

Description

Medical system having an X-ray machine and a therapy unit with a source of focused acoustic waves, and a method for coupling the therapy unit to the X-ray machine

The invention relates to a medical system having an X-ray machine comprising an X-ray system, which is provided with an X-ray source and an X-ray receiver and can be adjusted relative to an object, and having a therapy unit, with a source for generating acoustic waves converging at a focus, which can be coupled to the X-ray machine. The invention also relates to a method for coupling the therapy unit to the X-ray machine.

Such medical systems are used, for example, in pain therapy, bone restoration, for the purpose of crushing concretions in the body of a patient or for the purpose of treating body tissue, for example tumour tissue. As a rule the concretions or the body tissue are located with the aid of the X-ray machine and moved to the focus of the source of acoustic waves, after which focused acoustic waves are applied to them.

A medical system of the type mentioned at the beginning is known, for example, from EP 0 606 548 B1, which corresponds to DE 43 00 740 C1, which system has a mobile X-ray machine, with an X-ray system arranged on a C bow, and a therapy unit with an electro-acoustical transducer for generating focused sound waves. The therapy unit can be detachably connected to the C bow of the X-ray machine via a coupling device, it being possible for the C bow to be pivoted about the focus of the transducer after being coupled to the therapy unit. The C bow follows the pivoting movement of the transducer in this case.

US 4,984,575 describes a medical system which has an X-ray machine, which is provided with an X-ray system having a vertically adjustable X-ray source and

a fixed X-ray receiver, and a therapy unit with a source for generating focused acoustic waves. The source is detachably arranged on the X-ray source by means of a holding arm in such a way that the source
5 executes the same movements as the X-ray source in the event of a vertical adjustment of the X-ray source.

It proves to be disadvantageous with these known medical systems that it is necessary before coupling for the therapy unit and the X-ray machine to
10 be aligned relative to one another in a complicated and lengthy process so that the focus of the source is situated at least approximately in the beam path of the central beam of an X-ray bundle extending from the X-ray source to the X-ray receiver. A further
15 disadvantage is that the therapy unit can be coupled to the X-ray machine, and/or that the source of focused acoustic waves can be coupled to the X-ray source only in such a way that the possibilities of using the X-ray system for X-ray locating and X-ray monitoring are
20 limited by the coupling of the X-ray source and the source of focused acoustic waves.

DE 44 43 495 A1 has disclosed a therapy unit having a lithotripsy combination and with a carriage and, arranged thereon, a fixed-focus shock wave
25 generator, and having an X-ray machine for X-ray locating with a carriage and, arranged thereon, a C bow provided with an X-ray tube assembly and an X-ray image converter. The carriage of the therapy unit can be coupled to the carriage of the X-ray machine in such a
30 way that, after coupling, the focus of the shock wave generator is situated on the central beam, at least at the locating positions, said central beam connecting the X-ray tube assembly and the X-ray image converter to one another.

35 It proves to be disadvantageous in the lithotripsie combination that additional alignment processes are required so that after coupling of the equipment the focus of the shock wave generator is situated not only on the central beam of an X-ray

bundle extending from the X-ray tube assembly to the X-ray image converter, but also, in a frequently desired way, on the angulation axis of the X-ray machine. Moreover, the coupling of the carriages is inconvenient and requires a certain expenditure of force, since the carriages must be pushed precisely into one another, one carriage being raised by the other in order to be able to move the carriages jointly.

-Again, a machine for treating organisms with acoustic waves is known from DE 41 30 761 A1. Arranged on a C bow of the machine are an X-ray system, comprising an X-ray source and an X-ray receiver, and a source of acoustic waves which can be adjusted on the inner circumference of the C bow. However, the X-ray system and the source are not components of machines which are designed separately from one another and can be detachably coupled to one another.

It is the object of the invention to design a medical system of the type mentioned at the beginning so that the coupling of the therapy unit to the X-ray machine is simplified, and the possibilities for X-ray locating and X-ray monitoring by means of the X-ray system are extended. It is also the object of the invention to make available a simple and quick method for coupling the therapy unit to the X-ray machine.

According to the invention, the object relating to the medical system is achieved by a medical system having an X-ray machine comprising an X-ray system which is provided with an X-ray source and an X-ray receiver, can be adjusted relative to an object, and is arranged on a device and/or connected to a device which can be vertically adjusted at least indirectly and/or can be pivoted about a horizontally extending axis, which can be adjusted vertically together with the device, of the X-ray machine, and having a therapy unit with a source, arranged on a support arm for generating acoustic waves which converge at a focus, which support arm can be detachably coupled to the device in such a way that after the support arm has been coupled to the

device, the focus of the source is situated at least approximately on the horizontally extending axis of the X-ray machine and in the beam path of the central beam of an X-ray bundle extending from the X-ray source to the X-ray receiver, and the X-ray system can be adjusted relative to the source. In this case, the invention proceeds from the consideration that the support arm of the therapy unit is coupled to the device of the X-ray machine in a fashion defined in such a way that, without complicated aligning processes such as are described, for example, in EP 0 606 548 B1 or such as are required in the case of DE 44 43 495 A1, the focus of the source is situated at least approximately on the horizontally extending axis of the X-ray machine and in the beam path of the central beam of an X-ray bundle extending from the X-ray source to the X-ray receiver. Since the X-ray system of the X-ray machine can be adjusted relative to the source of acoustic waves even after the support arm has been coupled to the X-ray machine, the possibilities for X-ray locating of concrements or body tissue of a patient are extended, in addition. As a result, it is possible, for example, without simultaneously displacing the source to prepare radiographs from different directions of concrements or of a body tissue of a patient for the purpose of monitoring the progress of a treatment with focused acoustic waves. Coupling the support arm carrying the source to the device of the X-ray machine can be accomplished in this case in a simple way and without special expenditure of force.

In accordance with one variant of the invention, the source having an acoustic axis is provided with a central X-ray transparent region. It is preferable in this case, after the support arm has been coupled to the X-ray machine, for the central beam of an X-ray bundle emanating from the X-ray source to coincide essentially with the acoustic axis of the source. Such a source can thus also be arranged relative to the X-ray machine in such a way that the

central beam of an X-ray bundle emanating from the X-ray source extends through the X-ray transparent region of the source of acoustic waves.

In accordance with one embodiment of the invention, the therapy unit has a holder on which the support arm carrying the source is arranged, it being possible to remove the support arm from the holder. This is particularly advantageous when the therapy unit is of mobile design, with the result that after the support arm has been coupled to the X-ray machine the therapy unit can be positioned in a fashion spatially separated from the X-ray machine. In this way, a person treating a patient with the medical system, for example, has more room at his disposal at the X-ray machine and at the source of focused acoustic waves, and the X-ray machine and the source of focused acoustic waves are also effectively accessible on all sides after the support arm of the source has been coupled to the X-ray machine. The source of the support arm is connected in this case via lines to a unit carriage of the therapy unit which is arranged in a spatially remote fashion and contains the devices required to operate the source. The defined coupling of the support arm to the X-ray machine is preferably performed in such a way that the coupling point on the X-ray machine is situated as close as possible to the X-ray system, with the result that the support arm can be arranged on the X-ray machine in a fashion projecting relatively slightly. The result of this is that, after the coupling, the position of the focus of the source is situated relatively accurately in the beam path of the central beam of an X-ray bundle emanating from the X-ray source.

