A TRANSPORTABLE X-RAY APPARATUS FOR MASS CHEST SURVEY

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The transportable apparatus developed by North American Philips Co., Inc., for mass chest survey by fluorograms of groups of industrial workers, schoolchildren and others, is described. The pictures are recorded on 70 mm-film by a Fairchild camera with automatic film strip advance after every exposure, allowing 375 pictures to be made in uninterrupted succession. Constant average density of all pictures is achieved by the application of the photoelectric Morgan-Hodges timer, which automatically terminates the exposure when the film has received enough light from the fluorescent screen. In addition to these elements, the apparatus contains a series of other error-precluding devices, such as an interlocking mechanism actuated by the examinee's identification card, that serves to avoid a possible mix-up of the fluorograms. The weight of the total installation, based on a maximum X-ray tube rating of 100 kV, 200 mA, is only 1212 lbs; this is achieved through the extensive use of magnesium alloy castings. The apparatus may be disassembled in 12 pieces, thus allowing very rapid mounting and dismantling at the site of the day's assignment. A number of further details of the equipment are described, e.g. the vertical adjustment of the X-ray tube and screen, the control panel, the photoelectric timer, etc.

The modern fight against tuberculosis has been aided during the past ten years by a new diagnostic tool: the fluorogram. This is an X-ray picture of the thorax on a reduced scale, obtained by photographing the X-ray shadow picture appearing on a fluorescent screen; cf. fig. 1. Small size pictures, e.g. on 35, 45 or 70 mm roll film, have proved capable of giving information as to whether a lesion in

the lung tissues is present or not. Owing to the small film size, the series examination of large groups of an entire population is possible at relatively low cost and at a remarkably fast time rate. Thus, the method has proved extremely valuable for finding cases of pulmonary tuberculosis in the so-called symptomless stage (which offers best prospects for a successful treatment); more detailed diagnoses in the cases thus located can be obtained subsequently by the conventional full size radiographs.

The principle of the method of fluorography, which was first put into a practical form by de Abreu 1) in 1936, was discussed in this Review in an article in 1940, in which a series of experiments showing the usefulness of the method 2) was also described. In order to give an idea of the scale on which the method has been applied in the interim, it may be mentioned that during the years 1941-1944, 20 million fluorograms were taken in the U.S.A. alone 3).

It is obvious that the problems of organization for smoothly handling such enormous numbers of examinees become pre-eminent. They can be solved only with the aid of a highly specialized equipment, and the solution will be different for different groups of the population. A successful mass survey is most readily conducted with (though not restricted to) coherent groups such as soldiers, industrial workers, school children and hospital admissions. A few words will be said about the last of these groups at the end of this paper; as to the other groups, there are two possibilities of organization, viz., bringing the equipment to the examinees, or the reverse. If the number of examinees in a

1) M. de Abreu, Z. Tuberkulose 80, 70-91, 1938; M. de Abreu and A. de Paula, Roentgenfotografia, Livr. Aten. Rio de Janeiro 1940. There were a number of predecessors, i.a. Köhler and Biesalski (1909), Caldwell (1911), Gardner (1932), who saw the importance of the method, but had no adequate technical means for its successful realization.

2) A. Bouwers and G. C. E. Burger, X-Ray Photography with the Camera, Philips techn. Rev. 5, 258-263, 1940 (No. 9).

specific locality warrants the application of the first procedure — and if the locality affords a suitable power line supply or if a suitable gasoline generator is available —, this procedure should be adopted. It offers the advantages of causing the examinees to lose a minimum amount of time and of preventing them, as far as possible, from missing the examination. Therefore, in developing a radiographic equipment suited for general mass chest survey purposes, an essential requirement — in addition to the desired high quality of the pictures — was portability, to be achieved through low weight, small volume, and easy mounting and dismantling. Other important requirements which were to be met in order to make a large scale application feasible were: complete reliability, simple and quick operation by relatively unskilled operators, and safeguards against all kinds of possible errors.

