How imaging modalities used in medicine can benefit from floor-lock systems

Content:

Floor-lock systems offer a significant number of advantages if you are looking for a solution to make mobile medical devices stable and secure. They can be of particular benefit for imaging modalities. This is because if the device is not stable or moves around, it can have an especially serious effect.

Introduction

The importance of imaging modalities in medical diagnostics, such as CT, scintigraphy, SPECT and PET, is continually growing.

Their main advantage: to look inside the human body without having to use invasive measures. They enable one to see the smallest of details in the patient's body, enabling pathological changes to be identified.

However, the meaningfulness of the examination results greatly depends on the quality of the images produced by the devices. Therefore, it is critical that the imaging devices are completely stable and secure and do not vibrate, even if the floor is uneven.

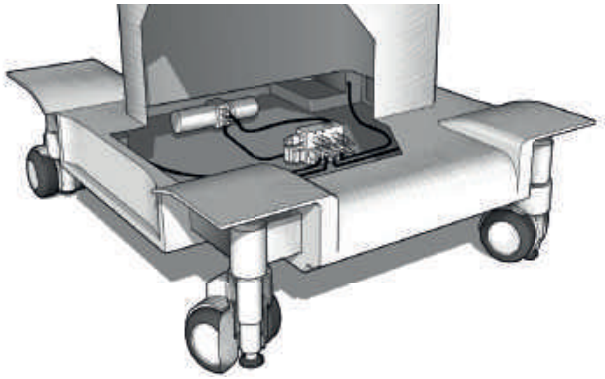
Due to the high cost pressures in the health sector, hospital managers are calling for an increase in flexibility and a higher device utilisation rate. As a result, these devices are becoming more and more mobile.

These two requirements – devices that are completely stable and secure, yet also mobile – are synthesized with the help of hydraulic floor-lock systems (the kind that have been in successful use in operating tables for decades), providing a simple, yet highly effective solution.

What are floor-lock systems and what can they do?

Floor-lock systems work in a similar way to a parking brake and ensure that mobile devices can be locked into position. From a purely technical point of view, they are not so much manual brakes, but rather hydraulic systems that make devices stable when stationary. They are compact system solutions that are very easy to integrate into the frame of a device and don't take up much space.

They have an incredibly simple functional principle. With the press of a button, a hydraulic power pack generates the necessary force using oil pressure and



Classic HAWE floor-lock system, whereby the jack cylinder and castor are structurally separated – here in combination with a complete lifting column. Image: HAWE Hydraulik

conveys it to the hydraulic cylinder by means of a manifold. Four small jack cylinders extend and very slightly lift the device off the ground. The device is completely stable and secure, even if the patient or the device itself is heavy in weight. If the hydraulic pressure is reduced via a release valve, the jack cylinders retract. The device becomes mobile again.

The advantage of this solution compared with a classic parking brake is that you don't have to operate every single castor brake individually. Instead, the device can be fixed into position automatically using a control panel or by pressing a button.

In particular with respect to high weight, floor-lock systems provide a considerably more stable solution than locking systems that lock the castors mechanically. Furthermore, if a device has more than three castors, there is the chance that it could wobble if manual brakes are used to secure the castors.

Application in imaging modalities

The increasing use of imaging modalities in diagnostics and for subsequent treatment (hybrid operations) opens up a great many new application areas for this reliable and flexible locking system.

As already mentioned, there is a growing trend for using mobile devices. If the devices are mobile, they can be assigned and used more flexibly for clinical procedures. It is much easier to maximise their capacity, which in turn leads to considerable cost-savings. And it becomes possible to meet the additional demands that have arisen through the emergence of hybrid operating rooms.

Mobile CT scanners, for example, could be deployed in smaller operating rooms – if the design is compact enough – and used during the operation. On an broader level, architects could design rooms in hospitals, and potentially outpatient practices, for more universal use in future, as the devices would be positioned based on requirements. This would create the perfect operating theatre for ensuring efficient workflows across different disciplines.

