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European Patent Office
Office européen des brevets

Publication number:

0 074 250
A2

EUROPEAN PATENT APPLICATION

Application number: 82304619.8

Int. Cl.³: B 30 B 15/14

Date of filing: 02.09.82

Priority: 08.09.81 US 299735

Date of publication of application:
16.03.83 Bulletin 83/11

Designated Contracting States:
CH DE FR GB IT LI SE

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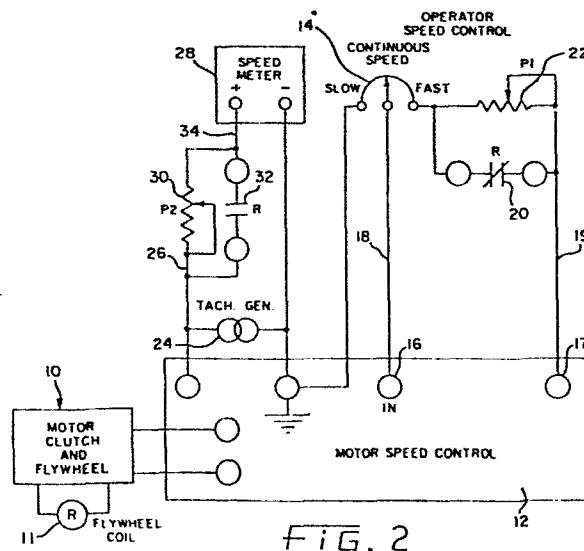
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Press speed control and indication system.

An electric motor supplied with a speed control voltage from a control 12 is connected to a flywheel 10 and drives the slide of a press through a clutch. A tachometer generator 24 coupled to the flywheel supplies to a speed meter 28 by way of a potentiometer 30 and relay contacts 32 a voltage indicative of the speed of the flywheel. Contacts 32 are open when the clutch is not energised and potentiometer 30 modifies the voltage supplied to the meter 28 to cause the meter to indicate a pre-set normal running speed of the press even though the flywheel is running at a speed higher than the said normal running speed. A second potentiometer 22 and relay contacts 20 which are closed when the clutch is not energised modifies the speed control voltage in such a way as to cause the flywheel to be driven at a higher than normal speed when the clutch is not energised but to be driven at its normal speed when the clutch is energised and the contacts 22 are opened. The meter 28 thus indicates normal running speed both during the over speed period when the clutch is de-energised and also when the speed falls as soon as the clutch is energised.



- 1 -

Press speed control and indication
system

The present invention relates to mechanical presses, and in particular to a speed control and indication system for such presses.

- One well-known type of mechanical press
5. comprises a frame having a slide reciprocably guided therein with at least one crankshaft rotatable in the crown portion of the frame and connected to the slide by a connection so that when the crankshaft rotates, the slide is caused
10. to reciprocate. In order to provide sufficient mechanical rotational inertia to the drive mechanism for the slide, a press of this type includes a massive flywheel which is driven by an electric motor through a clutch mechanism. A variable
15. speed coupling, such as an eddy current coupling is provided between the motor and flywheel so that the running speed of the flywheel can be varied by varying a speed control voltage. The flywheel rotates continuously when the motor is
20. energised, but the rotary motion is not coupled to the crankshaft as long as the clutch is de-energised. When the clutch is energised, however, the rotary motion of the flywheel is coupled to

the crankshaft, which generally runs at the same speed as the flywheel, although a gearing arrangement may be used to provide a drive ratio which is greater or less than 1:1. A tachometer generator is mechanically coupled to the flywheel to provide to a speed meter a voltage indicative of the speed of the flywheel.

Presses which utilise a massive flywheel for the storage of kinetic energy have a characteristic speed slow-down during engagement of the clutch because of the energy required to start the rotary and reciprocating parts in motion. As will be appreciated, the drive mechanism for a mechanical press is quite massive and there is a considerable amount of inertia which must be overcome. This results in a press speed which is lower than its set running speed, and it often requires several strokes before the running speed can be attained. Accordingly, the speed-time relationship of the press is at its normal running level with the clutch de-energised and the flywheel up to speed, then drops momentarily for several cycles of the press as the mechanical inertia of the drive mechanism is overcome, and then attains its normal running speed.

In some tooling applications, it is important that the press attain running speed on the first stroke after engagement of the clutch thereby making it necessary to prevent the drop in press speed discussed above. Since the amount

- 3 -

of speed drop is proportional to the rotational energy of the press parts which must be accelerated to running speed from a static condition, and since this energy is taken from the flywheel, the slow down effect can be eliminated by increasing the flywheel speed by a proportional amount. After the inertia is overcome, the press speed must be maintained at its normal running level.