One embodiment of the invention provides that the X-ray machine has a support device for the X-ray system which is mounted in a bearing arranged on a holding part. In this case, the bearing preferably has an axis about which the bearing can be pivoted and along which the bearing can be displaced with reference

to the holding part. In accordance with a further embodiment of the invention, the support device of the X-ray machine is constructed in the shape of a C bow and can be adjusted along its circumference in the bearing. In this way, the X-ray machine offers multifarious possibilities for setting the X-ray system relative to an object, for example relative to a patient to be treated, for the purpose of X-ray locating of concrements or body tissue of the patient.

10 A particularly preferred embodiment of the invention provides that the support device provided with the X-ray system has an isocentre, that is to say that the beam path of the central beam of an X-ray bundle emanating from the X-ray source extends through
15 the fulcrum of the support device in the shape of a C bow. This is particularly advantageous when the support arm can be coupled to the X-ray machine in such a way that the focus of the source is located at the isocentre of the support device in the shape of a
20 C bow. In the event of adjusting the support device in the shape of a C bow, for example along its circumference (orbital movement), the central beam then, to be precise, always extends through the isocentre of the support device in the shape of a C
25 bow, and therefore the focus of the source. Thus, the central beam does not go out of focus when the support device in the shape of a C bow is adjusted.

One variant of the invention provides that the support arm has a device which co-operates with a
30 coupling device of the device of the X-ray machine for the purpose of coupling the support arm to the X-ray machine. The device of the support arm and the coupling device of the X-ray machine are provided in this case, in accordance with a further variant of the invention,
35 with positioning aids which advantageously permit the support arm to be coupled simply, quickly and reliably to the X-ray machine.

A further variant of the invention provides that the coupling device of the X-ray machine has a

coupling plate provided with the positioning aids, the positioning aids of the coupling plate comprising a positioning nose and an approximately vertically extending cutout and the positioning aids of the device
5 of the support arm comprising a positioning groove and a positioning bolt. During coupling of the support arm to the device of the X-ray machine, the positioning bolt engages in the cutout, and the positioning nose engages in the positioning groove. By virtue of the
10 fact that the positioning nose of the coupling plate of the X-ray machine co-operates with a corresponding positioning groove of the device of the support arm, and that the positioning bolt of the device of the support arm co-operates with a corresponding cutout in
15 the coupling plate, the support arm can be coupled to the X-ray machine in a simple, quick and reliable way.

In accordance with one embodiment of the invention, the device of the support arm has a mechanism for locking the device of the support arm
20 with the coupling device of the X-ray machine. This prevents the coupling of the support arm to the X-ray machine from being loosened inadvertently.

In accordance with one variant of the invention, the support arm of the source can be coupled
25 to the holding part of the X-ray machine. In this case, the support arm provided with the source is constructed in such a way that after the support arm has been coupled to the holding part, the focus of the source is situated at least approximately in the beam path of the
30 central beam of an X-ray bundle. The support device in the shape of a C bow can, furthermore, be adjusted in position relative to the source along its circumference (orbital movement), and the bearing can be pivoted with the support device in the shape of a C bow about its
35 axis, at least in certain limits which can be influenced by the geometry of the support arm (angulation).

A further variant of the invention provides that the support arm of the source can be coupled to

the bearing. The support arm is designed in this case in such a way that after the support arm has been coupled to the bearing, the focus of the source is situated at least approximately in the beam path of the central beam of an X-ray bundle, and the support device
5 in the shape of a C bow can be adjusted relative to the source of focused acoustic waves along its circumference in the bearing (orbital movement).

Another embodiment of the invention provides
10 that the support arm of the source can be coupled to the support device. In this case, coupling the support arm to the support device is preferably performed via a pivot joint arranged on the support device. The defined coupling of the support arm to the pivot joint is
15 effected in this case by virtue of the fact that after the support arm has been coupled to the support device, the focus of the source is situated at least approximately in the beam path of the central beam of an X-ray bundle, and the bearing can be pivoted,
20 together with the support device about its axis, at least in certain limits, relative to the source of focused acoustic waves (angulation). In this embodiment of the invention, the support arm remains in fixed contact with the therapy unit as a rule, as a result of
25 which the support arm is stabilized.

The object relating to the method is achieved by a method for coupling the support arm of the therapy unit to the X-ray machine, the X-ray machine being provided with a lifting column, which can be rotated
30 about its central axis and has brakes, and on which the holding part is arranged, and the therapy unit and/or the X-ray machine being of mobile design, having the following method steps:

- a) Releasing the brakes provided for adjusting the
35 lifting column,
- b) Aligning the X-ray machine and the therapy unit relative to one another in such a way that the positioning bolt of the device of the support arm engages in the cutouts in the coupling plate of the

coupling device of the X-ray machine, and the device of the support arm of the source bears at least partially against the coupling plate,

- 5 c) Vertically adjusting the lifting column of the X-ray machine in such a way that the positioning nose of the coupling plate comes to be situated in the positioning groove of the device of the support arm,
- 10 d) Locking the mechanism of the device of the support arm in order to couple the support arm of the source to the X-ray machine, and
- e) Applying the brakes for the purpose of fixing the lifting column of the X-ray machine.

15 Coupling the support arm of the therapy unit to the X-ray machine by using the method according to the invention advantageously permits a simple, quick and reliable coupling of the therapy unit to the X-ray machine.

20 Exemplary embodiments of the invention are represented in the enclosed diagrammatic drawings, in which:

25 Figure 1 shows a medical system according to the invention, in which the support arm of the source is coupled to the holding part of the X-ray machine and is removed from the holder of the therapy unit,

30 Figure 2 shows the medical system according to the invention from Figure 1, in which the therapy unit is arranged next to the X-ray machine, the support arm of the source remaining on the holder of the therapy unit,

35 Figure 3 shows in a partially sectioned representation the device of the support arm and the coupling device of the X-ray machine for coupling the therapy unit to the X-ray machine,

Figure 4 shows a view of the coupling device of the X-ray machine from Figure 3,

5 Figure 5 shows another embodiment of the medical system, in which embodiment the support arm of the source is coupled to the bearing of the X-ray machine, and

10 Figure 6 shows a further embodiment of the medical system, in which embodiment the support arm of the source is coupled to the support device of the X-ray machine.

