **20** has a bore **22**, parallel to and spaced from the common axis of said shaft sections, and the driven component **21** has a corresponding bore at **23**, which is positioned co-axial to said bore **22** at a given angular relationship of said components **20** and **21** and, therefore, of said shaft sections **12** and **12'**. A connecting pin **24** is slidably arranged in bore **22** and can be axially advanced into said bore **23** upon attainment of said given angular relationship of said sections, for interconnection thereof. Such connecting or coupling pin **24** is secured to a grooved sleeve **25** slidably arranged about said shaft section **12** for axial movement to-and-fro thereabout, for engaging into and pulling out said bore **23** the said pin **24**, that is for mechanically coupling and respectively disconnecting said sections **12** and **12'** and consequently said printing units A and B.

The said grooved sleeve **25** is engaged by one end **26** of a bell crank lever **27** appertaining to the actuator device generally indicated at **16**, and which includes power means adapted to apply a resilient force in direction D on said lever **27**. Such power means preferably consists of a

conventionally constructed pressurized-air fed double-acting cylinder **28** supplied by means of an air supply, such as a compressor **74**, and through electromagnetically activated valves **49** and **50**. The piston of said cylinder **28** is connected to the opposite end **30** of the said bell crank **27**, which is subject to the action of spring means **29** arranged in a toggle joint-like arrangement with respect to said crank and to a stationary pivot at **31** secured to the machine structure (not shown), so that said bell crank lever and consequently said coupling means **14** is resiliently urged towards and held at either its connecting and disconnecting position.

Both of these conditions are signalled by contactors **32** and **33**, positioned to be activated by crank lever **27** in their end positions, and connected into the drive system controlling circuitry, described below with reference to FIG. 4, wherein the various electrical or electrically controlled or activated components are shown by means of conventional symbols and indicated by the same numerals which, in the described FIGS. 1 and 2, indicate the corresponding devices. In addition, in the diagram of FIG. 4 the reference numerals refer to various components of any same device such that the actuating coil and the actuated contact or contacts of any individual device are indicated by a like numeral with the addition of a letter suffix in each case.

Said circuitry includes a relay **40** to start the main motor **11**, an auxiliary relay **41** for synchronously operate all the units included in the printing machine, and a further auxiliary relay **42** connected for individual operation of the remaining unit, that is any unit of the machine, except the unit directly driven by the main motor to which such further auxiliary relay is electrically connected. Numeral **43** indicates another relay connected to an auxiliary motor **15**, and at **44** there is indicated still a further auxiliary relay which is depending from contactors **45** and **46** activated by cam followers **19** of the above described position signalling devices **17** of FIG. 1. Such contactors close the associated circuits as the rotary components of adjacent printing units are close to their predetermined angular relationship at which the required phasing of the units may occur. Therefore, as said approximate relationship is signalled by concurrent closure of contactors **45** and **46**, the actuator device **16** may be activated by applying pressurized air to the right end of cylinder **28** (FIG. 2) which resiliently urges bell crank lever **27** in direction D.

Provided that the main motor is actuated for driving section **12** of the compound shaft at the said given speed, and that the auxiliary motor **15** of the adjacent printing unit is driven at a speed not equal but close (preferably slightly less) to the said given speed, the components **20** and **21** of the coupling device (FIG. 2) will slowly rotate relative to one another. The cams **18** of the relative position-signalling devices **17** are shaped for activating the correlated contactors so that the pressure will be applied to the right end of actuator cylinder **28** as bores **22** and **23** of said components **20** and **21** are close to their relative co-axial position. As said slow relative rotation of said components **20** and **21** progresses until bores **22** and **23** are coaxial, the pressure applied to cylinder **28** will snap the coupling pin **24** into bore **23**, whereby the mechanical coupling of the adjacent printing units is obtained in the required phase relationship.

The performance of the operation of the coupling and consequent phasing of adjacent units is signalled by contactors **32** which are operated by bell crank **27** as fully displaced in direction D (FIG. 2). Such contactors cause the pressure applied to actuator cylinder **28** to be released. The coupling device is then maintained in its coupling position by the toggle device including spring **29**. The coupling of other units (if any) to the preceding one is performed in similar manner, as said preceding unit has been previously coupled (as signalled by activation of contactor **32**) to its respective preceding one and has in its turn attained the said given speed.

Also in the latter embodiment of the invention, summarized above, wherein any individual printing unit is provided with its own service motor, the coupling process and means is similar to the one described. The various motors of the machine's printing units are adjusted to run, when the coupling is to be performed, at slightly different speeds so that the components **20** and **21** of the interpositioned coupling mechanisms will rotate relatively slowly as they are approaching their relative positions at which the bores **22** and **23** are co-axial. The operation of the relative-position signalling devices **17** and of the coupling means actuator devices will be quite similar to the operation described above.