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According to the present invention a mechanical press of the type described is characterised by first means activated only when the clutch is not energised for modifying the voltage supplied to the meter to cause the meter to indicate a pre-set normal running speed of the press even though the flywheel is running at a speed higher than the said normal running speed, and second means activated only when the clutch is energised and which, when de-activated, allows the speed control voltage to assume a value to cause the flywheel to be driven at higher than its said normal running speed but when activated modifies the speed control voltage so that the flywheel is driven at the said normal running speed.

The press speed control and indication system of the present invention thus enables the press to be started and operated on its first stroke at its predetermined running speed by providing a control voltage to the speed control circuit that causes the flywheel to be rotated

- 4 -

- at a speed greater than its normal running speed when the clutch is de-energised. When the clutch is energised, the press will immediately drop to its normal running speed so that the proper speed will be realised on the first stroke of the slide. In order to enable the operator to set the press speed at the normal level, the control voltage to the speed meter is modified so that it indicates a speed lower than the actual speed of the flywheel during the time that the clutch is de-energised.
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- When the clutch is energised and the inertia of the press drive mechanism is being overcome, the actual flywheel speed will drop to its normal running speed, and at this time, the speed control voltage is modified so that the flywheel speed stays at the normal running speed, rather than increasing to the over speed condition as it otherwise would once the drive mechanism is accelerated. In order that the meter not read a speed which is now too low, the control voltage from the flywheel tachometer generator is no longer modified so that the meter reads the actual flywheel speed, which is now rotating at its predetermined running speed.
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- Preferably the first and second modifying means are variable resistors or potentiometers connected in parallel with respective relay contacts which are always in opposite states, that is to say when one is open,
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the other is closed, and vice versa.

5. The method of operating a press according to the present invention so as to control the speed of the flywheel and indicate to the press operator the speed thereof is thus characterised by causing the flywheel to run at a speed higher than a pre-set normal running speed when the clutch is de-energised and then run at the said pre-set normal running speed when the clutch is energised and causing the meter to indicate the flywheel speed as being the said pre-set normal running speed both when the clutch is de-energised and the flywheel is running at a higher speed, and when the clutch is energised and the flywheel is actually running at the said pre-set normal running speed.
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20. An example of mechanical press in accordance with the invention will now be described with reference to the accompanying drawings, in which:-

Figure 1 is a diagrammatic view of the press; and

25. Figure 2 is a schematic diagram of a press speed control and indication circuit for the press of Figure 1.

30. The speed control and indication system shown in Figure 2 is intended to be incorporated with a mechanical press 2 (Figure 1) which may be of the conventional variety, and includes a reciprocating slide 3 mechanically driven by a

- 6 -

- drive assembly 4, such as a crankshaft and connection assembly. The crankshaft 5 is connected to a massive flywheel 6, which in turn is belt driven by an electric motor 7 through a variable speed drive mechanism 8. For example, the speed at which motor output shaft is driven may be controlled by an eddy current coupling. As is conventional, the flywheel 6 is rotated continuously by the motor 7 at a speed selected by the press operator, and the crankshaft 5 is rotated only when a clutch 9 is energised thereby mechanically coupling the rotational energy of the flywheel 6 to the crankshaft 5, which in turn reciprocates the slide through the connections.
- Turning now to Figure 2, the assembly of motor, clutch and flywheel indicated at 10 is controlled by a conventional speed control 12, whereby the flywheel 6 rotates continuously at the pre-set speed. A control voltage for speed control 12 is derived from potentiometer 14 and connected to input 16 by line 18; terminal 17 and line 19 carry a bias voltage.
- With the motor 7 and flywheel 6 running and the clutch 9 de-energised, relay contacts 20 are closed by a flywheel coil 11 thereby shorting out a variable resistor or potentiometer 22 connected in series with the potentiometer 14 and applying to input 16 the appropriate voltage to cause speed control 12 to operate the motor 7 and flywheel 6 at an over-speed condition. In

- 7 -

this particular arrangement, a higher than normal voltage will be applied to input 16 over line 18 with potentiometer 22 shorted out.

5. Tachometer generator 24 which is mechanically coupled to the flywheel 6, produces an output voltage on line 26 which is proportional to the actual speed of flywheel 6 which, when the flywheel 6 is running but the clutch 9 is not yet energised, will be higher than the normal
10. operating speed of the press 2. When the press operator is about to operate the press 2, this would normally necessitate setting the press speed higher than the eventual running speed so that when the press slows down as the clutch 9 is
15. energised, the first stroke of the press will be at the proper running speed. This involves either estimating the amount of over-speed necessary to cause the press to operate at its normal running speed on the first stroke or
20. requires the operator to refer to a table for the proper conversion. According to the present invention, however, press speed meter 28 is caused to read the desired running speed of the press at all times, whether clutch 9 is energised
25. or not. This is accomplished by variable resistor or potentiometer 30 connected in parallel with normally open contacts 32 between the output 26 of tachometer generator 24 and the input 34 of speed meter 28. Contacts 32 are open when
30. clutch 9 is de-energised and function to decrease