Also in an emergency, it sometimes becomes necessary to bring in an additional device at short notice. This enables physicians to diagnose and treat the patient using all of the available treatment methods and interdisciplinary knowledge without having to actually move the patient. This eliminates the need to move the patient to another operating room, which is fraught with risk. In a hybrid operating room, the patient is operated on then and there, and monitored and examined with the appropriate devices.

Mobile imaging modalities are considerably more flexible in their potential fields of application – which increases efficiency and lowers costs. (Image: AdobeStock)

HAWE Hydraulik

HAWE Hydraulik has over 35 years experience in designing and manufacturing hydraulic systems for the medical technology sector, and has been the leading provider of integrated medical solutions for several years. The company's product portfolio covers bespoke components, sets, electronic control systems and complete lifting columns, which means it can provide optimally coordinated hydraulic solutions for application areas such as operating tables, emergency stretchers, robotic surgery and medical devices. HAWE Hydraulik's subsidiary, HAWE Micro Fluid GmbH, specialises in micro and compact hydraulics, and has established itself as the leading company in this sector, both in Germany and internationally. Hydraulic solutions made in Germany: to us this means having the highest of standards in the production and logistics processes, as well as in other processes and procedures. Our integrated medial solutions are compact in design, yet come with a high power density and excellent reliability, which makes them suitable for a board range of applications in the medical technology sector.

Thanks to innovatively designed devices with a narrow gantry structure but a large gantry diameter, it is becoming increasingly possible to examine patients in ways that before were impossible, or had been thought of as challenging. All of this is achieved with the smallest footprint possible, so that it is easier to integrate them into the existing facilities. This poses huge challenges for the locking system and the stability of the device.

Mobile x-ray devices, for example, are also required for patients who cannot physically be in the x-ray department. Taking image recordings on a ward – in particular in intensive care units – is possible if the generator and tubes are mounted to a mobile unit. Using con-

It is crucial for imaging modalities to be able to produce high-quality images, in order to ensure a reliable diagnosis and for subsequent treatment to be successful (Image: AdobeStock).

verter generators makes it possible to use smaller units that are powered either via a normal supply voltage or via integrated batteries. It is also important that these delicate devices are easy to manoeuvre.

However, the critical factor is that these imaging devices are completely still when capturing an image, to ensure that it is sharp and shows meaningful results. This applies for any imaging system, whether CT scanner (O-arms and C-arms), x-ray systems, gamma cameras for scintigraphy or SPECT and PET devices – to name but the most important ones. All of the modalities used are based on the analysis and calculation of coordinate points referenced to the patient's position.

Although the algorithms can correct errors in the measurements and, thus, retrospectively compensate for a certain degree of interference, the less that needs correcting, the better the resulting image will be, and the easier and more reliable the subsequent diagnosis and treatment will be, as well. In conclusion, it is safe to say that a reliable and completely stable, oscillation-free device locking system at the place of use is an important requirement when mobilising devices, even if the device has a small positioning foot.

It must also be possible to move the devices without having to exert much energy. It is important that they are easy to manoeuvre through long corridors, around tight corners, through hospital doors and into and out of lifts. This is where HAWE floor-lock systems come into play.

Floor-lock systems have several advantages

Floor-lock systems use hydraulics with a high power density, i.e. they can exert enormous force despite not requiring much space, and so present a great many advantages for the aforementioned applications.

The hydraulics enable the heavy load of the medical device to be shifted with precision and care and, in particular, smoothly. The machine manufacturer can tailor the operation of the floor-lock system to meet individual requirements, as the hydraulic system is connected to a higher-level control system.
The components used are extremely compact and, thus, easy to integrate into existing systems. For example, the hydraulic power pack is 65 x 65 x 300 mm in size, which saves space and gives manufacturers the freedom to be innovative in the design of the device.
Thanks to their integration-centric design, hydraulic floor-lock systems are also incredibly low-maintenance.

Floor-lock systems have been used successfully for operating tables for over 15 years. (Image: HAWE Hydraulik)

In the HAWE product range: standard sets

The HAWE product portfolio contains preconfigured standard sets with optimally coordinated components.
In our **classic system**, for example, the castors and jack cylinders are structurally separated.