15 Figure 1 shows a medical system according to the invention having a C bow X-ray machine 1 and a therapy unit 2.

The C bow X-ray machine 1 has a machine carriage 4, which can move on wheels 3, and is provided
20 with a lifting device (indicated only diagrammatically in Figure 1) with a lifting column 6 which has a longitudinal axis A about which the lifting column 6 can be rotated in the direction of the double arrow α . Arranged on the lifting column 6 is a holding part 7 on
25 which, in turn, a bearing 8 is arranged for bearing a C bow 9 having an isocentre IZ. The C bow 9 carries at its ends an X-ray source 10 and an X-ray receiver 11, which form an X-ray system and are arranged in a mutually opposite fashion in such a way that the
30 central beam ZS of an X-ray bundle emanating from the X-ray source 10 impinges approximately centrally on the X-ray receiver 11. The C bow 9 is mounted in the bearing 8 in a manner known per se such that it can be displaced along its circumference in the direction of
35 the double arrow a . The bearing 8 is mounted in a manner known per se such that it can pivot about a common axis B of the holding part 7 and of the bearing 8 (compare double arrow β) and can be displaced in the direction of the axis B (compare double arrow b). The C

bow 9, which is connected via the bearing 8 and the holding part 7 to the lifting column 6 of the lifting device 5, can be adjusted vertically relative to the machine carriage 4 with the aid of the lifting device 5.

The therapy unit 2 has a unit carriage 13 which can be moved on wheels 12, and a support arm 15 which is provided with a source 14, known per se, for generating acoustic waves converging at a focus F, as is described, for example, in DE 41 35 177 A1. The unit carriage 13 also has a holder 35 for the support arm 15, from which the support arm 15 can be removed. In the case of the present exemplary embodiment, the support arm 15 is removed from the holder 35 and coupled to the holding part 7 of the C bow X-ray machine 1. The source 14 is connected via the support arm 15 and supply lines 16 to the unit carriage 13, which contains in a manner known per se the devices required to operate the source 14. The support arm 15 of the source 14 is coupled in an accurately fitting and defined fashion to the holding part 7 in such a way that the focus F of the source 14, which in practice is a spatial focusing zone, is situated without complicated aligning processes in the beam path of the central beam ZS of an X-ray bundle emanating from the X-ray source 10. Despite the coupling of the therapy unit 2 to the C bow X-ray machine 1, specifically of the support arm 15 to the holding part 7, the C bow 9 of the C bow X-ray machine 1 can be adjusted together with the X-ray system relative to the source 14 along its circumference in the bearing 8 (orbital movement), and can be adjusted relative to the holding part 7 along the axis B in certain limits, which can be influenced by the shape of the support arm 15, together with the bearing 8 about the axis B (angulation) and together with the bearing 8 in the direction of the double arrow b. The medical system provided with the therapy unit 2 and the C bow X-ray machine 1 in this case has degrees of freedom such that the source 14 can

be aligned relative to a patient P supported on a patient couch 17, it being possible for the patient couch 17 to be designed without movement axes.

In the case of the present exemplary embodiment, the support arm 15 of the source 14 is even
5 arranged on the holding part 7 in a way defined such that the focus F of the source 14 is situated not only in the beam path of the central beam ZS of the X-ray bundle, but also at the isocentre IZ of the C bow 9.
10 The isocentric adjustment of the C bow 9 renders it possible in this case that a body tissue KG of the patient P, who is indicated in Figure 1 only diagrammatically and is supported on the patient couch 17, which body tissue has once been positioned at the
15 isocentre IZ of the C bow 9, is always located in the central beam ZS of the X-ray bundle when the X-ray system is being adjusted relative to the body tissue KG, without the X-ray system having to be readjusted for the purpose of taking X-ray images of the body
20 tissue from different projection directions. Since the focus F of the source 14 likewise remains at the isocentre IZ, it is possible, for example, to apply focused acoustic waves to the body tissue KG, and at the same time to monitor the progress of the treatment
25 from different projection angles by means of X-rays by independently adjusting the X-ray system relative to the source 14.

Figure 3 shows an embodiment of a device 18 of the support arm 15, and a coupling device 19 of the C
30 bow X-ray machine 1, which serve the purpose of coupling the therapy unit 2 to the C bow X-ray machine 1 in an accurately fitted and defined fashion. In the case of the present exemplary embodiment, the coupling device 19 is fitted to the holding part 7, for example
35 by means of screws (not represented in Figure 3), and the device 18 is fitted to the support arm 15, for example likewise by means of screws (not represented in Figure 3).

The coupling device 19 comprises two plates 23, 24 connected by pins, of which only the pins 21, 22 are visible in Figure 3, a coupling plate 25 provided with positioning aids being fitted to the latter plate. As
5 positioning aids, the coupling plate 25 has positioning noses 26, 27 and an approximately vertically extending cutout 28.

The device 18 of the support arm 15 has a base plate 29 which is provided with a positioning groove
10 30, a positioning bolt 31 and a mechanism 32 for locking the device 18 of the support arm 15 to the coupling device 19 of the supporting part 7. The mechanism 32 is provided with a clamping bracket 34 which acts on a locking bolt 33 and whose positions of
15 open o and closed g are illustrated in Figure 3.

Figure 4 shows a view of the coupling device 19 from Figure 3, with an only diagrammatically indicated cover 34 for the coupling device 19, the vertical
20 course of the cutout being clearly visible from Figure 4.

Thus, in the case of the present exemplary embodiment, the therapy unit 2 is coupled to the C bow X-ray machine 1 by coupling the device 18 of the support arm 15 to the coupling device 19 of the holding
25 part 7. In this case, the brakes, which are not represented in more detail but are known per se and necessarily present, and serve to fix the vertically adjustable and rotatable lifting column 6 of the C bow X-ray machine 1 are firstly released. Subsequently, for
30 example, the therapy unit 2 is moved up to the C bow X-ray machine 1 in such a way that the positioning bolt 31 of the device 18, which can be spring-loaded, engages in an accurately fitted fashion in the cutout 28 in the coupling plate 25 of the coupling device 19,
35 and the base plate 29 of the device 18 of the support arm 15 comes to bear at least partially against the coupling plate 25 of the coupling device 19. In order to achieve this, the holding part 7 arranged on the lifting column 6 must, if necessary, be adjusted

somewhat, vertically, with the lifting column 6. By virtue of the fact that the brakes of the lifting column 6 are released, the holding part 7 or the coupling device 19 can be aligned relative to the device 18 of the support arm 15, it being possible for the base plate 29 to be brought to bear relatively flat against the coupling plate 25. Subsequently, the lifting column 6 is vertically adjusted in such a way that the positioning nose 26 of the coupling plate 25 comes to be situated in an accurately fitted fashion in the positioning groove 30 of the device 18, the positioning bolt 31 moving in the vertical direction in the cutout 28. Thereafter, the mechanism 32 is locked by closing the clamping bracket 34, the locking bolt 33 being moved out and clamped to the coupling plate 25. Following thereupon, the brakes of the lifting column 6 are applied, thus concluding the coupling of the therapy unit 2 to the C bow X-ray device 1.

