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**Method for operating a combined clutch and brake device
of a punch press**

TECHNICAL FIELD

10 The present invention relates to a method for
operating a combined clutch and brake device of a punch
press equipped with dry friction linings, a combined
clutch and brake device for carrying out the method, and
a punch press with the clutch and brake device according
15 to the preambles of the independent patent claims.

BACKGROUND ART

 Dry-running clutch-brake combinations have
become established in high-performance automatic punch
20 presses. These transmit their torque via friction by
means of organic friction linings. The actuating pistons
in the clutch and brake are supplied with compressed air
via special safety valves, which usually contains
moisture and is enriched with oil. During shifting, this
25 moisty and oily air is released into the environment of
the punch press. Additional oil is released into the
ambient air by spraying the to be processed strip
material with cutting oil. The air that is thus enriched
with oil and water vapor comes into contact with the
30 friction linings of the clutch-brake combination during
operation, causing them to become increasingly oily with
increasing operating time and worsening the clutch and
brake torque until replacement or cleaning of the linings
is required. Since the linings are usually not subject to
35 any substantial wear that would require regular
replacement, the costs and downtimes incurred by
replacing or cleaning the oily linings are particularly
unpleasant.

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DISCLOSURE OF THE INVENTION

5 Therefore, the objective here is to provide a technical solution that does not have the disadvantages of the prior art described above or at least partially avoids them.

 This objective is achieved by the subject-
10 matter of the independent patent claims.

 According to these, a first aspect of the invention relates to a method for operating a combined clutch and brake device of a punch press equipped with dry friction linings. According to the invention, the
15 friction linings of the clutch and brake device are thereby arranged in a chamber sealed off from the environment of the punch press, e.g. in a housing surrounding the clutch and brake device, which is filled with a gaseous and essentially dry and oil-free medium,
20 e.g. with dry oil-free air. This effectively prevents moisture and oil mist from entering the region of the friction linings from the environment of the press, and a constant friction coefficient can be achieved over the mechanical service life of the friction linings.

25 Preferably, the chamber is pressurized with the gaseous medium under overpressure during the intended operation and even more preferably also during any putative operating breaks. In this way, in the event of leaks, no foreign medium possibly contaminated with oil
30 and/or moisture can enter the chamber and possibly change the friction coefficient of the friction linings.

 In a preferred embodiment of the method, the gaseous medium is set in motion in the chamber during the intended operation, e.g. circulated in the chamber by
35 means of forced convection. This allows heat to be transported away from the friction linings to the boundaries of the chamber and to be transferred to them. Also a uniform temperature distribution in the chamber can be achieved thereby, which is particularly
40 advantageous if the temperature of the gaseous medium is monitored and used to control certain interventions, e.g.

5 to control the replacement of heated gaseous medium in the chamber by new, cooler gaseous medium when a certain threshold temperature is reached or to trigger an emergency stop if there is a risk of overheating of the friction linings.

10 In another preferred embodiment of the method, gaseous medium is supplied to and discharged from the chamber continuously, intermittently, or under specific operating conditions.

For example, it is envisaged that a certain
15 amount of gaseous medium permanently flows out of the chamber, e.g. into the environment, via one or more discharge openings with a small flow cross-section and is replaced by newly supplied medium, so that there is a permanent exchange of medium in the chamber and thus a
20 concomitant removal of heat from the chamber. Thereby, the discharge openings should be dimensioned in such a way that, if possible, only as much medium flows out as is necessary to transport away the heat generated or to maintain a desired medium temperature in the chamber,
25 respectively. The discharge openings can be designed with fixed or variable flow cross-sections.

It is also envisaged that a complete or partial medium exchange or flushing of the chamber with fresh dry and oil-free gaseous medium, respectively, is
30 carried out intermittently, e.g. every 5 minutes during the intended operation, or only if certain operating conditions are present, e.g. if it is necessary to stop and restart several times with a very high stroke rate or if it is necessary to inch for a long time in setup mode.
35 It can also be envisaged, for example, that a medium exchange is initiated in a temperature-controlled manner, e.g. if a certain temperature is reached in the chamber.