Important contributions to the achievement of the latter aims were furnished by the development of automatic photographic cameras (Fairchild, Recordak), and of the automatic timing device of Morgan and Hodges 4). Both devices, a few details of which will be discussed in the following pages, are incorporated in most of the commercially available types of apparatus which have been designed for mass chest survey purposes. They are included in the apparatus described in this paper,


Fig. 2. Philips mass chest survey apparatus. X-ray tube and hood are mounted on two columns, clamped to a floor-plate. To the extreme right, the automatic Fairchild camera is fastened to the hood by two mounting hooks and two spring bands with a lock-type lever. The photoelectric timer is mounted in the top of the hood. The operator stands at the control panel behind a protective screen, where he can watch the examinee through a lead glass window. The three tank units located between the X-ray tube and the control panel, and linked to both of them by flexible cables, contain the two halves of the high tension transformer, each delivering up to 50 kV, and a bridge circuit with four high vacuum rectifying valves. In place of the two transformer units, which can supply 200 mA at 100 kV, a single unit can be optionally substituted delivering the total voltage of 100 kV with a maximum load of 100 mA. The leads connecting the camera and the photoelectric timer to the control panel are placed in a channel in the floor-plate.
along with a number of other features that warrant a more detailed description. This apparatus was developed by North American Philips Company, Inc., and has been in constant use at a number of Health Services throughout the U.S.A. and other countries during the past several years.

General description of the apparatus

A photograph of the complete equipment is reproduced in fig. 2. The X-ray tube and the hood with the camera, sketched in fig. 1, are mounted on two columns, whose relative position is fixed by a common floor-plate. The high tension generator consisting of three (or two) units, and a control stand for the operator are placed behind the X-ray tube. This arrangement requires a minimum of floor space and permits the working area around the unit to be kept free from obstructions such as cables, which is an important consideration when dealing with a more or less continuous stream of examinees.

The automatic Fairchild-camera, which is fastened to the small end of the hood, has been especially developed for miniature film radiography. It will accommodate a 100 foot strip of (unperforated) 70 mm roll film. After each exposure the film is transported automatically through one frame length by a small electric motor. Thus the task of the operator is facilitated and the risk of double exposures avoided. The picture size is 2.5" × 3", so that a 100 foot length of film permits 375 exposures to be taken without interruption for unloading and reloading the camera. Arguments concerning the most desirable picture size will not be appraised here. It may be stated, however, that — although smaller sizes are quite feasible and offer enhanced advantages of economy and easy handling — the 70 mm size has become rather popular because it permits the use of relatively coarse-grained and, therefore, very sensitive film material.

As a high speed optical system is of prime importance with fluorography, the Fairchild-camera contains a coated lens having an effective speed of f: 1.9 (with a subject-to-lens distance of 78 cm), designed especially for this purpose. The reconciliation of the contradictory requirements of a large aperture and of extremely sharp images was considerably simplified by the fact that a single invariable subject-to-lens distance is required and that the problem of chromatic aberration was rendered less serious because the types of fluorescent screen used for fluorography emit light with a fairly distinct maximum in its spectral distribution, either in the blue or in the green region.

The control-panel is shown in fig. 4. As it will be impracticable, in many cases, because of the limited time and supervisory personnel allotted, to determine and use the exact kilovoltage and current of the X-ray tube yielding best penetration and contrast with the specific chest dimensions of each individual examinee of a large group, medium values of e.g. 85 kV (peak) and 100 mA (mean value) are
ordinarily adopted. Other values need be used only with persons of very unusual proportions. For this
purpose, the kilovoltage may be adjusted to 75, 85 or 100 kV, while the current is adjustable to 50, 100 and 200 mA. The highest mA-value should be used only in places where the local power line has sufficiently small resistance not to produce too large a voltage drop with this heavy load.

The tube current is made independent of line voltage fluctuations by means of a filament voltage stabilizer, and the kilovoltage is made independent of the tube current by a set of compensating resistors, utilizing a method recently described in this Review 5). These precautions are taken in this apparatus only to obtain consistent contrast and sharpness of the radiographs; in contradistinction to normal diagnostic radiography they are not necessary for obtaining consistent film densities, this being insured by the automatic timer.

The exposure time necessary for an average chest size of 22.3 cm and with 100 kV and 100 mA is about 0.185 sec. For extreme chest sizes, exposure times under the same conditions may vary from about 0.1 to 0.6 seconds. Of course, with a given kilovoltage and tube current, the exposure time must not be so long as to cause an excessive heating of the anode of the X-ray tube. In order to insure that the time limit which corresponds to the permissible tube rating will never be exceeded, and also to protect the X-ray tube in case the photoelectric timer should entirely fail to function, a safety timer is provided which interrupts the X-ray tube supply (regardless of the action of the photoelectric timer) after a given time, set in accordance with the permissible tube rating to any one of seven values between 0.25 and 2.5 sec. Incidentally, the permissible exposure times with mass chest surveys are influenced by the great number of exposures which must be taken with only short intervals between them (on many assignments, 200 or 300 per hour).