Depending on the application, the support arm 15 can subsequently be removed from the holder 35 of the unit carriage 13 of the therapy unit 2, and the unit carriage 13 of the therapy unit 2 can be removed from the C bow X-ray machine 1 (compare Figure 1), or else remain on the C bow X-ray machine 1 (compare Figure 2).

The device 18 of the support arm 15, and the coupling device 19 of the C bow X-ray machine 1 can differ from those described in the present exemplary embodiment. For example, the positioning groove 30 can be arranged at the bottom, and the mechanism 32 can be arranged at the top on the device 18. Furthermore, the coupling device 19 can be arranged on the support arm 15, and the device 18 can be arranged on the holding part 7. Again, the positioning aids of the device 18 and of the coupling device 19 can differ within the scope of the invention from the embodiments described. It thus becomes clear that the embodiment, described in the present exemplary embodiment, of the device of the therapy unit and of the coupling device of the C bow X-

ray machine are to be understood only in an exemplary way.

Figures 5 and 6 show further embodiments of the medical system according to the invention, components of the medical systems of Figures 5 and 6 which are at least approximately the same in terms of function and design as components of the medical system from Figure 1 or Figure 2 being provided with the same reference symbols:

Figure 5 shows an embodiment of the medical system in which the support arm 15.1 of the therapy unit 2 is coupled to the bearing 8 of the C bow X-ray machine 1, the unit carriage of the therapy unit 2 not being represented in Figure 5. The support arm 15.1 is designed in such a way that the C bow 9 can still be adjusted relative to the source 14 along its circumference in the bearing 8 in the direction of the double arrow a (orbital movement). Furthermore, the C bow 9 arranged on the bearing 8 can be pivoted about the axis B of the bearing 8 together with the support arm 15.1 and the source 14. In the case of Figure 5, the support arm 15.1 is coupled to the bearing 8 in such a way that the focus F of the source 14 coincides with the isocentre IZ of the C bow 9.

For the rest, the C bow 9 of the C bow X-ray machine 1 need not necessarily have an isocentre IZ.

Figure 6 shows a further embodiment of a medical system according to the invention, in which the support arm 15.2 of the therapy unit 2 is coupled to the C bow 9. The unit carriage 13 of the therapy unit 2 is designed in this case with a holder 35 for the support arm 15.2 of the source 14 for the purpose of stabilizing the support arm 15.2. In the case of the medical system from Figure 6, the support arm 15.2 is coupled to the C bow 9 via a pivot joint 36 which connects the support arm 15.2 and the C bow 9 to one another. The defined fashion in which the support arm 15.2 is fitted to the pivot joint 13.6 aligns the therapy unit 2 relative to the C bow X-ray machine 1 in

such a way that the focus F of the source 14 is situated at the isocentre IZ and in the beam path of the central beam ZS of an X-ray bundle emanating from the X-ray source 10. The pivot joint 36 has the effect
5 in this case that the C bow 9 arranged on the bearing 8 remains capable of pivoting, at least within certain limits, about the axis B together with the bearing 8, depending on the embodiment of the support arm 15.2. Thus, the X-ray system can still be adjusted relative
10 to the source 14 within certain limits. In this embodiment of the medical system, for reasons of stability the support arm 15.2 is not as a rule moved from the holder 35 of the machine carriage 13.

For the rest, the support arm 15.1 can be
15 coupled to the bearing 8, and the support arm 15.2 can be coupled via the pivot joint 36 to the C bow 9 in a similar way to how the support arm 15 is coupled to the holding part 7, devices corresponding to the coupling device 18 and the coupling device 19 being provided on
20 the support arms 15.1, 15.2, and corresponding coupling devices being provided on the bearing 8 and the pivot joint 36, which are not shown in more detail in Figures 5 and 6. During the operation of coupling the holding arm 15.1 to the bearing 8 and coupling the
25 holding arm 15.2 to the pivot joint 36, it can be sensible in this case also to release the brakes of the bearing 8 so that the devices and coupling device can be aligned relative to one another.

Moreover, in a way not represented but known
30 per se the source 14 can have an ultrasonic locating unit in addition to the X-ray locating unit.

Furthermore, the medical system can be provided, in a way not represented, with means known per se for image processing and with display devices on
35 which it is possible to represent radiographs and ultrasonic images into which the position of the focus of the source 14, the position of the isocentre IZ etc. can be faded in.

Moreover, like the source described in DE 41 35 177 A1, the source of the therapy unit can have a central, X-ray transparent region. In this case, the support arm of the source is designed, and can be
5 coupled to the C bow X-ray machine, in such a way that the central beam of an X-ray bundle emanating from the X-ray source essentially coincides with the acoustic axis of the source.

The medical system according to the invention
10 has been explained above from the example of treating body tissue KG of a patient P. However, the medical system can also be used in pain therapy, bone restoration or for crushing concrements in the body of a patient.

Patent Claims

1. Medical system having an X-ray machine (1) comprising an X-ray system which is provided with an X-ray source (10) and an X-ray receiver (11), can be adjusted relative to an object (P), and is arranged on a device (9) and/or connected to a device (7, 8) which can be vertically adjusted at least indirectly and/or can be pivoted about a horizontally extending axis (B), which can be adjusted vertically together with the device (7, 8, 9), of the X-ray machine (1), and having a therapy unit (2) with a source (14), arranged on a support arm (15, 15.1, 15.2) for generating acoustic waves which converge at a focus (F), which support arm can be detachably coupled to the device (7, 8, 9) in such a way that after the support arm (15, 15.1, 15.2) has been coupled to the device (7, 8, 9), the focus (F) of the source (14) is situated at least approximately on the horizontally extending axis (B) of the X-ray machine (1) and in the beam path of the central beam (ZS) of an X-ray bundle extending from the X-ray source (10) to the X-ray receiver (11), and the X-ray system can be adjusted relative to the source (14).
2. Medical system according to Claim 1, in which the source (14) has a central X-ray transparent region.
3. Medical system according to Claim 1 or 2, in which the therapy unit (2) has a holder (35) on which the support arm (15, 15.2) carrying the source (14) is arranged, it being possible to remove the support arm (15, 15.2) from the holder (35).
4. Medical system according to one of Claims 1 to 3, in which the X-ray machine (1) has a support device (9) for the X-ray system which is mounted in a bearing (8) arranged on a holding part (7).
5. Medical system according to Claim 4, in which the support device (9) of the X-ray machine (1) is constructed in the shape of a C bow and can be adjusted along its circumference in the bearing (8).



6. Medical system according to Claim 5, in which the support device (9) provided with the X-ray system (1) has an isocentre (IZ).

7. Medical system according to one of Claims 1 to 5 6, in which the support arm (15) has a device (18) which co-operates with a coupling device (19) of the device (7) of the X-ray machine (1) for the purpose of coupling the support arm (15) to the X-ray machine (1).