In a preferred embodiment of the method, in which dry and oil-free gaseous medium is supplied to the
40 chamber and discharged from the chamber permanently, intermittently or under specific operating conditions,

5 the discharged medium is released into the environment of the punch press. In this way, an extremely simple method becomes possible which requires a minimum of technical equipment.

10 Thereby, it is in a first variant preferred that the dry and oil-free gaseous medium supplied to the chamber is air, which is drawn in from the environment of the punch press, cleaned, dried and/or de-oiled by means of a treatment device and then supplied to the chamber. In this way, any quantities of dry and oil-free gaseous
15 medium can be made available in a simple manner.

 In a second variant, it is preferred that the dry and oil-free gaseous medium supplied to the chamber is supplied to the chamber from a reservoir. This has the advantage that a particular gas atmosphere can
20 specifically be created in the chamber, e.g. of nitrogen or helium.

 In another preferred embodiment of the method, the chamber is part of a circuit in which, during the intended operation, the gaseous medium which is
25 discharged from the chamber is subjected to a treatment and then re-supplied to the chamber.

 Preferably, the treatment includes a cooling of the medium. Other preferred treatments include dehumidifying/de-oiling of the medium and/or a cleaning
30 of the medium, e.g. filtering.

 Such methods with closed medium circuits have the advantage that with very small quantities of gaseous medium a constant medium environment for the friction linings in terms of both medium temperature as well as
35 medium composition can be created, so that the same friction conditions are always present at all times.

 A second aspect of the invention relates to a combined clutch and brake device for carrying out the method according to the first aspect of the invention,
40 which is equipped with dry friction linings for transmitting the drive and brake torques.

5 The friction linings of the clutch and brake
device are arranged in a chamber which is sealed off from
the environment of the punch press, e.g. in a housing
surrounding the clutch and brake device, which during the
intended operation is filled with a gaseous and
10 essentially dry and oil-free medium, e.g. with dry oil-
free air. Thereby, an entry of moisture and oil mist into
the region of the friction linings from the environment
of the press is effectively prevented and thus a constant
friction coefficient is enabled over the mechanical
15 service life of the friction linings.

 Preferably, the clutch and brake device is
designed in such a way that the chamber can be
pressurized with the gaseous medium at an overpressure
during the intended operation, and even more preferably
20 also during any putative operating breaks. In this way,
in the event of leakages, no foreign medium possibly
contaminated with oil and/or moisture can enter the
chamber and possibly change the friction coefficient of
the friction linings.

25 In a preferred embodiment, the clutch and
brake device has means, e.g. internal fan blades, by
means of which the gaseous medium can be set in motion in
the chamber during the intended operation, e.g. can be
circulated in the chamber by means of forced convection.
30 In this way, heat can be transported away from the
friction linings to the boundaries of the chamber and
dissipated to them. Also a uniform temperature
distribution in the chamber can be achieved thereby,
which is particularly advantageous if the medium
35 temperature is monitored and used to control certain
interventions, e.g. to control a replacement of gaseous
medium heated in the chamber by new, cooler gaseous
medium when a certain threshold temperature is reached or
to trigger an emergency stop if there is a risk of
40 overheating of the friction linings.

5 In a further preferred embodiment, the chamber has supply and discharge openings through which, during the intended operation, gaseous medium can be supplied to and discharged from the chamber permanently, intermittently or under certain operating conditions.

10 For example, it is envisaged that the chamber has one or more discharge openings through which, during the intended operation, a certain amount of gaseous medium permanently flows out of the chamber, e.g. into the environment, and is replaced by newly supplied
15 medium, such that that there is a permanent exchange of medium in the chamber and thus a concomitant removal of heat from the chamber. The discharge openings are preferably dimensioned in such a way that only as much medium flows out as is necessary to remove the heat
20 generated or to maintain a desired medium temperature in the chamber, respectively. The discharge openings can have fixed or variable flow cross-sections.