The height of the X-ray tube and the screen must be adapted to the height of the examinee. Therefore, a vertical adjustment of the hood by means of a crank-wheel is provided. The X-ray tube is linked to the hood by a chain running through a channel in the floor-plate, so that the tube follows the hood in its vertical movement. This mechanism is illustrated by Fig. 5, in which a few more details of the design are also shown and explained. A foot form on the floor-plate and a chin-rest on the hood aid in rapid posturing of the examinee with respect to the screen.

The vertical adjustment may also be accomplished by means of a small motor provided with a special braking control developed for this specific purpose. The braking mechanism brings the fast running motor to a stop within two or three revolutions after the operating button has been released. This is very important when a quick adjustment is required, avoiding repeated overshooting.

Mechanical design of the equipment

As light weight is one of the most important requirements for transportable apparatus, magnesium was selected as the basic metal from which to fabricate the main assembly castings. Considerable experience has been gained before and during the last war by airplane manufacturers and aircraft parts foundries in handling this hitherto rather unfamiliar metal. For castings, the metal is generally used in the form of an alloy containing aluminum, small amounts of manganese, and sometimes zinc, e.g. 6 % Al, 0.2 % Mn, 3 % Zn. The specific gravity of this alloy is about 1.8, i.e. it is about 1/4 that of iron and 2/3 that of aluminum, so that considerable saving in weight could be expected from the use of this material.

It is true that part of the gain achieved by the low specific weight is lost because of the less favorable mechanical properties of magnesium, viz., its low shock resistance and low elastic modulus, as compared with common aluminum alloys (the elastic modulus for the magnesium alloy mentioned above

Fig. 4. View of the control panel of the apparatus. In the center is the switch for changing over from fluorography to full size radiography; below this switch is the control knob for kilovoltage selection, to the right, the mA-selector (with meter); to the left, the voltage adjusting knob (with meter) for compensating power line variations. Situated around these elements are pilot lights, the pushbutton for making the exposures and a register for counting the exposures. The circuits contained in the high tension generator, the photoelectric timer, the automatic camera and other devices are all connected to the control panel with plugs and jacks. All the plugs are coded and keyed in order to prevent the incorrect connection or accidental interchange of leads.

is $64 \times 10^6$ lb/in$^2$ ($4.5 \times 10^6$ kg/cm$^2$), for aluminum alloys $100 \times 10^6$ lb/in$^2$). These properties require the adoption of thicker sections, added stiffening ribs, generous tapers from heavier to lighter sections and larger fillet radii (about twice those that would be used for iron castings). Nevertheless, the magnesium castings turn out to be lighter than if made of any other material. This is partly due to the fortunate fact that the provisions necessary for compensating for low elastic modulus and low shock resistance are similar.

Due to the extensive use of magnesium it was possible to reduce the total weight of the apparatus to 1212 lbs (with the 200 mA-generator; if the 100 mA-generator is used, the weight is only 1052 lbs).

Other important requirements for portable apparatus were mentioned above; small size, easy and quick mounting and dismantling. To reduce size,

\[ \text{Fig. 5. The height of the hood } H \text{ is adjusted by means of crank } N \text{ and a rack and pinion drive. The X-ray tube } B \text{ follows the hood in synchronous movement, due to the inter-connection of the two supporting movable members } G_1 \text{ and } G_2 \text{ by chain } Y. \text{ The total weight of hood and X-ray tube is, at a position of medium height, exactly counterbalanced by the tension of the springs } X. \text{ Owing to the great length of these springs, their tension varies only slightly with the position of the hood; hence the counterbalanced condition is maintained to a good degree of approximation in all positions, and the adjustment of height requires negligible effort. (Counterbalancing by springs instead of by weight has the advantage of keeping the total weight of the apparatus and the inertia of the adjustable portions as low as possible.) The pulley } P \text{ may be lowered or raised to two fixed positions other than the normal one by swinging the bearing arm } J \text{ round its fulcrum } I \text{ by means of a crank; in this way, stereoscopic pictures can be taken, as the X-ray source in one position of } P \text{ is } 5 \text{ cm below, and in the other one } 5 \text{ cm above its normal height, thus producing two shadow images with the desired parallax. (In order to make separate sets of stereoscopic pictures, the roll film cassette of the camera can be substituted by a special adaptor for cut films; this is also most useful for making test fluorographs.)} \]

In addition to their low density, magnesium alloys in general offer the advantage of very favorable machining characteristics, so that high tool speeds and deep cuts are possible. However, due to the unique mechanical properties, machining practice, with respect to the cutter types and grinding and lubricating methods to be used is rather different from that in use for other metals. Ample data as to proper machining technique are available from the manufacturers of magnesium alloys $^6$).