8. -Medical system according to Claim 7, in which 10 the device (18) of the support arm (15) and the coupling device (19) of the device (7) of the X-ray machine (1) are provided with positioning aids (26, 28, 30, 31).

9. Medical system according to Claim 8, in which 15 the coupling device (19) of the device (7) of the X-ray machine (1) has a coupling plate (25) provided with the positioning aids (26, 28), the positioning aids of the coupling plate (25) comprising a positioning nose (26) and an at least approximately vertically extending 20 cutout (28) and the positioning aids of the device (18) of the support arm (15) comprising a positioning groove (30) and a positioning bolt (31), and, during coupling of the support arm (15) to the device (7) of the X-ray machine (1), the positioning bolt (31) engages in the 25 cutout (28) and the positioning nose (26) engages in the positioning groove (30).

10. Medical system according to one of Claims 7 to 9, in which the device (18) of the support arm (15) has a mechanism (32) for locking the device (18) with the 30 coupling device (19) of the device (7) of the X-ray machine (1).

11. Medical system according to one of Claims 4 to 10, in which the support arm (15) of the source (14) can be coupled to the holding part (7).

35 12. Medical system according to one of Claims 4 to 10, in which the support arm (15.1) of the source (14) can be coupled to the bearing (8).



13. Medical system according to one of Claims 4 to 10, in which the support arm (15.2) of the source (14) can be coupled to the support device (9).

14. Method for coupling the support arm (15) of the
5 therapy unit (2) to the X-ray machine (1) according to one of Claims 11 to 13, the X-ray machine being provided with a lifting column (6), which can be rotated about its central axis (A) and has brakes, and on which the holding part (7) is arranged, and the
10 therapy unit (2) and/or the X-ray machine (1) being of mobile design, having the following method steps:

- a) Releasing the brakes provided for fixing the lifting column (6),
- 15 b) Aligning the X-ray machine (1) and the therapy unit (2) relative to one another in such a way that the positioning bolt (31) of the device (18) of the support arm (15) engages in the cutout (28) in the coupling plate (25) of the coupling device (19) of the X-ray machine (1), and the device (18) of the
20 support arm (15) bears at least partially against the coupling plate (25),
- c) Vertically adjusting the lifting column (6) of the X-ray machine (1) in such a way that the positioning nose (26) of the coupling plate (25)
25 comes to be situated in the positioning groove (30) of the device (18),
- d) Locking the mechanism (32) of the device (18) of the support arm (15) in order to couple the support arm (15) to the X-ray machine (1), and
- 30 e) Applying the brakes for the purpose of fixing the lifting column (6) of the X-ray machine (1).