- the voltage at input 34 so that meter 28 will read low. Thus, even though flywheel 6 may be rotating at its over-speed level, potentiometer 30 causes meter 28 to indicate to the operator
5. that the press is set properly for an eventual press running speed at the desired level.
- Potentiometer 22 is adjustable for the amount of inertial slow-down associated with the press 2, and potentiometer 14 is set for the
10. proper over-speed level necessary to compensate for this inertial slow-down. In operation, before clutch 9 is energised, potentiometer 22 is shorted out and the high voltage on line 18 causes flywheel 6 to be rotated in an over-speed
15. condition. Since contacts 32 are open, potentiometer 30 causes meter 28 to indicate the pre-set speed that the potentiometer 14 is set for. When clutch 9 is engaged, however, relay contacts 20 are opened and relay contacts
20. 32 are closed. This results in placing potentiometer 22 in series with line 18 so that a lower voltage is applied at input 16 thereby causing speed control 12 to run flywheel 6 at a lower speed, which speed is the normal running
25. speed of the press that is desired for that particular operation. Since contacts 32 are now closed, potentiometer 30 is shorted out and meter 28 is controlled by the actual voltage developed on the output 26 of tachometer generator
30. 24, which voltage corresponds to the actual running

- speed of flywheel 6. By synchronising the opening of contacts 20 with the energisation of clutch 9, as soon as the press speed is slowed down, the lower voltage input on line 18 causes
5. press speed control 21 to maintain the speed of flywheel 6 at the slow-down level from that point on, rather than permitting the system to speed up again to its over speed condition. Assuming that the system is operating properly, meter 12
10. will always indicate the pre-set running speed of the press, regardless of whether flywheel 6 is rotating at its over speed or normal running speed. This makes it easy for the operator to see and adjust the actual speed of the press
15. so that the proper continuous speed can be maintained once clutch 9 has been energised.
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C L A I M S

1. A mechanical press having a reciprocable slide driven by a mechanical drive train, a motor drivingly connected to a flywheel for continuously rotating the flywheel, a clutch for coupling the rotation of the flywheel to the mechanical drive train when the clutch is energised, a speed control for providing a variable speed control voltage to the motor to control the speed of the flywheel, and a tachometer generator mechanically coupled to the flywheel to provide to a speed meter a voltage indicative of the speed of the flywheel characterised by first means 30, 32 activated only when the clutch is not energised for modifying the voltage supplied to the meter 28 to cause the meter to indicate a pre-set normal running speed of the press even though the flywheel is running at a speed higher than the said normal running speed, and second means 20, 22 activated only when the clutch is energised and which, when de-activated, allows the speed control voltage to assume a value to cause the flywheel to be driven at higher than its said normal running speed but when activated modifies the speed control voltage so that the flywheel is driven at the said normal running speed.
5. 10. 15. 20. 25.
2. A press according to claim 1 characterised in that the first and second modifying means are variable resistors or potentiometers 22, 30 connected in parallel with respective relay

- 11 -

contacts 20, 32 which are always in opposite states.

3. A method of operating a press according to claim 1 so as to control the speed of the flywheel and indicate to the press operator the speed thereof characterised by causing the flywheel to run at a speed higher than a pre-set normal running speed when the clutch is de-energised and then run at the said pre-set normal running speed when the clutch is energised, and causing the meter to indicate the flywheel speed as being the said pre-set normal running speed both when the clutch is de-energised and the flywheel is running at a higher speed, and when the clutch is energised and the flywheel is actually running at the said pre-set normal running speed.
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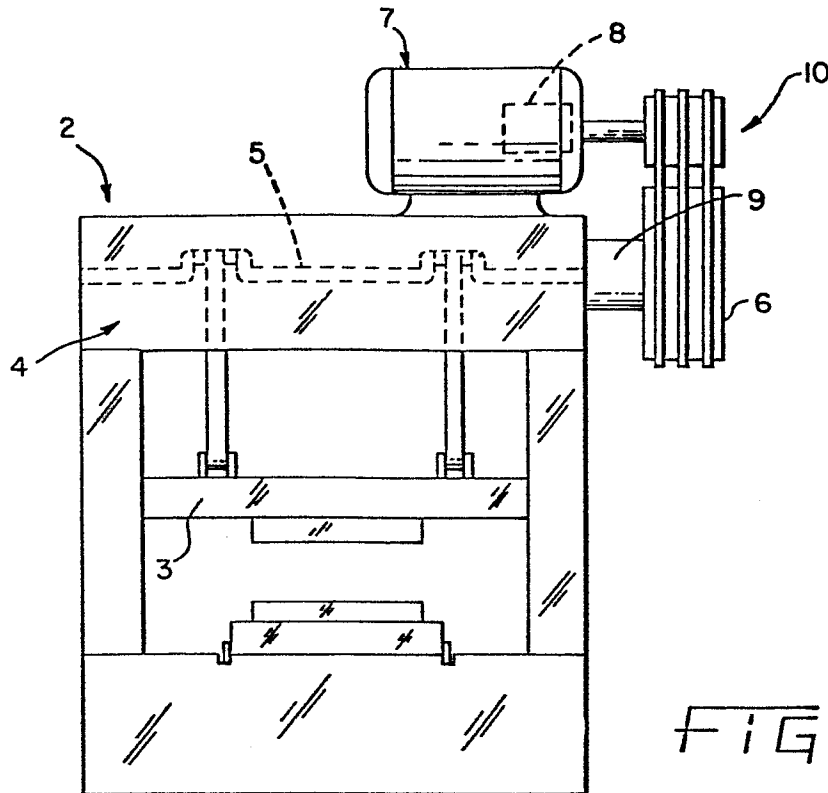