Numeral **47** indicates an auxiliary relay connected for activating the compressor **74** which supplies the actuator cylinder **28** of any actuator means included in the machine. A relay **48** closes the circuit of a magnetically operated valve **49** (shown in FIG. 2 in simplified manner, and whose coil is shown in FIG. 4) which applies the pressurized air to the left end of actuator cylinder **28** for disengaging the components of the coupling means **14**, said disengaging being signalled by contactor **33**, while the opposite contactor **32** will be open. The magnetically operated valve **50**, similarly shown in FIGS. 2 and 4, actuates the actuator cylinder by supplying pressurized air to the right end of the actuator cylinder **28**. The activation of such actuating valve **50** is subject to closing of said relay contactors **45** and **46**, so that the coupling can be performed in the desired phase relationship only.

The circuitry of FIG. 4 includes a multiple switch **52** designed for switching the equipment either in the condition of phased and synchronous operation of all units, or in the condition of individual running of each printing unit. As shown in the diagrams, such switch alternatively connects and by-passes the various relays of the described circuits. Upon operation of the said switch **52**, by acting on a press-button contactor **53** the coupling process may be started and automatically proceeded. The contactors **54** and **55** may be manually opened for individually stopping the individual first and respectively second unit, when disengaged and individually run.

The circuitry includes also safety means for preventing any incorrect operation of the machine, and signalling means for signalling the actual condition of the equipment. Such means include a relay **60** fed through said bell crank controlled contactor **32** and cam controlled contactors **45** of the preceding unit, and **46** of the subsequent unit, said relay **60** being controlled by a further cam **18**. In the event that the coupling should occur when the adjacent units are not properly phased, said relay **60** will cause the activation of a warning lamp or other warning device, and of a coil **62** which may be made use of for holding up the operation of some essential component of the machine, such as the sheet feeding device (not shown), so that the printing machine cannot operate if the units thereof have not been correctly phased.

On the other hand, when activated (that is when the various adjacent units had been properly interconnected in their correct phase relationship) said relay **60** will activate another lamp **61** which therefore signals that the equipment is ready for operation and cut off the current to coil **62**, so that the service of said essential component of the machine will be prevented.

The equipment may be provided with auxiliary signalling means for visually indicating the state of readiness of the machine for operation, and even to facilitate manual coupling of the adjacent units. Such coupling may be performed by acting directly, or by making use of a proper tool, on the bell crank lever **27**, upon manual rotation of the rotary components of the units to the required phased relative position. Such signal might include marks **71** on the cams **18** or other rotary com-

ponent of the units, cooperating with related stationary marks **71***a* for signalling the approximate relative position of phasing, and marks **71'** and **71'***a* on the components **21** and **20** of the coupling device for signalling the exact relative position of said components at which coupling pin **24** may be engaged in the mating bore **23**.

A further signalling lamp **75** (FIG. 4) may be connected into a circuit controlled by contactor **33** for warning that the various units have been disconnected from each other. When such units have been disconnected, that is when the interpositioned coupling devices **14** are in the position shown in FIG. 2, the individual units may be separately operated. In particular:

For operating the unit A, driven by the main motor **11**, the contactor **76** is manually closed for activating the coil of relay **42** which in turn will activate the relay **40** connected to the main motor **11** supply circuit (not shown).

For operating any of the remaining units, the contactor **77** appertaining to the circuit of the desired unit is manually operated, so that the coil of respective relay **43** is activated for closing the circuit (not shown) which supplies the respective auxiliary or service motor drivingly coupled to the respective remaining unit.

It is therefore believed to be evident that the present invention includes various advantageous features, and it will be understood, too, that each of the new features described, and any combination thereof, may also find useful application in other types of multi-unit printing machines or apparatus differing from the one described.

Without further analysis the foregoing will so fully reveal the gist of this invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of this invention and, therefore, such adaptations should and are intended to be comprehended within the spirit and meaning of equivalents of the invention, as defined in and by the appended claims.

Having thus described the invention and the mode of making use thereof, what is claimed as new and desired to be protected by Letters Patent is:

1. In an apparatus in which a pair of rotary units are to be connected in a preselected angular relationship for simultaneous rotation with each other, in combination,

shaft means comprising a pair of shaft sections, one for each rotary unit; a pair of gear means respectively connecting said shaft sections to said rotary units so as to rotate said units with an angular speed different from that of said shaft sections, each of said gear means providing the same ratio transmission between the respective shaft section and rotary unit; coupling means cooperating with said shaft sections and being movable between a disconnected position in which said shaft sections are free to rotate relative to each other and a connected position in which said coupling means fixedly connect said shaft sections in a given angular relationship for rotation with each other; a pair of motor means respectively connected with said shaft sections for driving the same, when said coupling means is in said disconnected position, with slightly different speeds; actuator means operatively connected to said coupling means for exerting, when actuated, pressure on said coupling means tending to move the latter to said connected position when said shaft sections are in said given angular relationship; and means cooperating with said rotary units for sensing the angular relationship thereof and operatively connected to said actuator means for actuating the latter slightly before said rotary units reach said preselected angular position so that said coupling means will couple said shaft sections when the latter reach said given angular position to connect thereby said units in said preselected angular position for rotation with each other.

2. In an apparatus as set forth in claim **1**, in which said rotary units are mounted for rotation about parallel axes and in which said shaft means extends at an angle substantially normal to said axes of said rotary units.

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