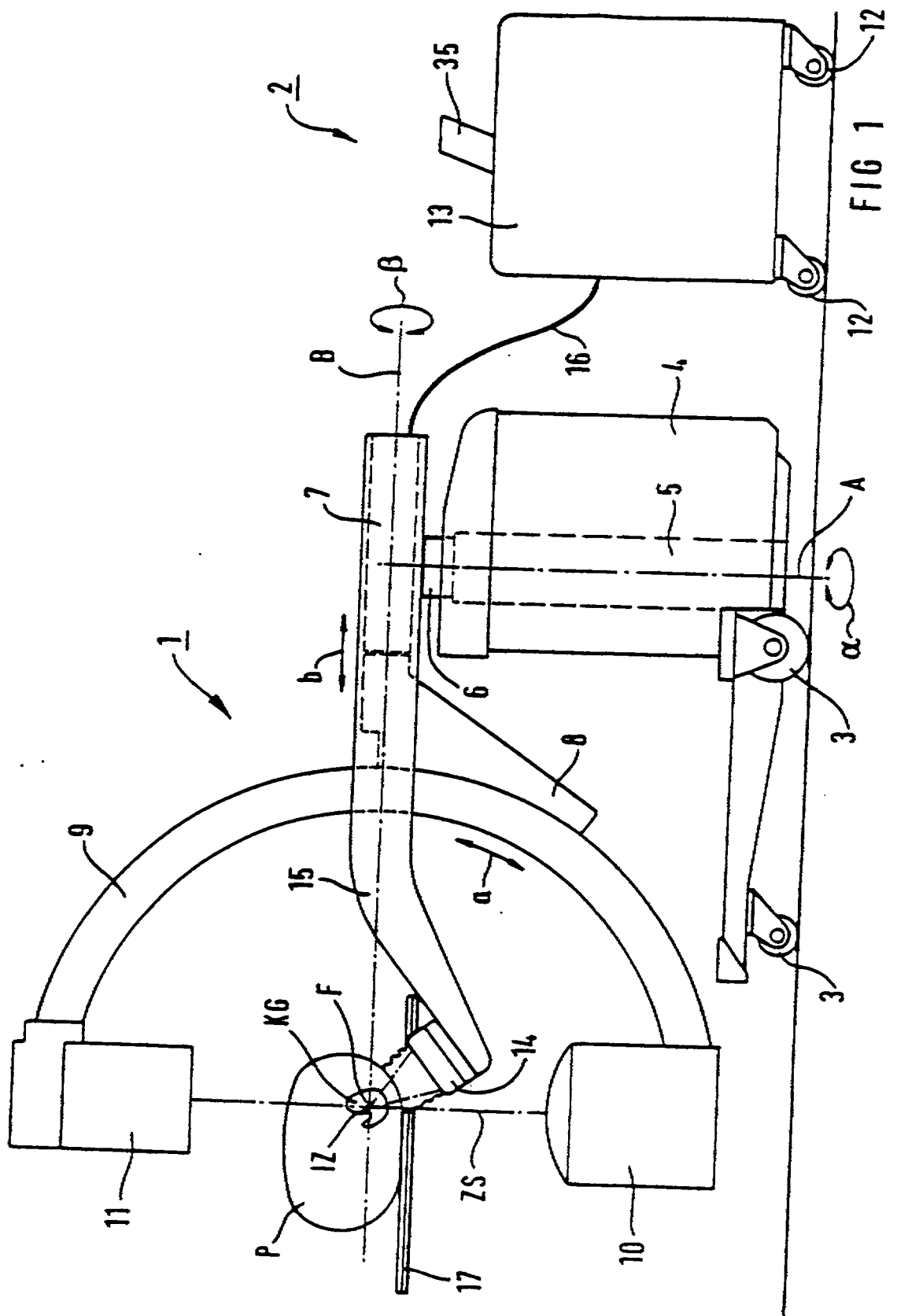


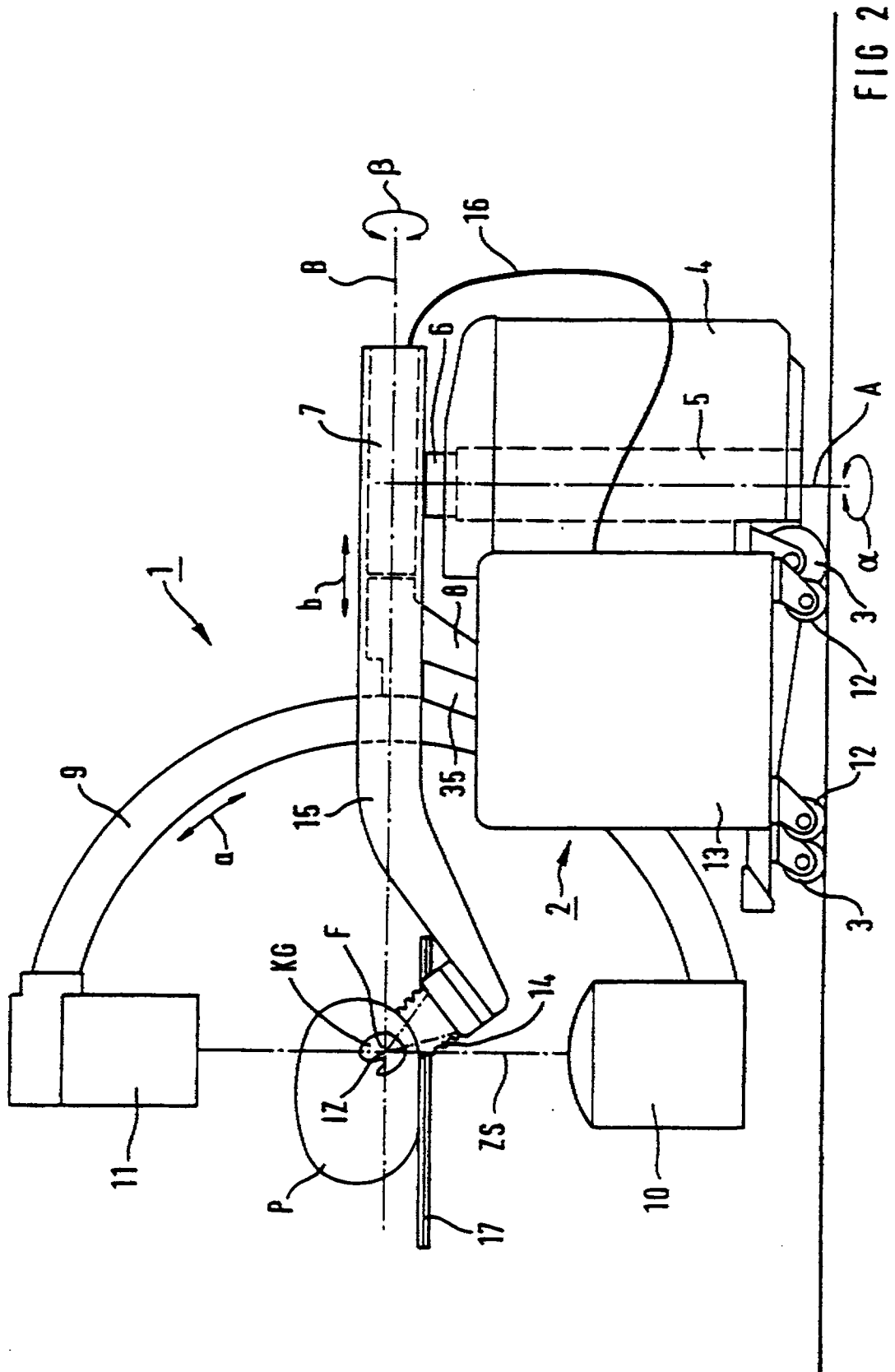
Abstract

Medical system having an X-ray machine and a therapy unit with a source of focused acoustic waves, and a method for coupling the therapy unit to the X-ray machine

The invention relates to a medical system having an X-ray machine (1) comprising an X-ray system which is provided with an X-ray source (10) and an X-ray receiver (11), and having a therapy unit (2) with a source (14) of focused acoustic waves, it being possible to couple the therapy unit (2) detachably to the X-ray machine (1). The invention also relates to a method for coupling the therapy unit to the X-ray machine. The coupling is performed in such a way that after the therapy unit (2) has been coupled to the X-ray machine (1) the focus (F) of the source (14) is situated at least approximately in the beam path of the central beam (ZS) of an X-ray bundle extending from the X-ray source (10) to the X-ray receiver (11), and the X-ray system can be adjusted relative to the source (14).