 Thereby, in a first variant of this embodiment, it is preferred that the clutch and brake
25 device comprises an air treatment device by means of which air can be drawn in from the environment of the punch press during the intended operation, cleaned, dried and/or de-oiled, and then supplied to the chamber. In this way, any desired quantities of dry and oil-free
30 gaseous medium can be made available in a simple manner.

 In a second variant of this embodiment, it is preferred that the clutch and brake device comprises a reservoir for the gaseous and essentially dry and oil-free medium, from which this medium can be supplied to
35 the chamber. This has the advantage that a specific gas atmosphere can be created in the chamber, e.g. of nitrogen or helium.

 In a third variant of this embodiment, it is preferred that the chamber is part of a circuit in which
40 the gaseous medium is circulated during the intended operation.

5 Advantageously, means are arranged in the circuit for treating the gaseous medium circulated therein during the intended operation, preferably for cooling, dehumidifying and/or de-oiling of the gaseous medium circulated therein.

10 It is also preferred that cleaning and/or filtering devices are present in the circuit for cleaning and/or filtering the gaseous medium circulated therein during the intended operation.

 Such embodiments of the clutch and brake
15 device according to the invention with closed medium circuits have the advantage that with very small quantities of gaseous medium, a constant medium environment can be created for the friction linings with regard to both the medium temperature and the medium
20 composition, such that the same friction conditions are always present at all times.

 A third aspect of the invention relates to a punch press with a clutch and brake device in accordance with the second aspect of the invention. In such
25 machines, the advantages of the invention are particularly apparent.

30 BRIEF DESCRIPTION OF THE DRAWINGS

 Further preferred embodiments of the invention are apparent from the dependent claims and from the now following description with reference to the figures. Thereby show:

35 Fig. 1 a first punch press according to the invention in a rear view;

 Fig. 2 a vertical section along the line A-A in Fig. 1;

 Fig. 3 the detail X from Fig. 2;

40 Fig. 4 a second punch press according to the invention in a rear view;

5 Fig. 5 a vertical section along the line B-B
in Fig. 4;

 Fig. 6 the detail Y from Fig. 5;

 Fig. 7 a third punch press according to the
invention in a rear view;

10 Fig. 8 a vertical section along the line C-C
in Fig. 7; and

 Fig. 9 the detail Z from Fig. 8.

MODES FOR CARRYING OUT THE INVENTION

15 Fig. 1 shows a first punch press 1 according
to the invention in the rear view. The press 1 comprises
a press structure 2 with a machine table and a press ram
operating against the machine table, which is driven by
an electric motor 3 via a belt drive 4 and a combined
20 clutch and brake device 5 according to the invention with
flywheel 6.

 The press 1 is arranged in a closed
soundproofing booth, of which only a section of a side
wall 15 is shown.

25 Fig. 2 shows a vertical section through the
clutch and brake device 5 according to the invention. As
can be seen in conjunction with Fig. 3, which shows the
detail from Fig. 2 enlarged and without the belt cover
19, the flywheel 6 of the clutch and brake device 5 as
30 well as its friction linings 7, 8 are arranged in a
housing 9, the boundary walls of which are formed by the
machine housing 10 of the press 1, an adjoining sealing
housing 11 and a cover 12 for the flywheel 6.

 The cover 12 has a supply port 13 for clean
35 dry air on its upper side and is passed through centrally
in the axial direction by the belt pulley 14 for the
drive belt (not shown), thereby forming a narrow sealing
gap S between the belt pulley 14 and the cover 12 (see
Fig. 3). Otherwise, the housing 9 is hermetically closed
40 and thus forms a chamber R sealed off from the
environment of the punch press 1, in which the flywheel 6

5 together with the friction discs and the friction linings
7, 8 of both the brake group and the clutch group are
arranged.

As can be seen in Fig. 1, clean and dry air
is drawn in from the environment of the soundproofing
10 booth by means of an axial fan 16 in the side wall 15 of
the soundproofing booth and supplied to this chamber R
via an air duct 17 and the supply port 13.