With the classic system, users have the choice of two different cylinder designs with a lift height of 15 or 30 mm. This system is popular mainly in markets where price is a priority. (Image: HAWE Hydraulik)

The second floor-lock system in the HAWE standard range – the **integrated system** – features double castors with integrated jack cylinders.

If the cylinder is integrated into the castor, both the castor and the jack cylinder can be positioned as far away from the centre of the device as possible. This allows for maximum stability. (Image: HAWE Hydraulik)

The plastic castors with TPU double wheels and precision ball bearings are particularly quiet when rolling across the floor. As a result, even heavy devices require comparably less energy to shift around, and can thus be easily manoeuvred and placed into position. Each castor has a bearing load of 250 kg.

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They are also very simple to install and commission. Floor-lock systems are assembled as a plug-and-play solution in the factory and tested before delivery. All that is left to do is integrate them and supply them with power. The fact that they are pre-assembled in the factory minimises the risk of leakages and dirt ingress.

Another advantage of floor-lock systems is that they can easily be retrofitted to existing devices. Systems that have castors with a central-locking mechanism can be retrofitted hassle-free, as the cylinder connection dimensions correspond to the dimensions of the short bed castor bolt (32 mm in diameter).

Mobile medical devices that have a traditional floor-lock system can be modernised by simply swapping the cylinders.

Thanks to all of these advantages, floor-lock systems meet even the most challenging of requirements for the day-to-day operations of a clinic environment, and are the perfect solution for mobilising medical devices.

Extensive range of individual components for customised solutions:

As well as the aforementioned standard sets, HAWE application specialists develop customised solutions for customers' individual requirements. There is a vast array of individual components to choose from, including two different manifolds with different functionalities.

Both variants can be equipped with a passive oscillation damping function, whereby the cylinders extend until they touch the floor, but don't lift the device off the ground. As force is being exerted on the ground at all four corners of the system, it is not possible for it to vibrate.

One of the features of the **non-self-compensating** manifold is that all of the jack cylinders extend until the end stop and lift up the medical device by around three millimetres.

Specially designed for uneven ground: the **self-compensation** manifold. It has two cylinders that extend all the way, thus raising the device by approximately three millimetres. The two other cylinders extend only until they touch the ground, thus stabilising the device.

Various types of cylinder designs with different positioning foot designs and different lift heights are available.

There is a selection of hydraulic power packs to choose from, which provides a modular framework for tailoring the individual requirements and required function. Upon request, a foot pump can also be integrated.

Future prospects

The ability to see inside the human body is one of the great achievements of modern medicine. It all started back in 1895 with the discovery of x-rays. Ever since, imaging modalities have continually evolved, and this evolution is expected to continue.

Until now, routine examination of patients was at the focus of the procedures, but now we are seeing more and more sophisticated diagnostics systems being developed. Like the trend that has been ongoing for ECG devices for years. This evolution is being driven through the use of artificial intelligence, which allows newly recorded images to be compared with older, archived images of patients. In addition, the vast stash of thousands of "old" diagnosis images of other patients can also be used.

The universal standards required for the development of software solutions with respect to the above are already in progress. This will ensure that the examination results can be linked independent of the device. Only then will it be possible to leverage the full potential of imaging modalities for medical technology.

The aim is to be able to make concrete statements about a patient's entire course of disease and about the best treatment for each individual patient.

Another trend that we are noticing is that the devices are becoming more and more multifunctional, to be able to provide relief for the patient during treatment and diagnosis. Fraunhofer scientists, for example, have developed a device that can capture both ultrasound and MRT scans simultaneously. This means patients can avoid having to undergo multiple uncomfortable scans for biopsies.

Ultimately, the increasing cost pressures in the health sector and the call from hospital manager for ever greater utilisation rates, efficiency an flexibility in scope of application are expected to continue. Mobile devices will be a part of the solution. This is based on the assumption that the crucial moment when the device has to be stable and vibration-free can be achieved using secure and functionally reliable locking systems. In this respect, floor-lock systems are one of the cutting-edge technology solutions.

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