$^6$ A curious detail of the machining of magnesium is the necessity of avoiding the hazard of fire: as is well-known, very fine magnesium chips are easily inflammable, as exemplified by the old-fashioned photographic flash powders. Therefore, special precautions are necessary in cutting and in disposing of the shavings.
the X-ray tube are assembled. The columns are fastened to the floor-plate by four integral clamping screws. The hood is simply placed on its pedestal inserting a mounting stud in the corresponding hole, two small auxiliary pins ensuring proper alignment. The X-ray tube and the tube support bracket are mounted in a similar way, suitable indexing arrangements being provided. The hood, bracket and tube are heavy enough to remain securely seated in their proper places without requiring any sort of clamping. The chain connecting the hood and the X-ray tube is composed of two parts, each part, upon disassembling the unit, being retractable into its respective column where it can be fastened in place. This automatically locks the sliding section of the tube column, so as not to risk damage during transport.

Error-precluding devices

The apparatus contains several devices to prevent operators from making errors which would cause damage to the equipment or impair the usefulness of the survey. The automatic motor-driven camera and the automatic timer, as error-precluding devices, were mentioned above. A few others are described here.

During the survey the possibility of mix-ups resulting from improperly identified photographs is completely eliminated by an identification system visible in the lower part of fig. 3. For every examinee, an identification card E containing name, serial number or other data must be properly inserted in a card holder in the hood. The proper insertion of the card operates a relay system, which is connected in the circuit in such a way that until it is operated the X-ray tube cannot be loaded. During the exposure the identification card is illuminated by a lamp D and photographed on the lower part of the fluorogram. After the exposure the apparatus is automatically interlocked, and only the extraction of the card from the holder and the proper insertion of a new one (or of the same card again, if a second exposure of the examinee is desired) will re-establish the conditions necessary for energizing the X-ray tube.

The actual exposure is effected by simply pressing a pushbutton on the control panel (cf. fig. 4) and holding it down. The relay system actuated by this button switches on the illumination for the identification card in the hood, boosts the filaments of the rectifying valves and energizes the stator of the X-ray tube, rapidly accelerating the anode to full speed (this, of course, applies only to the case of a rotating anode tube; tubes with stationary anode may also be used). Approximately one second after the button is pressed the X-rays come on, this condition being indicated by a red pilot light on the control panel. When the proper exposure time has elapsed, the X-ray tube is automatically de-energized by the photoelectric timer and the red pilot light is extinguished. Now the pushbutton can be released, whereupon the automatic advance of the film strip to the next frame takes place.

Releasing the pushbutton at an earlier moment will terminate the exposure and de-energize the apparatus at once. Thus, the operation remains continuously under control and may be interrupted without delay if this should be necessary.

In addition to the proper insertion of a new identification card, there are other conditions necessary to prepare the apparatus for the next exposure. If the end of the film strip has been reached, or if the camera magazine was accidentally left unloaded, no exposures can be made. A similar condition will exist when the safety timer has terminated an exposure before actuation of the photoelectric timer. This is indicated by a white pilot light on the timer panel. When this light is on, a reset button on the panel must be depressed in order to restore the normal conditions. This serves to direct the attention of the operator to the fact that the density of the preceding fluorogram will be low, as the full exposure time was not received. He can try, in that case, to repeat the exposure with a higher kilovoltage, yielding better penetration of the chest under examination.

In addition to the red and white pilot lights already mentioned, a blue light on the control panel is provided which blinks during the moving of the film, and a light marked "Ready" verifying that all conditions for making the next exposure are fulfilled.