Figure 5





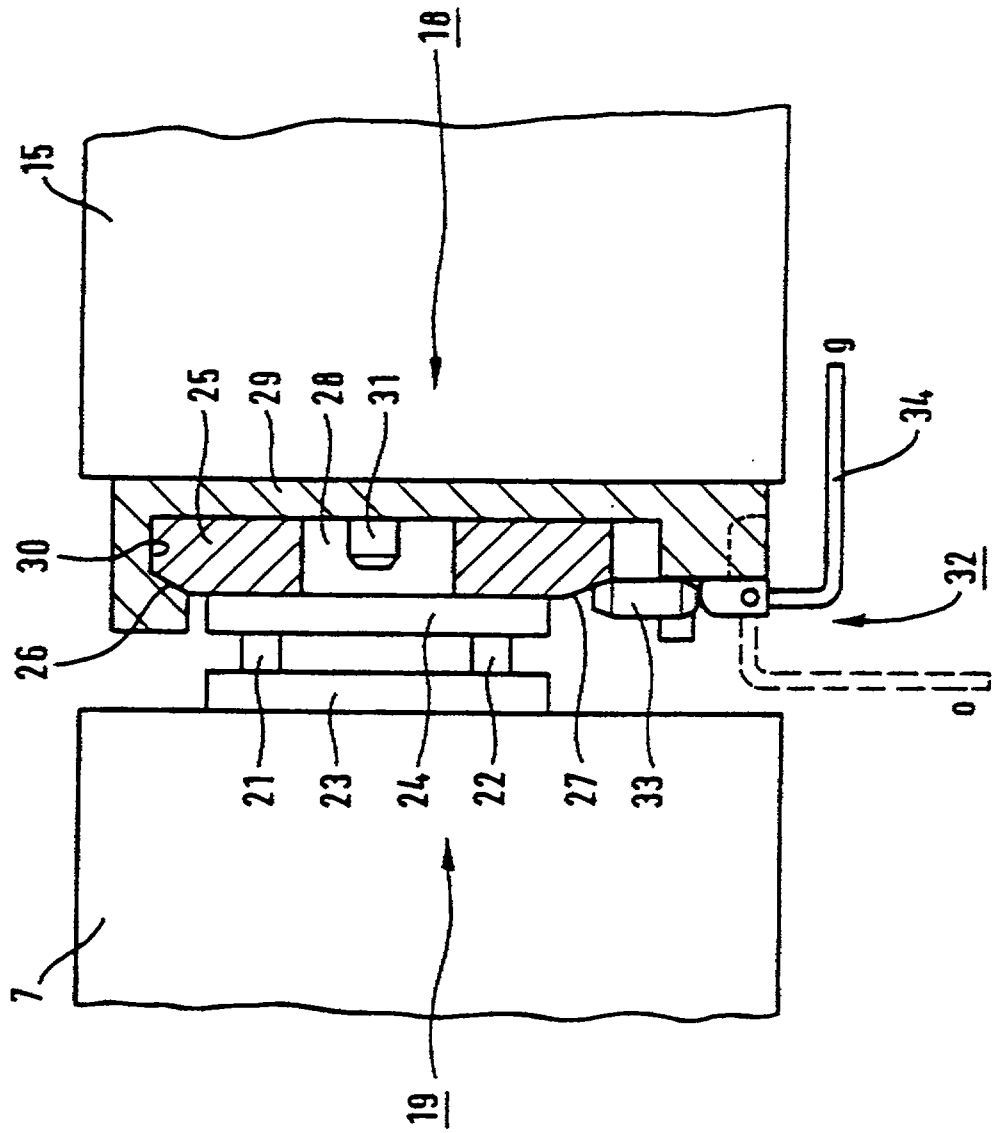


FIG 3

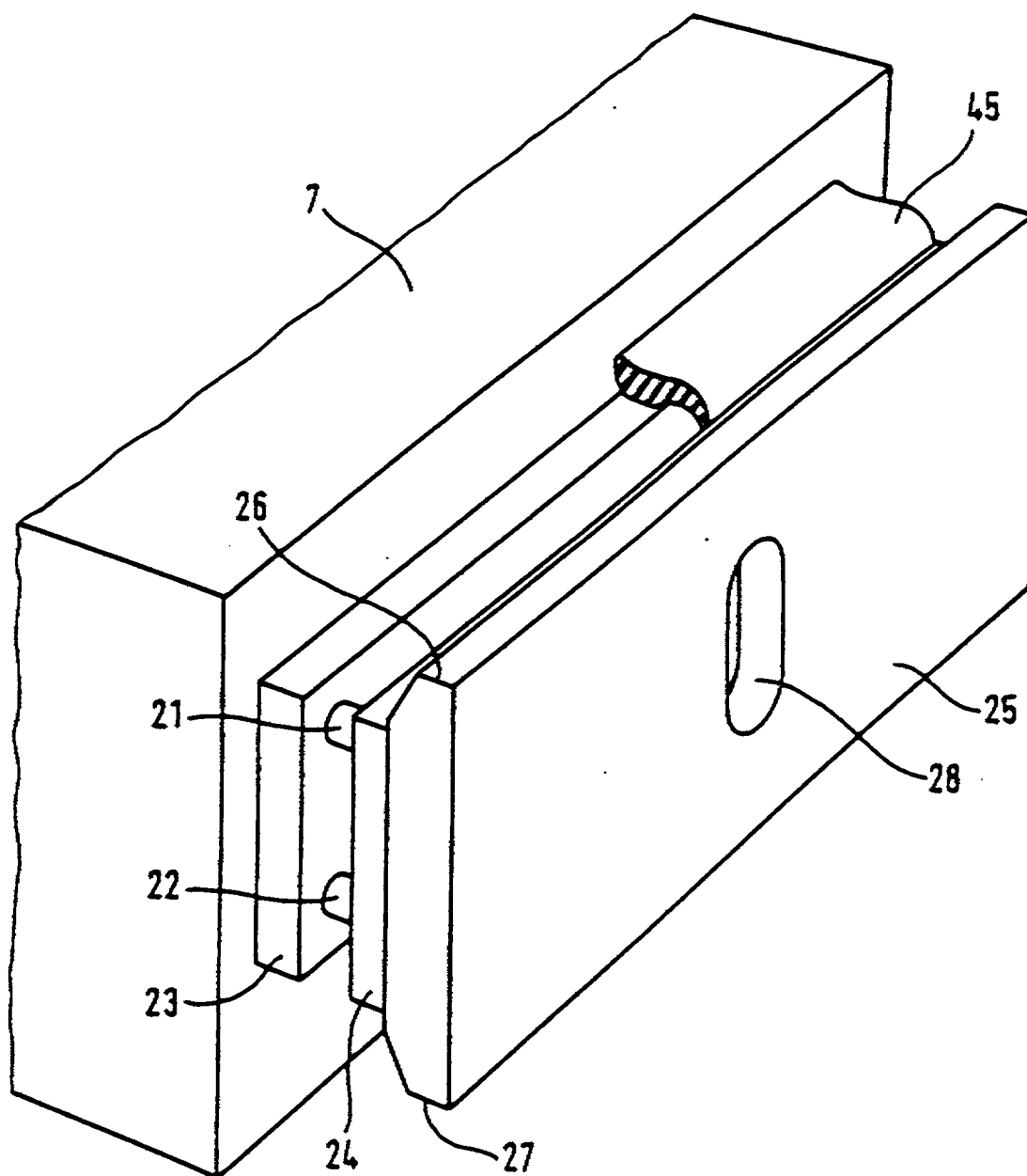


FIG 4

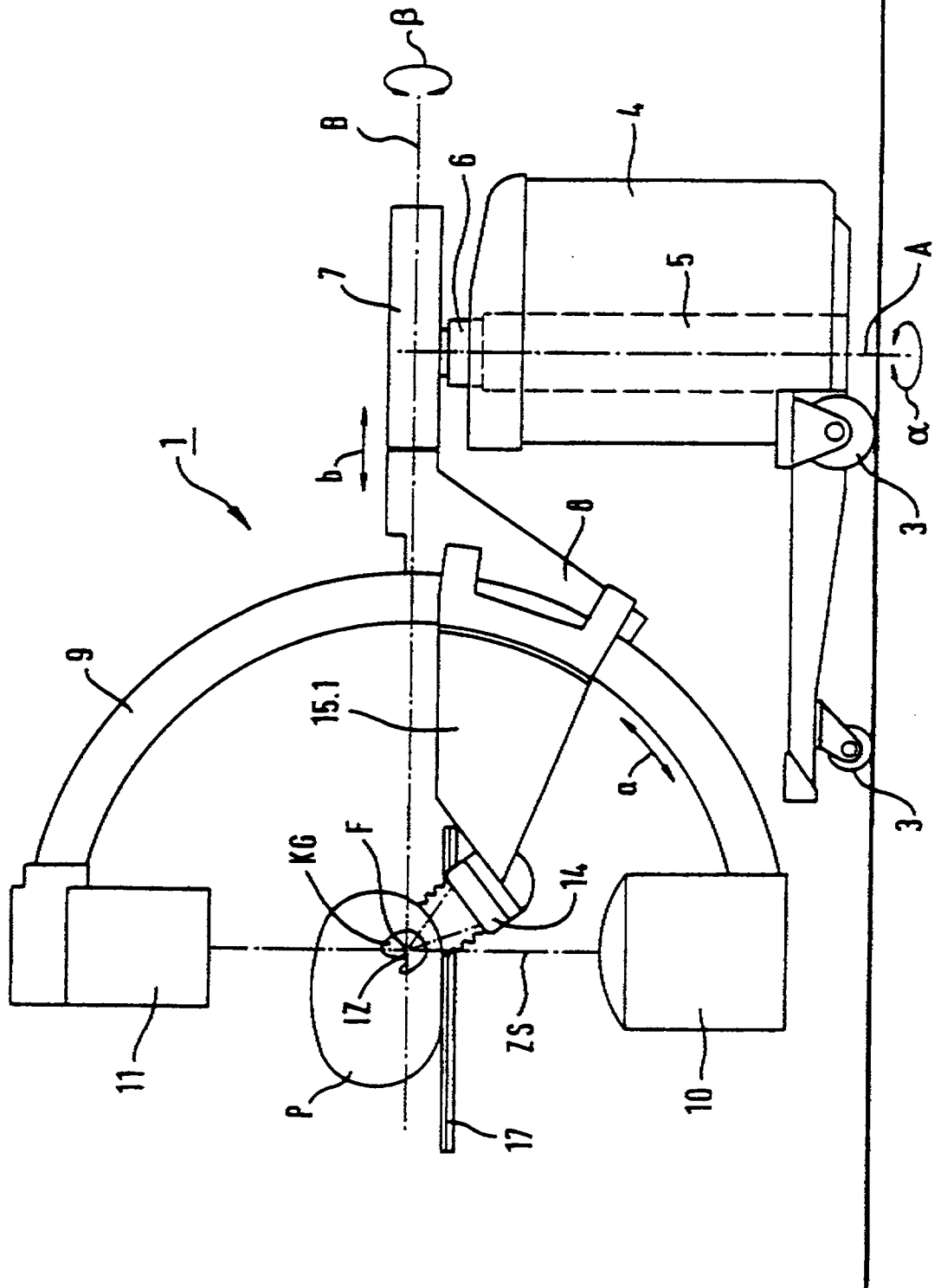
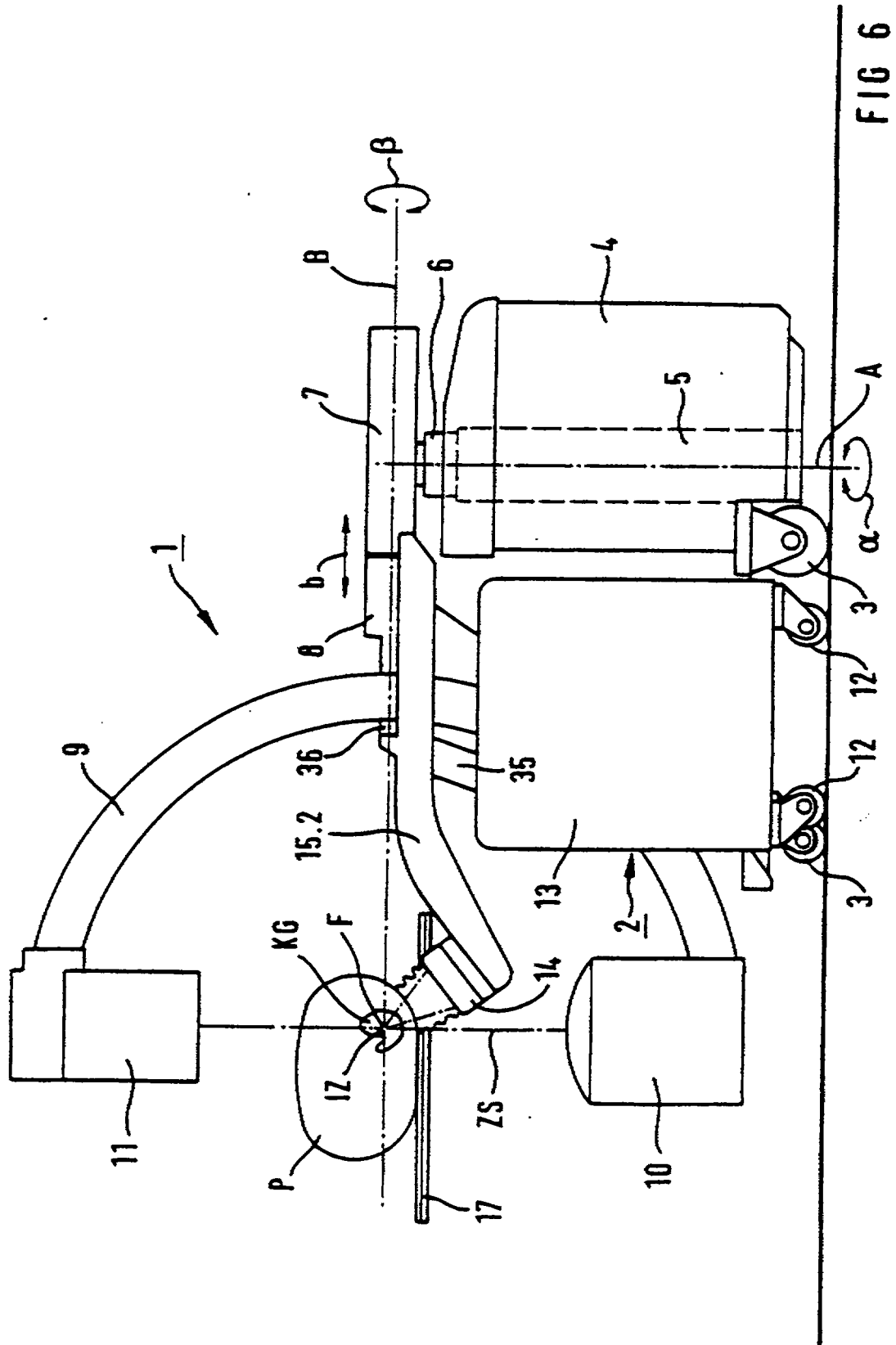


FIG 5



List of reference symbols

1	C bow X-ray machine
2	Therapy unit
3	Wheels
4	Machine carriage
5	Lifting device
6	Lifting column
7	Holding part
8	Bearing
9	C bow
10	X-ray source
11	X-ray receiver
12	Wheels
13	Unit carriage
14	Source of focused acoustic waves
15, 15.1, 15.2	Support arm
16	Lines
17	Patient couch
18	Device
19	Coupling device
21, 22	Pins
23, 24	Plates
25	Coupling plate
26, 27	Positioning nose
28	Cutout
29	Base plate
30	Positioning groove
31	Positioning bolt
32	Mechanism
33	Locking bolt
34	Clamping bracket
35	Holder
36	Pivot joint

A	Longitudinal axis
B	Axis
a, b	Adjusting directions
α , β	Directions of rotation
F	Focus
KG	Body tissue
IZ	Isocentre
ZS	Central beam
P	Patient
o	Open
g	Closed