As can be seen in particular from the arrows
shown in Fig. 3, it meets a deflector plate 18 there,
15 which ensures that the main part of the air is directed
into the area between the machine housing 10 and the
flywheel 6, i.e. where the brake group is arranged. The
air then flows around the clutch and brake device 5 and
enters the belt cover 19 via the narrow sealing gap S
20 formed between the belt pulley 14 and the cover 12, from
where it flows into the direction of the drive motor 3
and then escapes into the environment. Because the
sealing gap S is the only opening through which the air
can escape from the chamber R, the outflowing air volume
25 and the overpressure in the chamber R can be set via its
flow cross-section and via the operating parameters of
the axial fan 16.

If the air in the vicinity of the
soundproofing booth is contaminated with dust, moisture
30 and/or oil mist, the axial fan 16 is followed by devices
for appropriate treatment of the air drawn in
(filtering/dehumidifying/de-oiling), which the air must
pass through before it is supplied to the chamber R.

The Figures 4, 5 and 6 show illustrations,
35 like the Figures 1, 2 and 3, of a second punch press 1
according to the invention. This differs from the one
shown in the Figures 1 to 3 in that here, the gap between
the belt pulley 14 and the cover 12 is closed with a seal
20 and the cover 12 has a connection port 21, 13 each on
40 both its upper side and its lower side, the lower of
which serves as a supply port 13 and the upper as a

5 discharge port 21. The two connection ports 13, 21 are
connected via an air duct 17, in which a cooling device
22 with a circulation fan and with a filter is arranged,
which, during the intended operation, draws heated air
out of the chamber R via the upper connecting piece 21,
10 cools and filters it and then blows it back into the
chamber R via the lower connection port 13. In this way,
the chamber R is part of a circuit in which the air
circulates during the intended operation and is cooled
and filtered.

15 The Figures 7, 8 and 9 show illustrations
like the Figures 1, 2 and 3 of a third punch press 1
according to the invention. This differs from the one
shown in the Figures 1 to 3 in that here the gap between
the belt pulley 14 and the cover 12 is closed with a seal
20 20 and the cover 12 has no supply port 13. The chamber R
therefore has neither supply nor discharge openings and
is completely sealed off from the environment of the
punch press.

As can be seen in the Figures 8 and 9, here,
25 the flywheel 6 has a large number of fan blades 23 on its
side facing the brake group, which ensure that the air
present in the chamber R circulates and flows along the
inner wall of the cover 12, thereby dissipating heat to
it. For better heat dissipation, the cover 12 has a
30 plurality of cooling fins 24 on its outer circumference.

While preferred embodiments of the invention
are described in the present application, it should be
clearly noted that the invention is not limited thereto
and may be carried out in other ways within the scope of
35 the now following claims.

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CLAIMS

1. Method for operating a combined clutch and brake device (5) of a punch press (1) equipped with dry friction linings (7, 8), characterized in that the
10 friction linings (7, 8) are arranged in a chamber (R) which is sealed off from the environment of the punch press (1) and is filled with a dry and oil-free gaseous medium, in particular with dry and oil-free air.

15 2. Method according to claim 1, wherein the chamber (R) with the gaseous medium is put under an overpressure.

20 3. Method according to any one of the preceding claims, wherein the gaseous medium is set in motion in the chamber (R), in particular circulated.

25 4. Method according to any one of the preceding claims, wherein dry and oil-free gaseous medium is supplied to the chamber (R) and discharged from the chamber (R) permanently, intermittently or under specific operating conditions.

30 5. Method according to claim 4, wherein medium is discharged from the chamber (R) into the environment of the punch press (1).

35 6. Method according to any one of the claims 4 to 5, wherein air is drawn in from the environment of the punch press (1), is cleaned, dried and/or d-oiled by means of a treatment device and is then supplied to the chamber (R).