As the remarkable simplicity of operation is largely due to the use of the photoelectric timer, a description of a few details of this device seems worthwhile. A simplified circuit diagram is shown in fig. 6. The timer can be preset to produce a fixed average density of the fluorograms by adjusting the amplification factor of the 9-stage photomultiplier tube. For this purpose the accelerating voltage between successive electrodes in this tube may be varied between 25 and 100 V, causing the amplification factor to vary between 100 and 106 and hence allowing variation by a factor of 104 in the exposure of the film before the X-ray tube is switched off. As for the reproducibility of the density (or the product of screen brightness and
exposure time), it is clear from the above that the density obtained will be very sensitive to small voltage fluctuations on the phototube. Therefore, the voltage supply of the timer unit is stabilized. Another factor that had to be considered is the finite time required to open the contactor actuated by the relay-tube of the timer. When no allowances for this are made, all exposure times \( t \), "proposed" by the photo-multiplier tube, will be prolonged by this constant break-contact time \( T \), which amounts to about 1/60 second. Thus, the desired inverse proportionality between the actual exposure time \( t' \) (= \( t + T \)) and the brightness of the fluorescent screen (magnitude of photoelectric current) would not be strictly realized. To correct for this small but not insignificant error, a resistor \( R \) was inserted in the phototube circuit as shown in fig. 6.

Without the resistor, the following equation would hold:

\[
\frac{i \cdot t}{C} = E, \quad \ldots \ldots \ldots (1)
\]

where \( C \) is the capacitance of the capacitor, charged by the photoelectric current \( i \), and \( E \) the voltage across it necessary for firing the relay-tube. Thus the total exposure time would be

\[
t' = t + T = \frac{CE}{i} + T.
\]

With the resistor, however, we have instead of (1):

\[
\frac{i \cdot t}{C} + i \cdot R = E. \quad \ldots \ldots \ldots (2)
\]

Hence

\[
t' = t + T = \frac{CE}{i} - RC + T.
\]

Choosing \( R \) so that

\[ RC = T, \]

we get

\[ t' = \frac{CE}{i}, \]

i.e. the desired constancy of the product \( i \cdot t' \), which determines the density of the fluorogram, is achieved.

The automatic timer may also be used in making full size radiographs, if this is desired. In that case the timer is automatically set for proper full size radiograph density by throwing the corresponding switch on the control panel. The ease with which full size pictures may be taken in this way is very important for assignments in isolated places: as soon as the film has been processed and inspected, the suspicious cases thus discovered can be picked out for normal radiography with the same equipment.

In this section a few remarks are added concerning the reliability of the whole apparatus. Special care was devoted to this point, because on many assignments the apparatus is to be used at large distances from its home base so that possible troubles might cause considerable delay for want of proper servicing facilities. An important feature in this respect is that the X-ray tube, which is normally supplied with full-wave rectified a.c., can also be made to work on self-rectification (provided the type of tube adopted is suited for a.c. supply). In the normal case, the tank unit mentioned earlier, containing a complete bridge circuit of four high vacuum rectifying valves immersed in oil and a transformer for the filament current of the X-ray tube, is connected in series with the two high tension transformer units; cf. fig. 7. Obviously the rectifying valves and the X-ray tube are the most vulnerable parts of the equipment, possessing a limited (though very long)
life. As a rule, a spare X-ray tube is carried with the equipment, but it would hardly be feasible to carry along a spare specimen of the rather heavy rectifier unit as well, and replacement of a single rectifying valve at the site is not convenient because of the oil-filling. Therefore, the cathode unit (A') of the high tension transformer is provided with an additional filament transformer which is not in operation under normal conditions, but which renders it possible to connect the X-ray tube directly to the transformer, bypassing the entire rectifier unit. Thus, in an emergency, a survey already in progress can be continued with a.c. voltage on the X-ray tube. However, the rating of the tube will be lower in this case and one must be satisfied with a lower quality of the radiographs.

Similar provisions, insuring continuation of a survey in progress, have been made for the photoelectric timer and for the motor drive unit used for the vertical adjustment. Each of these can be readily detached and replaced in its entirety by another unit; or, if desired, a non-automatic hand- or clock-work-timer can be substituted for the photoelectric timer, and the manual adjustment substituted for the motor drive.