FIG. 1

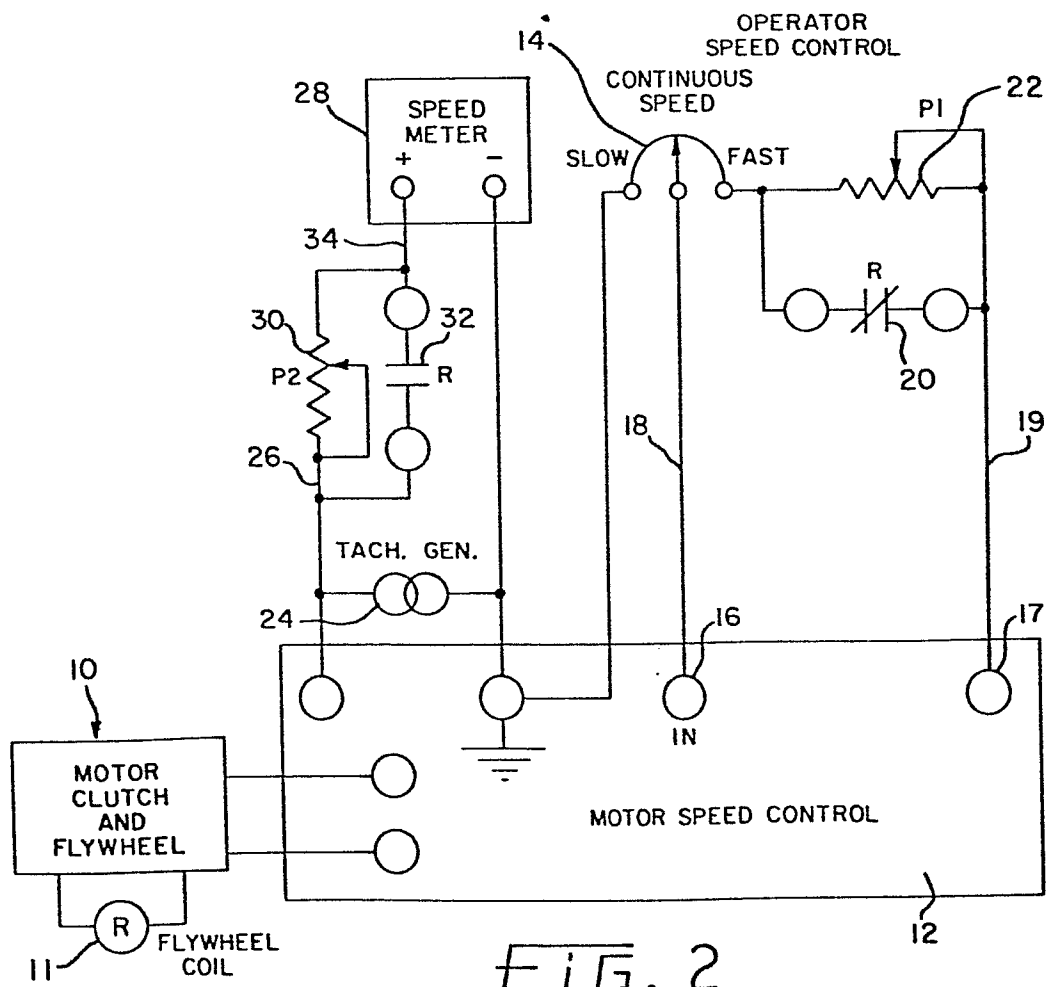


FIG. 2