40 7. Method according to any one of the claims 4 to 6, wherein the clutch and brake device (5) is arranged together with the punch press (1) in a closed

5 soundproofing booth (15) and air is drawn in from the environment of the soundproofing booth (15) and supplied to the chamber (R).

8. Method according to any one of the claims
10 4 to 5, wherein the gaseous and substantially dry and oil-free medium is supplied to the chamber from a reservoir.

9. Method according to claim 4, wherein the
15 chamber (R) is part of a circuit in which, during the intended operation, the gaseous medium which is discharged from the chamber (R) is subjected to a treatment and is subsequently supplied back to the chamber (R).

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10. Method according to claim 9, wherein the gaseous medium discharged from the chamber (R) is cooled before it is supplied back to the chamber (R).

25 11. Method according to any one of the claims 9 to 10, wherein the gaseous medium discharged from the chamber (R) is dehumidified and/or de-oiled before it is supplied back to the chamber (R).

30 12. Method according to any one of the claims 9 to 11, wherein the gaseous medium discharged from the chamber (R) is purified, in particular filtered, before it is supplied back into the chamber (R).

35 13. Combined clutch and brake device (5) for carrying out the method according to any one of the preceding claims, with dry friction linings (7, 8) for transmitting the drive and brake torques, characterized in that the friction linings (7, 8) are arranged in a
40 chamber (R) which is sealed off from the environment of the punch press (1) and which is filled or can be filled

5 with a dry and oil-free gaseous medium, in particular
with dry oil-free air.

14. Clutch and brake device (5) according to
claim 13, wherein the device is designed in such a way
10 that the chamber (R) can be pressurized with the medium
during the intended operation.

15. Clutch and brake device (5) according to
any one of the claims 13 to 14, wherein the device
15 comprises means (22, 23), in particular internal
ventilation blades (23), with which a movement, in
particular a circulation, of the gaseous medium in the
chamber (R) can be generated during the intended
operation.

20 16. Clutch and brake device (5) according to
any one of the claims 13 to 15, wherein the chamber (R)
has supply and discharge openings (13, S; 13, 21) via
which, during the intended operation, gaseous medium can
25 be supplied to the chamber (R) and discharged from the
chamber (R) permanently, intermittently or under certain
operating conditions.

17. Clutch and brake device (5) according to
30 claim 16, further comprising an air treatment device (25)
by means of which, during the intended operation of the
device, air can be drawn in from the environment of the
punch press (1), cleaned, dried and/or de-oiled and can
then be supplied to the chamber (R).

35 18. Clutch and brake device (5) according to
one of the claims 16 to 17, wherein the clutch and brake
device (5) together with the punch press (1) is arranged
in a closed soundproofing booth (15) and devices (16, 25)
40 are present by means of which, during the intended
operation, air can be drawn in from the environment of

5 the soundproofing booth (15) and supplied to the chamber (R) .

19. Clutch and brake device according to claim 16, further comprising a reservoir for the gaseous and substantially dry and oil-free medium from which it
10 can be supplied into the chamber.

20. Clutch and brake device (5) according to claim 16, wherein the chamber (R) is part of a circuit in
15 which the gaseous medium can be circulated during the intended operation.

21. Clutch and brake device (5) according to claim 20, wherein means (22) are arranged in the circuit
20 for treating the gaseous medium circulated therein during the intended operation.

22. Clutch and brake device (5) according to claim 21, wherein cooling means (22) are present in the
25 circuit for cooling the gaseous medium circulated therein during the intended operation.

23. Clutch and brake device (5) according to any one of the claims 21 to 22, wherein dehumidifying
30 and/or de-oiling means are present in the circuit for dehumidifying and/or de-oiling the gaseous medium circulated therein during the intended operation.

24. Clutch and brake device (5) according to any one of the claims 21 to 23, wherein cleaning and/or
35 filtering means (22) are present in the circuit for cleaning and/or filtering the gaseous medium circulated therein during the intended operation.

40 25. Punch press (1) with a clutch and brake device (5) according to any one of the claims 13 to 24.