X-ray protection

In connection with an X-ray survey involving great numbers of exposures executed at all kinds of sites, in factories, class rooms, barracks etc., it is evident that special attention must be paid to X-ray protection. It need hardly be mentioned that the X-ray tube must be of the ray- (and shock-) proof type, allowing a cone of X-rays to emerge only in the direction of the examinee. A further conventional measure is the protection of the operator against the radiation scattered from the examinee, the fluorescent screen, etc.: he is placed behind a protective screen (cf. fig. 2) provided with lead glass windows. The protective screen consists of sheet steel and has a thickness of 1/16", equivalent to 0.25 mm of lead. Weight reduction by selection of suitable material was not possible in this case, as the effectiveness of the screen in absorbing X-rays depends directly on its weight.

If the exposures are made with the help of other personnel standing near the examinee, these persons likewise must be protected by means of similar screens.

The danger that might arise for other persons through excessive exposure to radiation, even if the X-ray tube is pointed — as it should be — toward an outer wall or an empty room, is minimized with this apparatus by placing a diaphragm before the X-ray tube window, cutting off all the rays of the primary cone which would not strike the fluorescent screen. As provision is made for three different focal spot-to-screen distances, the distance desirable for full size radiography being different from that for fluorography, a different properly related position of the diaphragm is provided in the diaphragm holder for each of these distances (cf. fig. 8 a, b, c), in order to insure the exact limitation of the primary radiation to the screen in all three cases.

The radiation cone itself is not sharply limited, owing to the finite width of the focal spot (1.5 mm with rotating anode tubes, 4 tot 5 mm with stationary anodes); a "half-shadow" or penumbra, gradually widening at increasing distances from the tube, is present around the useful cone. As provision is made for three different focal spot-to-screen distances, the distance desirable for full size radiography being different from that for fluorography, a different properly related position of the diaphragm is provided in the diaphragm holder for each of these distances (cf. fig. 8 a, b, c), in order to insure the exact limitation of the primary radiation to the screen in all three cases.

Fig. 7. Circuit diagram of the power supply of the X-ray tube (B). A' and A'': high tension transformer units, each delivering 50 KV, 200 mA. Q: rectifier unit, containing four rectifying valves and the filament transformer Tp for the X-ray tube. The receptacles a1 and a2 are identical, and so are a2 and a3. Thus the entire rectifier unit Q can readily be eliminated in case of a breakdown of one of the valves, the cable from b1 being plugged into a1, that from b2 into a2; the spare filament transformer Tp automatically takes over the supply of the X-ray tube filament. The X-ray tube then is run with self-rectification.
seen from fig. 8d, the undesired half-shadow region will be reduced by placing the abovementioned diaphragm \( D_1 \) at a greater distance from the tube. In order to be able to do so without unduly increasing the flange width of the diaphragm designed to absorb the useless outer parts of the primary cone, a second diaphragm \( D_2 \) nearer to the X-ray tube is provided. This intercepts a large part \( IV \) of the useless outer rays, leaving the exact limitation of the remaining cone to be performed by the first diaphragm \( D_1 \), whose size is in this way kept within reasonable limits.

Equipment for survey of hospital admissions

Among the groups of persons eligible for a systematic chest survey, hospital admissions have been named as one of the most important. Considering the fact that, in the United States, e.g. about 16 000 000 hospital admissions per year occur, it is seen that an appreciable part of an entire population could be surveyed in this way. With respect to organization, the examination of hospital admissions is a comparatively easy job, and with respect to possible consequences, the recognition of cases of tuberculosis with these persons (and with hospital personnel) is particularly important. Experience already obtained \(^7\) demonstrates that about 1.5 to 4.3% of the admissions (depending on age, living standard etc. of the groups examined) show significant tuberculous disease. Incidentally, 10 to 20% exhibit non-tuberculous abnormalities of the lungs, heart, spine or other parts visible on the radiographs.

X-ray equipment for this special survey work in hospital locations need not be transportable, but on the other hand, it must meet the requirement of being suited for both ambulant and non-ambulant patients. North American Philips Co., Inc., has designed a specially adapted equipment for this purpose, cf. fig. 9. The X-ray tube and hood can be swung to a vertical alignment.

Fig. 9. Mass chest survey equipment for hospital admissions. To enable fluorograms of incoming stretcher patients to be taken, the X-ray tube and hood can be swung to a vertical alignment.

The following statements are taken from a report issued in 1946 by the Council on Professional Practice of the American Hospital Organization. In this report is mentioned a 1943 questionnaire sent to 934 major hospitals, which revealed that 46 of them had already adopted the chest survey of all admissions as a routine practice. To-day it has undoubtedly been adopted by many more.

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